## SYLLABI FOR FIVE YEAR INTEGRATED BACHELOR OF ENGINEERING (CHEMICAL WITH M.B.A.)

### EXAMINATIONS 2011 - 2012

### SCHEME OF TEACHING AND EXAMINATION

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<th>Subject</th>
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Department Elective I

1. Principles of Management

L: Lectures/Week
T: Tutorials/Week
P: Practical Hours/Week
C: Number of Credits
NC: No Credits
**SCHEME OF TEACHING AND EXAMINATION (2011 – 2012)**

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* There will be 4 weeks’ training in Basic Workshop Techniques during the summer vacations.
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The Comprehensive Viva Voce-I Examination (Paper CHE 5455) will cover the subjects taught during the First, Second, Third and Fourth Semesters.
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<td>1300</td>
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### SYLLABI FOR FIVE YEAR INTEGRATED BACHELOR OF ENGINEERING (CHEMICAL WITH M.B.A.)
EXAMINATIONS 2011 - 2012
SCHEME OF TEACHING AND EXAMINATION

<table>
<thead>
<tr>
<th>Paper</th>
<th>Subject</th>
<th>Teaching Hrs. per Week</th>
<th>Exam. Marks</th>
<th>Sessional Marks</th>
<th>Total Marks</th>
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### Practicals

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<th>Exam. Marks</th>
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<td>CHE 5856 Viva Voce-II (Comprehensive)</td>
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| Total | 21  4  10 | 1000 | 700 | 1700 |
SYLLABUS FOR FIVE YEAR INTEGRATED
BACHELOR OF ENGINEERING (CHEMICAL) WITH M.B.A.

FIRST SEMESTER

CHE 5101  MATHEMATICS-I

Convergence and divergence of infinite series and some simple problems, trigonometric and exponential functions of a complex variable, hyperbolic functions, separations into real and imaginary parts, summation of series (“C+IS” method only).

Successive differentiation, expansion of function, applications of maxima and minima of a function of two or more variables, curves in polar co-ordinates, angle between radius vector and tangent line, curvature, partial differentiation, Asymptotes singular and multiple points, curve tracing.

Definite integrals and their properties, definite integrals as the limit of a sum of the fundamental theorem of integral calculus, determination of areas and lengths of curves, volumes and surfaces and solids of revolution. Double and triple integrals with their simple applications.

Solution of ordinary differential equations of first order and first degree with simple applications of engineering problems.

Books Recommended:


CHE 5102  PRINCIPLES OF MANAGEMENT

Objectives: The objective of this course is to familiarize the students with the principles and practice of management with special reference to Indian organizations.
UNIT-I
School of management Thought: Forerunners of Scientific Management; the era of Scientific Management: The human behaviour school; The social system school: Decision theory school.

UNIT-II
The mathematical and quantitative school; The systems school; The contingency theory of Management; Contemporary management thinkers; Contemporary organizational theories.

UNIT-III


UNIT-IV

Controlling: The systems and process of controlling, Control Techniques, Control of overall performance Ensuing Effective Controlling.

Books Recommended:
4. Rue and Books : Management theory and application.
10. Andrez, H. : Management Gurus

CHE 5103 CHEMISTRY (ORGANIC)

3. *Chemistry of hydrocarbons*: House synthesis, halogenation of alkanes, free radical mechanism, cracking, effect of structure on physical properties of compounds. Alkenes, catalytic hydrogenation, dehydrogenation, Saytzeff rule, electrophilic addition reactions, peroxide effect, mechanism of allylic substitution, acidity of 1-alkynes, conjugated dienes, 1,2-and 1,4-additions, free radical and ionic mechanisms of addition polymerisation reactions, ring-opening reactions of cyclopropane and cyclobutane, chemistry of benzene and alkylbenzenes, aromatic electrophilic substitution reactions, Friedel-Crafts reactions.

4. *Chemistry of functional groups*: Alkyl and aryl halides, nucleophilic substitution, synthetic utility of Grignard reagents and alkyllithiums, mechanism of Grignard reactions of alcohols, benzylalcohol, acidity of phenols keto compounds, Anisole nucleophilic addition, benzaldehyde, acetophene, benzophenone, aldol condensation, acidity of acids, alkyl and aryl amines.

5. Synthetic utility of diazonium salts, basicity of amines, multistep synthesis.

*Books Recommended:*


**CHE 5104 ENGINEERING MECHANICS**


4. *Friction*: State and kinetic friction, laws of dry friction, co-efficient of friction, angle of friction, angle of repose, cone of friction, frictional lock, friction of flat pivot and collered thrust bearings, friction of journal-bearing, friction in screws, derivation of equation $n T_1/T_2 = \mu_c A$ and its application.

5. *Distributed Forces*: Determination of centre of gravity, centre of mass and centroid by direct integration and by the method of composite bodies, mass moment of inertia and area moment of inertia by direct integration and composite bodies method, radius of gyration, parallel axis theorem, Pappus theorems, polar moment of inertia.

7. **Kinetics of Particles**: Equation of motion, rectilinear motion and curvilinear motion, work energy equation, conservation of energy, impulse and momentum, conservation of momentum, impact of bodies, co-efficient of restitution, loss of energy during impact.

8. **Kinematics of Rigid Bodies**: Concept of rigid body, types of rigid body motion, absolute motion, introduction to relative velocity, relative acceleration (Corioli’s component excluded) and instantaneous centre of zero velocity. Velocity and acceleration polygons for four bar mechanism and single slider mechanism.

9. **Kinematics of Rigid Bodies**: Equation of motion, transitory motion and fixed axis rotation, application of work energy, principles to rigid bodies conservation of energy.

10. **Vibration**: Classification, torsional free vibrations-single rotor and two rotor systems. Spring mass system-its damped (linear dash pot) and undamped free vibrations, spring in series and parallel, simple problems.

**Books Recommended:**

3. Hidgen, Stiles : Statics and Dynamics, Longman

**CHE 5105 INTRODUCTION TO CHEMICAL ENGINEERING**

1. What is chemical Engineering? A.I.Ch.E. Definition of Chemical Engineering. Brief history of chemical engineering. General aspects of Chemical Engg. like communications, human relations, technical reading and professional bodies. Engg. problems in chemical processes in scaling up from laboratory to commercial scale.
2. Systematic analysis of chemical processes; unit operations and unit process, material and energy balances, thermodynamics and kinetics, process instrumentation and control and economics.
3. Functions of chemical engineer/career opportunities for chemical engineers.
4. Scope of chemical engineering with respect to the new emerging areas in the field of chemical engineering like environmental engineering, bio-chemical and bio-medical engineering, membrane separation techniques, polymer science and engineering etc.
5. Factors for selecting a suitable site for the location of a process plant.
6. Systems of units and unit conversions involving process variables like pressure, viscosity, temperature, density/specific gravity etc.
7. Composition of mixtures and solutions; mass fractions/mole fractions, molarity and normality etc.
8. P-V-T relations for gas and gas mixtures, calculations using ideal gas law, compressibility factor and vander Waal’s equations of state.
9. Liquid and liquid mixtures; Vapour pressures (c ox chart, Duhrings lines, Clausius Clapeyron equation), vapour-liquid equilibrium calculations using Raoult’s law, Henry’s law.
10. Gas-vapour mixtures; humidity calculations from partial pressures and vapour pressures. Dry bulb, wet bulb and adiabatic saturation temperatures.
11. Introduction to material balances with and without chemical reactions, combustion calculations, use of by-pass, recycle and purge streams.

12. Introduction to energy balances: Various forms of energy, types of systems, intensive/extensive properties, general energy balance equation for a flow process, heat capacity and mean heat capacity, energy balances for simple flow processes.

13. Thermo chemical calculations: Laplace Law and Hess’s Law, heats of formation, heats of combustion, heats of reaction, Kirchoff’s equation for calculating heats of reaction at different temperature.

Books Recommended:


CHE 5106 PHYSICAL CHEMISTRY

1. Solutions: Ideal and non-ideal solutions, Raoult’s law, change of free energy, enthalpy, and entropy on mixing of liquids, distillation of binary solutions. Partially miscible liquids such as Phenol- water, triethylamine- water, and Nicotine- water systems. Henry’s law, Nernst distribution law, Colligative properties of dilute solutions. Abnormal molar mass, degree of dissociation and association of solutes.

2. Chemical Kinetics: Rate equation of reactions of various orders, rate mechanism, kinetics of complex reactions. Concept of energy barrier and energy of activation. Theories of reaction rates, measurement of extent of reaction, zero order reactions. Rates of flow systems. Lindemann theory of unimolecular reactions.


6. Electrochemical Cells: Reversible and irreversible cells, e.m.f. and its measurement, cell reactions and e.m.f., thermodynamics of electrode potentials, half- cell potential and its
determination, Nernst equation, concentration cells, liquid junction potential, determination of activity co-efficient from cell potential data, potentiometric titrations.

Books recommended:

4. Rose, J. : Dynamics of Physical Chemistry, Lond Pitman

CHE 5151 ORGANIC CHEMISTRY LAB

1. Lab – Safety
2. Preparation of Benzamide & Aspirin-Purification, determination of melting point and percentage yield.

CHE 5152 ENGINEERING GRAPHICS -1 LAB

Introduction to Engineering Graphics, Methods of projections, Theory of orthographic projection.

Conventional practices, dimensioning as per BIS SP 46-1988

Pictorial sketching
Projection of points, lines and planes on principal planes

Projection on auxiliary planes

Recommended Books

1. James D. Bethune: AutoCAD, Pearson Publishers

CHE 5153 PHYSICAL CHEMISTRY LAB.

1. Surface tension of liquids using Stalagmometer and calculation of Parachor values.
2. Distribution of Iodine between water and carbon tetrachloride.
3. Kinetics of the hydrolysis of methylacetate in the presence of hydrochloric acid.
4. Adsorption of acetic acid on activated charcoal.
5. Viscosity of liquids and composition of a binary solution.
6. Conductometry
   • Variation of equivalent conductance and specific conductance on dilution.
   • Dissociation constant of acetic acid.
   • Solubility of sparingly soluble salts.
   • Conductometric titrations of HCl vs NaOH and acetic acid vs NaOH.
7. Potentiometric titration of HCl vs NaOH and acetic acid vs NaOH and determination of dissociation constant of acetic acid.
8. Colorimetry
   • Verification of Lambert-Beer Law.
   • Determination of concentration of solution of KMnO₄/K₂Cr₂O₇.
   • Determination of composition of Fe-Salicylic Acid Complex by Job’s Method.

Books Recommended:

SYLLABUS FOR FIVE YEAR INTEGRATED
BACHELOR OF ENGINEERING (CHEMICAL) WITH M.B.A.
SECOND SEMESTER

CHE 5201 MATHEMATICS-II

Relationship between cartesian, cylindrical polar and spherical polar co-ordinate systems: standard forms of equation of sphere, cone, cylinder.

Matrices: Rank of matrix, elementary transformation, Eigen-values, Eigen-vectors, Cayley-Hamilton Theorem.


Vectors: Gradient, Divergence, Curl, Statement of Green’s Gauss and Stoke’s Theorem and their simple applications.

Linear Differential Equations with constant Coefficients, Homogeneous Linear Equations, method of variation of Parameters, Simultaneous Linear Differential Equations with Constants Coefficients.

Books Recommended:


CHE 5202 APPLIED PHYSICS

1. Relativity: Frames of reference, Michelson – Morley experiment, Galilean and Lorentz transformation, Lorentz Fitz Gerald contraction, time dilation, postulates of special theory of relativity, variation of mass with velocity, mass energy relation.

2. Mechanics: Surface tension, how to calculate surface tension for a drop, experimental determination of surface tension by Jaeger’s method. Viscosity: Coefficient of viscosity, critical
velocity, Poiseuille’s equation for flow of a liquid through a tube, motion in viscous medium, Reynolds number, Bernouille’s equation and its applications: venturimeter and pitot tube.

3. **Optics**: Ultrasonics: production, detection and uses of ultrasonics. **Interference**: Formations of colours in thin films, Newton’s rings, Michelson interferometer. **Diffraction**: Diffraction at a single slit, double slit diffraction grating, its theory, dispersive power and resolving power. **Polarization**: Polarization by reflection, scattering, absorption and double refraction. Quarter wave and half wave plates, production and analysis of plane, circular and elliptically polarized light. **Fiber optics**: Basic principle, step index and graded index fiber, qualitative idea of signal distortion and dispersion, transmission losses, fiber optics sensors and their applications. **Laser**: Elementary ideas, He-Ne and Ruby laser, uses. **Holography**: Basis principle, theory.

4. **Quantum Physics**: Difficulties with classical physics, blackbody radiation, photoelectric effect, Compton effect, Debroglie hypothesis, uncertainty principle, time dependent and independent Schrodinger’s equation, properties of well behaved wave function. Operators and their expectation value. X-ray diffraction and Bragg’s law.

5. **Physics of Materials**: Magnetic materials, classification of materials, ferromagnetism, ferri and anti ferromagnetism, hysteresis. Superconductivity, Meissner effect, thermodynamics of superconducting transitions, qualitative idea of BCS theory.

**Books Recommended:**


**CHE 5203 CHEMISTRY (INORGANIC)**

1. **Quantum theory and atomic structure**: Introduction to wave mechanics, the Schrodinger equation, the Schrodinger equation as applied to hydrogen atom, the origin of quantum numbers and shapes of orbitals.
2. **Chemical Bonding**: Molecular orbital and valence bond theories of bond formation and application of molecular orbital theory to the formation of homonuclear and heteronuclear diatomic molecules.
3. **The Solid State**: A recapitulation of close packing of spheres, structures of NaCl, CsCl, ZnS, CaF₂, crystal defects and applications of defect structures (transistors, rectifiers, photovoltaic cells and computer chips).
4. **Coordination Compounds**: Werner’s theory, effective atomic number, bonding of transition metal complexes: valence bond theory, crystal field theory, crystal field splitting in tetrahedral, octahedral and distorted octahedral (square planar) crystal fields. Thermodynamic aspects of coordination compounds (crystal field stabilization energies of octahedral and tetrahedral complexes, spectrochemical series). Kinetic aspects of coordination compounds (substitution reactions in complexes with coordination number 4 and 6 and their mechanism - SN₁, SN₂). Magnetic behaviour of complexes – Para magnetism,
diamagnetism, ferromagnetism and antiferromagnetism and measurement of magnetic susceptibility of complexes by Guoy’s method.

5. **Organometallic Compounds**: Nomenclature, types of ligands and bonding in organometallic compounds, use of organometallics in industry.

6. **Inorganic polymers**: Types of inorganic polymers, polyphosphazenes, polysiloxanes – their structures and properties.

7. **Role of Metals in Biological Systems**: Bio-inorganic Chemistry of Iron – Heme proteins & Non-Heme iron proteins; bioinorganic chemistry of cobalt-vitamin B$_{12}$ and metalloenzymes.

8. **Metal toxicology**: Toxic effects of heavy metals with special reference to Cd, Pb, Hg and As.


**Books Recommended:**


**CHE 5204  PROCESS PLANT MATERIAL AND ENERGY BALANCES**

1. Review: Stoichiometric and composition relationship gas laws; Gaseous mixtures, vapor pressure, humidity, etc.

2. Material Balances for Non-reaction systems including balances involving recycle and by-pass streams.

3. Material Balances for Reacting systems including balances involving recycle and purge streams.


5. Energy balances on nonreactive and reactive systems.
**Books Recommended:**


**CHE 5205  STRENGTH OF MATERIALS**


2. *Compound Stresses and Compound Strains*: Oblique stress, simple tension, state of pure shear, pure normal stresses of given planes, general two-dimensional stress system, principle planes, principle stresses, maximum shear stress, Mohr’s stress circle, Poisson’s ratio, principle strains in three dimensions. Principle stresses determined from principal strains, analysis of strain, Mohr’s strain circle, volumetric strain, elastic constants and relations between them, numerical problems.


5. *Axial and Bending Loading Combined*: General eccentric loading, eccentric longitudinal loads, load eccentric about both the axes, middle third rule of rectangular section, middle quarter rule of circular sections, numerical problems.


7. *Torsion of Shafts*: Circular shafts, shafts of varying diameter, compound shafts, combined bending and torsion, torsion of thin circular tubes, combined end thrust, bending and torsion, equivalent torque, equivalent bending moment, numerical problems.

8. *Struts and Columns*: Definition, pin ended (hinged) strut axially loaded, direction fixed at one end and free at the other, direction fixed at one end and position fixed at the other, strut with eccentric load, limitations of Euler theory, Rankine-Gordon formula, strut with lateral loading, numerical problems.
9. **Stresses and Strains in Thin Shells**: Thin cylinder under internal pressure, thin spherical shell under internal pressure, cylindrical shell with hemispherical ends, volumetric strain, modifications for built-up shells, numerical problems.

10. **Stresses and Strains in Springs**: Close coiled helical springs, open coiled helical springs, leaf springs, numerical problems.

11. **Strain Energy and Theories of Elastic Failure**: Strain energy in tension energy in compression, strain energy in shear, strain energy in bending, strain energy in torsion, strain energy under compound loading, theories of elastic failure and their graphical representation, numerical problems.

**Books Recommended:**


**CHE 5206 ENVIRONMENTAL STUDIES**

Unit –I : The Multi-disciplinary nature of Environmental Studies: Definition, scope and importance; need for public awareness.

Unit –II : Ecology and Ecosystems: Definition of ecology: Structure and function of ecosystem; Producers, conserver and decomposers; Energy flow in the ecosystem; Ecological succession; Food chains, food webs and ecological pyramids.

Introduction, types, characteristic features, structure and function of the following ecosystems: Forest ecosystem; Grassland ecosystem; Desert ecosystem; Aquatic ecosystem (ponds, streams, lakes, rivers, oceans, estuaries).

Unit –III : Biodiversity and its conservation: Introduction - Definition: Genetic species and ecosystem diversity. Value of biodiversity: Consumptive use, productive use, social, ethical, aesthetic and option values; Biodiversity at global, National and local levels; India as a mega-diversity nation; Hotspots of biodiversity; Threats to biodiversity: Habitat loss, poaching of wildlife, man wildlife conflicts; Endangered and endemic species of India; Conservation of biodiversity; In-situ and Ex-situ conservation of biodiversity.

Unit –IV : Natural Resources: Natural resources and their conservation:
(a) Air Resources: Features, composition, structure; air quality management.
(b) Forest Resources: Use and over-exploitation, deforestation, case studies, timber extraction, mining, dams and their effects on forests and tribal people.
(c) Water Resources: Use and over utilization of surface and ground water, floods, drought, conflicts over water, dams benefits and problems; water quality management; manager of water resources e.g. rivers, lakes, ground water, etc. Fluorosis and arsenic problems.
(d) Mineral Resources: Draw on and exploitation, environmental effects of extracting and using mineral resources, case studies.
(e) Food Resources: World food problems, changes caused by agriculture and overgrazing, effects of modem agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
(f) Energy Resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies.
(g) Land Resources: Land as a resource, land degradation: Man induced landslides, solid erosion and desertification. Role of an individual in conservation of natural resources and prevention of pollution; Equitable use of resources for sustainable lifestyles; Disaster management: Floods, earthquake, cyclone and landslides.

Unit –V: Environment Pollution: Definition -Air pollution: Definition, causes, effects and control measures: Air Quality Management; Air Pollution Case Studies.

Water Pollution: Definition, causes, effects and control measures; Case studies; Water Quality Management: Definition, causes, effects and control measures.

Marine pollution.

Thermal pollution.

Soil pollution: Definition, causes and control measures: Case studies.

Noise pollution.

Nuclear hazards waste management.

Waste management through cleaner technologies: Reuse and recycling of wastes.

Solid waste management: Causes, effects and control measures of urban and industrial wastes, hazardous waster; bio-medical waste; Role of an individual in prevention of pollution; Pollution case studies.

Disaster Management: Floods, earthquake, cyclone and landslides.

Unit – VI: Social issues and the Environment: From Unsustainable to Sustainable development; Urban problems related to energy; Water conservation, rain water harvesting, watershed management; Resettlement and rehabilitation of people: Its problems and concerns. Case studies; Environmental ethics: Environmental value relationships; Environmental ethics and species preservation; Climate change: Global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies. Wasteland
reclamation; Consumerism and waste products. Legislation to Protect the Environment: Environmental Protection Act; Air (Prevention and Control of Pollution) Act; Water (Prevention and Control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act; Environmental Impact Assessment (EIA); Environmental Management Systems (EMS); Environmental Information Systems (EIS); P.I.L: Public Hearing and Role of NGO's; ISO 9000 and 14000; Issues involved in enforcement of environmental legislation; Public awareness.

Environmental Economics: Environment and standard of living.


CHE 5251 ENGINEERING GRAPHICS-II LAB

Projection of solids, solid modeling

Section of solids

Elementary development and intersection of solids

General introduction to isometric views

Applications: Drawing of threaded fasteners and assembly drawing using 1st angle/3rd angle projections.

Introduction and application to CAD software.

Recommended Books

1. James D. Bethune : AutoCAD, Pearson Publishers

CHE 5252 PHYSICS LAB

Coefficient of viscosity of water by flow through a capillary tube, Surface tension of water by Jaeger's method. Mechanical equivalent of heat by Calandar and Borne's apparatus. Refractive index of the material of glass prism by spectrometer. Wave length of sodium light by Newton's rings. Wavelength of

**Books Recommended:**


3. **Khanna & Gulati** : Practical Physics, 11th Edition,

**CHE 5253 INORGANIC CHEMISTRY LAB**

1. Volumetric Analysis
   (i) Redox Titrations:-
      Titrations involving
      a. KMnO₄ (Estimation of C₂O₄⁻²)
      b. K₂Cr₂O₇ (Estimation of Fe⁺²/Fe⁺³)
      c. Iodine [Iodometry & Iodimetry] (Estimation of Cu⁺², AsO₃⁻³ and Sb⁺³)
   (ii) Complexometric Titrations- Determination of Zn by EDTA titration.

2. Gravimetric Analysis
   (a) Estimation of Ba⁺²/SO₄⁻² as BaSO₄
   (b) Estimation of Fe⁺²/Fe⁺³ as Fe₂O₃

**CHE 5254 BASIC WORKSHOP TECHNIQUES**

*Carpentry Shop:* Introduction to various types of timber and particle, boards defects in timber, seasoning of wood. Description and use of carpenter's tools, i.e. saws, planes, chisels, adze, etc. Different types of timber in common use, making of lap joint, Bridle joint, dovetail joint and Mitre joint.

*Machine Shop:* Classification of fabrication processes, machine tools and materials, introduction to working of lathe, shaper, milling and drilling machines, power hacksaw, shearing machine and grinding wheel. Simple turning, threading, drilling board and knurling operations on a lathe.

*Welding:* Use of arc welding and gas welding in making different types of joints.

**CHE 5255 BEHAVIOUR SCIENCES AND COMMUNICATION SKILLS**
1. **Need and Importance:** Need of good communication skills, Presentation skills – with and without physical media (Computer and Multimedia Projector), Communication skills in a group – Group discussion, communication skills in an employment interview, Communication skills and proper body language, Professional and Social etiquette, Professional meeting skills.

2. **Role Playing:** Role playing as an event comparer, Role playing as Chairman, Role playing as team leader. The workshop would involve learning of practical skills to develop and perfect communication ability. Students would be required to give presentations both as an individual and in a team. Group discussions would be held to develop the communication skills while in a group.

   Role playing would require the students to practice the knowledge and expertise gained in communication skills to various situations where they would be required to perform the roles mentioned.

   The students would be evaluated on the basis of their communication skills, participation in various activities and on the ability to work in a team.

**Books Recommended:**

CHE 5301  OPERATION RESEARCH


2. Transportation model, Transhipment problem, traveling salesman problem, Assignment models, Sequencing model, Replacement model.

3. Theory of Games: Pure strategy games, principle of dominance; mixed strategy games (Algebraic, Graphical & Linear programming method), 2-person, non-zero- sum games.

4. Queuing Theory: Introduction, elementary queuing system; single channel queuing model, queuing cost behaviour, multiple channel queuing model, Poisson arrivals and Erlang service distribution; benefits and limitations of queuing theory.

Books Recommended:


CHE 5302  MECHANICAL OPERATIONS


   - Motion of particle through a fluid: Stoke’s Newton’s law. Free and hindered setting.
- Setting tank and double cone classifiers
- Batch and continuous thickeners
- Settling chamber, cyclone, filter bag and electrostatic precipitators.

3. **Filtration**: Plate and frame filter press, continuous rotary vacuum filter, filter aids, theory of filtration for non-compressible cakes.

4. **Centrifugation**: Tubular bowl centrifuge, disk centrifuge and batch basket centrifuge.


6. **Mixing and Agitation**: Basic ideas and characteristics of mixing equipment power consumptions scale-up.

7. **Conveying**: Mechanical and pneumatic conveying systems, storage & handling of materials.

### Books Recommended:


### CHE 5303  ENGINEERING MATERIALS

1. **Atomic Structure**: Review of bonding in solids, structure–property-processing relationship

2. **Crystal Structure**: Space lattice, crystal systems, Miller indices, effect of radius ratio on co-ordination, structures of common metallic, polymeric, ceramic, amorphous and partly crystalline materials


5. *Materials*: Standards and specifications, unified alloy numbering system, ferrous metals and alloys, non-ferrous metals and alloys; overview of ceramic, polymeric and composite materials; Mechanical tests: standard test procedures for mechanical property determination-strength, toughness, fracture toughness, hardness, deformation, fatigue, creep etc.

6. Corrosion: Types and mechanism of corrosion, factors influencing corrosion, combating corrosion, selection of materials of construction for handling different chemicals.

**Books Recommended:**

4. Raghavan, V. : Material Science & Engineering, Prentice Hall of India

**CHE 5304  FLUID FLOW**

*Fluid Statics*: Normal forces in fluids, Pressure Measurements, Forces on Submerged bodies, Buoyancy and Stability.


*Navier stokes equation*: Applications of Dimensional analysis to Fluid Flow. Problems.


*Flow of compressible fluids*: Compressible flow and flow through nozzles.

*Flow Measurements*: Pilot tube, Orifice, Venturi, Rotameter and Notches, wet gas metre etc.
Books Recommended:


CHE 5305  FUNDAMENTALS OF ELECTRICAL & ELECTRONICS ENGINEERING

DC Circuits and Single Phase A.C. Fundamentals: General introduction to Electrical Engineering, Kirchoff’s Laws, Mesh and Node analysis, Superposition theorem, Thevenin Theorem, Norton Theorem, Maximum power transfer theorem, Generation of alternating voltages and currents, Equations for AC quantities, cycle, time period, frequency, amplitude, calculation of R.M.S values, Average values for different waveforms, solution and phasor diagram of single phase AC circuit with sinusoidal source of excitation, AC through pure resistance, inductance and capacitance, series and parallel combination of R-L-C circuits, resonance in series and parallel circuits.

Three Phase AC Fundamentals: Disadvantages of single phase system, star and delta connection in three phase circuits, relation between line and phasor quantities, power in three phase system, solution of three phase balanced circuits, power and power factor measurement by two wattmeter method.

Semiconductor Diodes and Transistors: General introduction to Electronics. Concept of stiff Voltage and Current Source. PN Junction, Depletion layer, Barrier Potential, Forward and Reverse Bias, Breakdown voltage, V-I characteristics, Half wave and full wave rectifiers, Zener diode. Introduction to junction transistors, Transistor amplifying action, CB, CE, CC-configuration characteristics, applications of transistor as an amplifier.

Operational Amplifiers: Block Diagram, characteristics of an ideal OP-AMP, Application of OP-AMP as an inverting amplifier, Phase Shifter, Scale Changer, Non-Inverting Amplifier, Adder, Differential, Integrating amplifier.

Digital Electronics: Binary and Hexadecimal number system, conversion of numbers from one system to other, OR, AND, NOR, NAND, NOT Gates, Universal Gates, Exclusive OR, NOR gates, De-Morgan’s Theorem, Boolean Relations: Commutative, Associative and Distributive Laws. Concept of flip-flops, RS,D, JK, T types, master-slave flip flops, Shift registers,Concept of synchronous and asynchronous counters.


Books Recommended:


CHE 5306 QUANTITATIVE TECHNIQUES FOR MANAGERIAL APPLICATION

1. Correlation & Regression: Types of relationship, methods of measuring co-relation, Karl Pearson’s, Product moment and Spearman’s rank correlation, concurrent deviation, probable error; simple linear regression model and least squares estimates of regression coefficients, coefficient to determination, multiple correlation, partial correlation and multiple regression (upto three variables only).
2. Time Series and Forecasting: Variation in time series, trend analysis-fitting linear and second degree trends, method of semi-average, moving average, principles to least squares cyclic variations method to simple average, moving Lavenge, principle of least squares, cyclic variations, seasonal variation, method of simple averages, ratio to trend method, ratio to moving average method, method of link relatives, irregular variation.

3. Analysis to Variance: Test for difference among more than two samples. Inference about a population variance and about two population variances, one way and two way analysis of variance.

4. Decision Theory: Decision making under uncertainty (Maximax, Maximin, Equally likely, Hurwicz criterion, Mini Max regret) and risk (expected profit/loss), using continuous distributions, Marginal Analysis, utility as a decision criterion, decision tree analysis.

Books Recommended:


CHE 5351 COMPUTER PROGRAMMING LAB

C++ fundamentals

- Control statements
- Loops and Decisions: Relation operators, Iterations: While Loop, for Loop, do Loop, Decisions: if statement, if else statement, nested if else statement, switch statement. Logical operators, other control statements: break statement, continue statement and go to statement.
- Programming and Compiling, Exercises
- Functions

Books Recommended:

CHE 5352 FLUID MECHANICS LAB

1. General study of pipe fittings, valves and other equipments in the unit operations laboratory.
2. Pressure drop for flow through pipelines, valves & fittings.
3. Characteristics of pumps.
4. Flow measurement by the use of orificemeter, venturimeter, rotameter & pitot tube.
5. Flow over weirs and notches.
6. Flow measurement of compressible fluids.

CHE 5353 ELECTRICAL & ELECTRONICS ENGINEERING LAB

Note: Minimum eight experiments are to be done.

1. Overview of the equipments, instruments and procedure to be used, safety precautions and report writing.
2. To study resonance in R-L-C series and parallel circuit.
3. Measurement of power and power factor by three voltmeter method.
4. Measurement of power and power factor by three ammeter method.
5. To measure power and power factor using a single wattmeter in a single phase circuit.
6. Measurement of power and power factor of three phase balanced load by two wattmeter method.

7. To perform open circuit test and short circuit test on a single phase transformer and draw equivalent circuit.

8. To obtain magnetization characteristics of DC Machine

9. Study the forward and reverse biased diode characteristics.

10. Study the CB, CE, CC transistor characteristics.
SYLLABUS FOR FIVE YEAR INTEGRATED
BACHELOR OF ENGINEERING (CHEMICAL) WITH M.B.A.

FOURTH SEMESTER

CHE 5401  MATHEMATICS – III

Fourier Series: Euler’s Formulae, Dirichiel’s Conditions for Expansion, Change of interval, Odd and Even Functions, Expansion of Odd and Even Periodic Functions, Introduction to Harmonic Analysis. Vectors: Gradient, Divergence, Curl, Statement of Green’s Gauss and Stoke’s Theorem and their simple applications. (6 Hrs.)

Linear Differential Equations with constant Coefficients, Homogeneous Linear Equations, method of variation of Parameters, Simultaneous Linear Differential Equations with Constants Coefficients.


Function of complex variable, analytic functions, Cauchy’s theorem, Cauchy’s integral formula, introduction to Taylor’s series and Laurent’s series, Residues, theorem and its simple applications.

Books Recommended:


CHE 5402  ORGANIZATIONAL BEHAVIOUR

Introduction to Organization Behavior

Definition and meaning of OB, impact of other sciences (Anthropology, Sociology,
Psychology) on OB, perception, self esteem, attitude & personality, meaning of culture, impact of technology on OB.

Motivation, Learning & Leadership

Meaning of Motivation, Content theories of motivation (Maslows Hierarchy of needs, Herzberg’s two factor theory), Process theories (Vroom’s Expectancy theory, Porter-Lawler Model), Motivation applied (Job design, job rotation, goal setting, MBO), various methods of motivating employees, Behavioral & Cognitive theories of learning, Leadership theories (Trait theory, Fiedler’s Contingency theory, Path – Goal leadership theory), Leadership styles (Blake & Mouton managerial grid, Hersey & Blanchard’s life cycle approach)

Group behavior:

Group Dynamics, conflict, power & politics, Group behavior, types of groups, group decision making, conflict in organizations and reason, interpersonal conflict, intergroup conflict, meaning of power, classification of power, politics in organizations

Organization environment & Communication

Authority & responsibility, delegation and division of work, quality of work life, communication process, modes of communication in organization and barriers to communication, formal & informal communication,

Recommended Books:


CHE 5403 MANAGERIAL ECONOMICS

Objectives: To provide students with an understanding of basic economic principles of production & exchange-essential tools in making business decisions in today’s global economy. The object presents the foundation to understanding how the economy works, covering microeconomic description of business applications, including pricing for profit maximization, price elasticity, market structures and modeling of business in varying economic climates. The focus is on market economics, the organization that operation there and their business strategies.
Introduction to Managerial Economics: Nature Scope and Importance of Managerial Economics, opportunity costs, incremental principle, time perspective, discounts and equi marginal principles.

Demand Concepts and Analysis

Individual Demand, Market Demand, Kinds of Demand, Determinants of Demand, Demand Functions, Functions, Demand Schedule and Law of Demand.

Theory of Consumer Behavior:

Cardinal Utility Approach and Ordinal Utility (Indifference Curves) Approach;

Elasticity of Demand:

Concept, Types, Measurement and importance.

Demand Forecasting:

Sources of Data-Expert Opinions, Surveys and Market Experiments; Time Series Analysis-Trend Projection; Barometric Forecasting-Leading Indicators, Composite and diffusion Indices.

Production Function:

Concept and types, Returns to Factor and Returns to Scale, Law of Variable Proportions.

Cost concepts and Analysis:

Concept of Cost, Short run and Lung-run Cost Curves, Relationships among various costs, Break-even Analysis.
Revenue Curves: Concept and Types.

Perfect Competition:
Characteristics, Equilibrium Price, Profit Maximizing output in Short Run and Long Run;

Monopoly:
Characteristics, Equilibrium Price, Profit Maximizing output in Short Run and Long Run; Price Discrimination;

Imperfect Competition: Monopolistic Competition, oligopoly and Barriers to Entry.

References:

8. Mote, Paul Gupta: Managerial Economics, Vikas Publisher, New Delhi, 1st ed.

CHE 5404 HEAT TRANSFER

Conduction: Steady state conduction in one dimensional system, general conduction equation, effect of variable thermal conductivity, steady state conduction involving internal heat generation, lagging on pipes, the critical thickness of insulation on pipes, extended surfaces of uniform thickness and fin effectiveness, fin efficiency.
Convection: Free and forced convection, concept of heat transfer co-efficient, dimensionless numbers in free and forced convection, Dimensional analysis, Determination of Heat transfer coefficient using heat and momentum transfer analogies, experimental determination of heat transfer coefficient and common working correlations.

Condensation and Boiling: Condensation heat transfer phenomenon, film condensation on vertical plates and cylinders as well as on horizontal cylinders. Effects of non-condensable gases and vapor velocity on condensation, pool boiling, forced convection boiling, working correlations for pool boiling.

Evaporation: Types of Evaporators, single and multiple effects, single and multiple effects calculations, evaporator capacity, economy, effect of liquid head and boiling point elevation, methods of feeding.

Heat Exchangers: Various types of heat exchangers, overall heat transfer coefficients, heat exchanger mean temperature differences, heat exchanger effectiveness and the number of transfer units.

Radiation Heat Transfer: Black Body radiation, and grey body radiation, physical mechanism, radiation properties and shape factor, heat exchange between non-black bodies, radiation shields pyrometry and effect of radiation on temperature measurement.

Books Recommended:


CHE 5405 ENVIRONMENTAL ENGINEERING

Ambient air and water standards. Principal sources of pollution.

Inter-relationship between energy and environment pollution. Prevention of environmental pollution through conservation, raw material substitutions, process and equipment modifications. A case study on the concept of zero discharge.

Air Pollution:
- Principal air pollutants and their usual sources.
- Effect of air pollutants on human health, animals, vegetation and materials.
- Atmospheric dispersion of air pollutants, temperature inversions, Estimation of pollutants by Gaussian plume model.
- Process and equipments used for the control of particulate pollutants.

*Water Pollution:*
- Types of water pollutants, their sources and effects.
- BOD and COD
- Waste water treatment techniques and equipments, flocculation, skimming, floatation, etc.
- Primary Treatment-through settling.
- Secondary Treatment-Aerobic and anaerobic digestion, activated sludge process, trickle filter and oxidation ponds.

*Solid wastes:* Control and disposal, sanitary landfill, incineration, pyrolysis gasification and recycling.

*Books Recommended:*


**CHE 5451 PROCESS EQUIPMENT DESIGN**

2. General design considerations for pressure vessels: Design pressure, design temperature, materials, design stress (nominal design strength), welded joint efficiency and construction categories, corrosion allowance, design loads, minimum practical wall thickness.

3. Design of thin-walled vessels under internal pressure: Cylinders and spherical shells, heads and closures, design of flat ends, design of domes ends, conical sections and end closures.

4. Design of vessels subject to external pressure: Cylindrical shells, design of stiffening rings, vessels heads.

5. Design of vessels subject to combined loading: Weight loads, wind loads (tall vessels), torque.

6. Design of Foundation and supports.

7. Design of Bolted flanged joints and welded joints.

Books Recommended:

1. Battacharyya, B.C. : Introduction to Chemical Equipment Design Mechanical aspects, Chemical Engineering Education Development Centre.


CHE 5452 PROCESS PLANT DESIGN – I


2. Selection, specification & power requirements of process pumps, fans and blowers.

3. Design of settling equipments like Dor thickeners, dust chambers, cyclone separators and centrifuges.

4. Design of agitated vessels using various types of impellers.

5. Design of Conveyor system for solids.

Books Recommended:


CHE 5453 ENVIRONMENTAL ENGINEERING LAB
1. To find BOD of water sample.
2. To find COD of waste sample.
3. To find the total dissolved solids (TDS) and its volatile and non-volatile components.
4. To find the total suspended solids (TSS) and its volatile and non-volatile components.
5. To do the chromium separation by different techniques from electroplating wastes.
6. To find the phenol content of water sample and evolution of parameters.
7. To operate the electrodialysis apparatus.
8. To find the biodegradation constant (K) and the effect of timing on it.
9. To use the membrane separation techniques for salt brine and reverse osmosis process for sugar.
10. To use stack monitoring kit to find:
11. Efficiency of a cyclone.
12. Dust sampling.

Note: Any six of the above mentioned experiments are to be conducted.

CHE 5454 PARTICLE MECHANICS LAB

Pressure drop and two phase flow characteristics in packed and fluidized beds, Measurement of drag force, Batch settling of slurries, Constant pressure filtration, Mixing, crushing, grinding, screening and particle size analysis.

CHE 5455 VIVA VOCE-I (COMPREHENSIVE)

The viva-voce examinations will be comprehensive and covering all subjects taught during first to fourth semesters.
SYLLABUS FOR FIVE YEAR INTEGRATED
BACHELOR OF ENGINEERING (CHEMICAL) WITH M.B.A.

FIFTH SEMESTER

CHE 5501  MATHEMATICS-IV

Solution of differential equations in series with reference to Bessel and Legendre equations, elementary properties of Bessel and Legendre functions

Solution of differential equations by numerical methods, Picard’s method, Euler’s method, Runge-Kutta method, Milne’s method.

Solution of difference equation with constant coefficients.

Formation and classification of partial differential equations, first order linear equations, standard forms of non linear equations, Charpit’s method, homogeneous linear equations with constant coefficients.

Different methods for parabolic equations, hyperbolic equations and elliptic equations.

Solution of partial differential equations of engineering interest by method of separation of variables.


Books Recommended:


CHE 5502  OPERATIONS RESEARCH – II

Queuing Theory: Introduction, elementary queuing system; single channel queuing model, queuing cost behaviour, multiple channel queuing model, Poisson arrivals and Erlang service distribution; benefits and limitations of queuing theory.

Project Management: Introduction, Basic difference and significance of using PERT and CPM, phases of project management, PERT/CPM network components and precedence relationships, critical path
method, programme evaluation and review technique. Cost analysis and crashing the network, Resource scheduling, objectives, advantages and limitations of network, applications of network techniques, linear programming formulation.

Non linear Programming: Introduction, local and global optimum, concave and convex functions, unconstrained optimization, linearly constrained optimization, quadratic programming, separable programming, geometric programming, stochastic programming.

**Books Recommended:**


**CHE 5503  CHEMICAL TECHNOLOGY (ORGANIC)**

*Pulp & Paper:* Raw materials, types of pulp, manufacture of paper.

*Sugar:* Introduction, juice extraction, defacation, sulphonation, carbonation, concentration, refining.

*Fermentation:* Production of ethyl alcohol from molasses, citric acid and antibiotics like pencillin.

*Oils & Fats:* Extraction of oils from vegetable oils, refining of oils and fats, hydrogenation of oils.

*Soaps and Detergents:* Introduction, raw materials, manufacture of soap, classification of detergents, finishing of detergents.


*Nanotechnology:* Introduction, properties of nano particles like optical properties, reactivity, synthesis of nano particles by RF plasma process.

Carbon nanotubes: Introduction, structure and properties of carbon nanotubes and fabrication of carbon nanotubes, applications.

**Books Recommended:**


6. Bansal, R.C., Donnet, J.B. and Stoeckli, F.: Active Carbon, Marcel Dekker, N.Y.


**CHE 5504  MASS TRANSFER – I**

Mass transfer operations, classification of mass transfer operations, choice of separation methods, methods of conducting mass transfer operations, design principles.

Introduction to mass transfer and diffusion, molecular diffusion in gases and liquids, diffusion coefficients for gases and liquids, diffusion in solids, types of solid diffusion.

Mass transfer coefficients, types of mass transfer coefficients, mass transfer coefficients in laminar flow, theories of mass transfer.

Interphase mass transfer, concept of overall mass transfer coefficient.

Working principle, construction and industrial applications of various gas liquid contacting equipments like sparged vessels, mechanically agitated vessels, tray towers, packed towers, spray chambers, venturi scrubbers.

Humidification operations, psychometric chart, adiabatic saturation temperatures, wet bulb temperature, adiabatic operations, types of cooling towers.

Principle of drying, batch drying, drying curve, constructional details and working of different dryers.

**Books Recommended:**


CHE 5505  ENERGY TECHNOLOGY

Fuels: Types of conventional fuels, their merits and demerits. Non-conventional/renewable energy sources, their importance for sustainable development and environmental protection.


Liquid fuels: Origin of petroleum, refining and distillation of crude oil, uses of petroleum products.

Gaseous fuels: Natural gas, manufacture of water gas and producer gas, gas cleaning methods.


Furnaces: Classification of furnaces, draught, furnace atmosphere, Portland cement continuous rotary kiln, blast furnace, glass melting furnace

Alternate sources of energy:

➤ Introduction to solar radiation and evaluation of radiation incident on a solar collector.
➤ Applications of solar thermal energy such as solar water heater, solar cooker, solar concentrators and solar thermal power generation.
➤ Types of solar photovoltaic systems and applications.
➤ Photosynthesis and biomass conversion systems.
➤ Other renewable energy sources such as geothermal, tidal, ocean and wave.

Books Recommended:


CHE 5551  CHEMICAL ENGINEERING COMPUTATION LAB

Errors analysis, Solution of linear and non-linear algebraic equations.

Numerical differential & integration.
Interpolation.
Least squares approximation.
Ordinary, partial differential equations.
Development of computer programmes based on the above topics using Matlab and their applications in chemical process computations.

**Books Recommended:**


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**CHE 5552 CHEMICAL TECHNOLOGY LAB (ORGANIC)**

3. *Soaps*: Determination of free and combined alkali, total fatty matter, moisture and insolubles

**CHE 5553 FLUID MECHANICS LAB**

1. General study of pipe fittings, valves and other equipments in the unit operations laboratory.
2. Pressure drop for flow through pipelines, valves & fittings.
3. Characteristics of pumps.
4. Flow measurement by the use of orificemeter, venturimeter, rotameter & pitot tube.
5. Flow over weirs and notches.
6. Flow measurement of compressible fluids.
SYLLABUS FOR FIVE YEAR INTEGRATED
BACHELOR OF ENGINEERING (CHEMICAL) WITH M.B.A.

SIXTH SEMESTER

CHE 5601 CHEMICAL REACTION ENGINEERING–I

Introduction and a brief review of the kinetics of homogeneous reactions.
Interpretation of rate data from constant volume and constant pressure systems.
Single Ideal reactors.
Design for single reactions.
Design for multiple reactions
Thermal characteristics of reactors: temperature and pressure effects
Non-ideality in reactors and its effects on chemical conversion. One parameter models to represent the
behaviour of chemical reactors

Books Recommended:


CHE 5602 MASS TRANSFER-II

Absorption: Equilibria for absorption systems – use of Raoult’s law, Henry’s law for solubility
predictions, Selection of absorbent, limiting liquid gas ratios, absorption factor use in design of plate
absorbers. Kremser equation for ideal plates and translation of ideal plates to real plates using various
efficiencies. Concept of transfer units for the design of packed absorbers.

Distillation: Limitations and applications, prediction of VLE using thermodynamic & experimental
techniques. Dew point & bubble point estimations for binary & multicomponent mixtures. Distillation
methods – flash distillation, differential distillation for binary systems, steam distillation, optimum reflux
ratio. Fractionation of binary mixtures using McCabe – Thiele method and enthalpy concentration method
(Ponchon and Savarit method). Packed distillation columns. Azeotropic & extractive distillation
preliminaries and molecular distillation.
**Liquid-Liquid Extraction:** Ternary Equilibria and its representation on various plots. Selection criteria for solvent, Multistage extraction using partially miscible & immiscible solvents. Stagewise contact for countercurrent and crosscurrent extraction. Constructional details of equipment like mixer-settler, packed columns, pulsed extractor, sieve-tray extractor and centrifugal extractor.

**Leaching:** Preparation of solid, countercurrent and crosscurrent multistage contact Shank’s system. Constructional details of equipment like Rotocel extractor, Hildebrandt extractor, Bollman extractor, Kennedy Extractor & Beet-Sugar Diffusion battery extractor.

**Adsorption:** Types of adsorption, nature of adsorbents, equilibria for adsorption systems. Brief manufacture and commercial applications and characteristics for common adsorbents. Stagewise & continuous contacting of fluid and solid phase. Description of contact filtration adsorption system. Hypersorber Ion-exchange system.


**Books Recommended:**


**CHE 5603 ENVIRONMENTAL ENGINEERING**

Ambient air and water standards. Principal sources of pollution.

Inter-relationship between energy and environment pollution. Prevention of environmental pollution through conservation, raw material substitutions, process and equipment modifications. A case study on the concept of zero discharge.

**Air Pollution:**
- Principal air pollutants and their usual sources.
- Effect of air pollutants on human health, animals, vegetation and materials.
- Atmospheric dispersion of air pollutants, temperature inversions, Estimation of pollutants by Gaussian plume model.
- Process and equipments used for the control of particulate pollutants. (12 Hrs.)

**Water Pollution:**

- Types of water pollutants, their sources and effects.
- BOD and COD
- Waste water treatment techniques and equipments, flocculation, skimming, floatation, etc.
- Primary Treatment-through settling.
- Secondary Treatment-Aerobic and anaerobic digestion, activated sludge process, trickle filter and oxidation ponds.

*Solid wastes:* Control and disposal, sanitary landfill, incineration, pyrolysis gasification and recycling.

**Books Recommended:**


**CHE 5604   PETROLEUM PROCESSING ENGINEERING**

Introduction to petroleum industry, world petroleum resources, petroleum industry in India. Origin, exploration & drilling of petroleum crude. Transportation of crude and products.

Crude pretreatment: Refining and distillation of petroleum crude, composition and classification of petroleum crude, methods of evaluation: ASTM, TBP and EFV distillation. Properties and specifications of petroleum products such as LPG, gasoline, naphtha, kerosene, diesel, lubricating oils and waxes.

Separation Processes: Design and operation of topping and vacuum distillation units and tube still furnaces. Solvent extraction processes for lube oil base stock and for aromatics from naphtha and kerosene steams, solvent dewaxing.

Conversion Processes: Thermal cracking: visbreaking and coking processes, catalytic cracking, thermal reforming and catalytic reforming, alkylation, polymerization, isomerisation and hydroprocessing.

Safety and pollution considerations in refineries.
Books Recommended:

TEXT BOOKS


REFERENCE BOOKS


CHE 5605 CHEMICAL TECHNOLOGY (INORGANIC)

Chlor-Alkali Industry: Voltage efficiency, Current efficiency, Current density, Decomposition efficiency, Manufacture of Soda Ash by Solvay and Modified Solvay process, Manufacture of caustic soda.

Sulphuric Acid: Introduction, Manufacture of sulphuric acid by Chamber and Contact process


Ceramics: Introduction, Properties of ceramics, Classification of refractories, Important steps involved in the manufacture of refractories.

Industrial gases: Manufacture and uses of carbon dioxide, oxygen, nitrogen and acetylene.

Paints: Introduction, Classification of paints, Manufacture of paints, Requirement of a good paint.


Books Recommended:

CHE 5606 CHEMICAL ENGINEERING THERMODYNAMICS


*Phase Equilibria:*

Partial molar properties, partial molar Gibbs free energy, Chemical potential and its dependence on temperature and pressure Ideal solutions (Lewis-Randel Rule).

Fugacity and its calculations. Dependence of fugacity of temperatures and pressure.


*Chemical Equilibria:*

Equilibrium constant in terms of measurable properties variations of equilibrium constant with temperature and pressure.

Adiabatic reactions, Gibbs phase rule, equilibria in heterogeneous reactions.

*Books Recommended:*


**CHE 5651 PARTICLE MECHANICS LAB.**

1. Pressure drop and two phase flow characteristics in packed and fluidized beds.
4. Constant pressure filtration.
5. Mixing, crushing, grinding, screening and particle size analysis.

**CHE 5652 ENVIRONMENTAL ENGINEERING LAB**

1. To find BOD of water sample.
2. To find COD of waste sample.
3. To find the total dissolved solids (TDS) and its volatile and non-volatile components.
4. To find the total suspended solids (TSS) and its volatile and non-volatile components.
5. To do the chromium separation by different techniques from electroplating wastes.
6. To find the phenol content of water sample and evolution of parameters.
7. To operate the electrodialysis apparatus.
8. To find the biodegradation constant (K) and the effect of timing on it.
9. To use the membrane separation techniques for salt brine and reverse osmosis process for sugar.
10. To use stack monitoring kit to find:
    (a) Efficiency of a cyclone.
    (b) Dust sampling.

Note: Any six of the above mentioned experiments are to be conducted.

**CHE 5653 PROCESS PLANT DESIGN –II**

1. Process design and specifications of double pipe heat exchanger, shell and tube heat exchanger, plate type heat exchanger, condensor and reboiler.
2. Equilibrium procurement techniques – experimental and use of thermodynamics for its evaluation and then use in design height of distillation column. Calculations using McCabe Thiele, Plate-to-Plate calculation methods for fractionators, design of batch fractionating columns, design of fractionator internals for sieve-tray.
3. Absorber/Stripper design of stage-wise and continuous contact equipment (packed column), height of column and diameter calculation, design of various internals of absorber/stripper.

4. Process flow sheets, material and energy balance flow sheeting analysis.

Books Recommended:


CHE 5654   CHEMICAL TECHNOLOGY LAB. (INORGANIC)

1. Fertilizers (i) Determination of N-P-K Values
   (ii) Determination of micronutrients

2. Cement: Loss of ignition, silica, insolubles, estimation of Mg, Ca, Fe.

3. Water.

CHE 5655   PETROLEUM PROCESSING ENGINEERING

1. To plot ASTM distillation curve for gasoline, diesel oil.

2. To determine Flash point (Closed – cup) and smoke point for kerosene.

3. To determine Aniline point, Diesel Index and cetane number for diesel oil.

4. To determine pour point and cloud point for furnace oil and diesel oil.

5. To determine viscosity at different temperatures using Ostwald viscometer for hydrocarbon solvents.

6. To determine softening point and penetration number for asphalt and grease samples.

7. To determine viscosity index of lubricating oil by Redwood viscometer.

8. To determine water content in petroleum products by Dean and Starks method.

SYLLABUS FOR FIVE YEAR INTEGRATED

BACHELOR OF ENGINEERING (CHEMICAL) WITH M.B.A.
SEVENTH SEMESTER

CHE 5701 CHEMICAL REACTION ENGINEERING-II

Heterogeneous catalyses: A brief review of catalyses catalytic specificity. Preparation testing and characterisation of catalysts, catalyst poisoning and catalyst regeneration

Fluid Solid catalytic reaction: Kinetics; external transport processes, Reaction -and diffusion within porous catalysts. Effective diffusivity, thermal conductivity and effectiveness factors. Analysis of rate data design outline and selection of fixed bed, fluid bed and slurry reactions.

Fluid - fluid reactions rate equations and their application to the design of reactors.

Fluid Solid non-catalytic reactors rate equations and their application to the design of reactors.

Books Recommended:

1. Levenspiel, O : Chemical Reaction Engg., John Wiley

CHE 5702 PROCESS ENGINEERING ECONOMICS


Interest and Investment Costs: Simple and compound interest. Nominal and effective rates of interest. Continuous interest ordinary annuity. Perpetuities and capitalized costs.

Taxes and Insurance: Types of taxes and tax returns, types of insurance and legal responsibility.

Depreciation: Types of depreciation. service life salvage value, present value and methods of determining depreciation, single unit and group depreciation.

Optimum Design: Procedure with one variable, optimum reflux ratio in distillation and other examples.

Preliminary Steps in Plant Design: Plant design factors, project organization, plant location, preliminary data collection, process engineering.

Books Recommended:


CHE 5703 ORGANIZATIONAL BEHAVIOUR

Introduction to Organization Behavior

Definition and meaning of OB, impact of other sciences (Anthropology, Sociology, Psychology) on OB, perception, self esteem, attitude & personality, meaning of culture, impact of technology on OB.

Motivation, Learning & Leadership

Meaning of Motivation, Content theories of motivation (Maslows Hierarchy of needs, Herzberg’s two factor theory), Process theories (Vroom’s Expectancy theory, Porter-Lawler Model), Motivation applied (Job design, job rotation, goal setting, MBO), various methods of motivating employees, Behavioral & Cognitive theories of learning, Leadership theories (Trait theory, Fiedler’s Contingency theory, Path – Goal leadership theory), Leadership styles (Blake & Mouton managerial grid, Hersey & Blanchard’s life cycle approach).

Group behavior:
Group Dynamics, conflict, power & politics, Group behavior, types of groups, group decision making, conflict in organizations and reason, interpersonal conflict, inter group conflict, meaning of power, classification of power, politics in organizations

Organization environment & Communication

Authority & responsibility, delegation and division of work, quality of work life, communication process, modes of communication in organization and barriers to communication, formal & informal communication,

**Recommended Books:**


**CHE 5704 TRANSPORT PHENOMENA**

Transport of momentum, heat and mass by molecular motion-Newton’s law of Viscosity, Fourier’s law of heat conduction, Fick’s law of diffusion

Transport properties – Viscosity, thermal conductivity and mass diffusivity

Emphasis on the analogy between momentum, heat and mass transfer with respect to transport mechanism and governing equations

Development of mathematical models of transfer process through shell momentum balance, shell energy balance and shell mass balance for solving specific problems of transport of momentum, heat and mass in laminar flow or in solids in one dimension.

Development of general differential equations of fluid flow, heat transfer and mass transfer and their applications in solving one-dimensional steady state and unsteady state problems of momentum, heat and mass transfer.

Interphase transport of momentum, heat and mass and dimensionless correlation for each one of them.

Momentum, heat and mass transfer analysis.

**Books Recommended:**

CHE 5705 PROCESS INSTRUMENTATION

General Concept: Need and classification of measurements and instruments, Basic and auxiliary functional elements of a measurement system

Static and Dynamic Characteristics of Instruments:

Static Characteristics: Range and span, accuracy and static error, reproducibility and drift, sensitivity and dead zone.

Dynamic Characteristics: Speed of response and lag, fidelity and dynamic error, dead time.

Temperature measurement:
Thermocouples, metal resistance thermometers and thermistors, optical and radiation pyrometers, radiation receiving elements.

Pressure measurement:

Use of manometers, Bourdon gauge, bellows type gauge. Vacuum measurement–McLeod gauge, thermoionic type ionization gauge, pirani vacuum gauge. Measurement of pressure in corrosive fluids: Diaphragm seal, liquid seal and purge system.

Liquid level measurement:

Direct measurement of liquid level –Float & tape liquid level gauge, float and shaft liquid level unit, hydraulic remote transmission of liquid level.

Level measurement in open vessels: Bubbler system, diaphragm box system, air trap system. Level measurement in pressure vessels – Differential pressure manometer, use of liquid seals with a manometer, displacement float liquid level gauge.

Measurement of viscosity, conductivity, humidity and pH.

Density measurement – liquid level method, displacement meter and hydrometer.

Measurement of weight – spring scale, pneumatic force meter and hydrostatic force meter.

Process Instrumentation–Recording instruments, indicating and signaling instruments, control centre, transmission of instrument reading, instrumentation diagrams.

Books Recommended:

1. Eckman, Donald P. : Industrial Instrumentation, CBS Publisher and Distributors, Indian Reprint 2004.

CHE 5706 MARKETING MANAGEMENT

Objectives: (i) To understand the nature, tasks and the environment under which marketing operates. (ii) To study the theory, principles and practical aspects of various marketing functions. (iii) To learn to take marketing decisions.

Introduction to Marketing:

Definition; Scope and Importance of Marketing; Key Customer Markets;

Concepts/Philosophies of Marketing; Holistic Marketing Concept; Marketing Tasks;

Marketing Mix

Marketing Environment:

Marketing Environment; New Marketing Realities; New Consumer Capabilities;

Demographic Environment; Social-Cultural Environment; Natural Environment;

Technological Environment and Political-Legal Environment; SWOT analysis.

Analyzing Markets:

Marketing Research Process; Sources of data collection; factors influencing consumer behavior; buying decision process; post-purchase behavior; Organizational Buying; Stages in the Buying Process.

Market Segmentation: Levels of market segmentation; segmenting consumer markets; Niche Marketing; segmenting business markets; Michael Porter’s five forces model; Analyzing competitors; strategies for market leaders; Targeting and Positioning.

Product Decisions:
Product characteristics; classifications; differentiation; packaging and labeling; Product Life Cycle.

Pricing Strategies: Understanding Pricing; Setting the Price; Initiating and Responding to Price Changes; Reactions to Competitor’s Price Changes.

Marketing Channels: Marketing Channels; Role of Marketing Channels; Identifying Major Channel Alternatives; Types of Intermediaries; Channel-Management Decisions, Retailing, Wholesaling.

Marketing Communication: The Role of Marketing Communications; Communications Mix-Advertising, Sales Promotion, Public Relations and Publicity, Events and Experiences, Direct and Interactive Marketing, Personal Selling.

Books Recommended:

2. Ramaswamy, V.S. & Namakumari, S: Marketing management, planning, implementation and control, 3rd, Mechmillan.
3. Hepner H.W.: Modern Marketing- Dynamics and Management, 11th, UBS.
5. Britt and Boyd (ed): Marketing Management and Administration, 2nd, PHI.

CHE 5751 HEAT TRANSFER LAB
1. Determination of heat transfer coefficient for different types of heat transfer equipment. Wilson plots.
2. Unsteady state heat transfer in jacketed vessels. (Open pan evaporator)
3. Correlation of instantaneous heat transfer coefficients with time study deposition of scale on a heating surface.
4. Determination of heat losses for insulated pipes
5. Study of double pipe heat exchanger and to determine overall heat transfer coefficient
6. Study the performance characteristics of a 1.2 - shell and tube heat exchanger
7. Study and **operation** of long tube, forced circulation and multiple effect evaporators.
8. Duhring plot for solutions involving nonvolatile solutes.

**CHE 5752 REACTION ENGINEERING LAB**

1. Kinetic studies in a batch reactor.
2. Kinetic studies in a plug flow reactor.
3. Kinetic studies in a CSTR.
4. Kinetic studies in a semi batch reactor.
5. RTD studies in CSTR.
6. Dispersion number for packed bed reactor.
7. Adiabatic batch reactor.

**CHE 5753 PROCESS PLANT DESIGN-III**

1. Design of liquid-liquid and liquid-solid extraction equipment (stagewise and continuous contact).
2. Design of Heterogeneous catalytic Reactors.
   2.1 Fixed-bed reactors
      (i) Isothermal and adiabatic
      (ii) Non-isothermal non-adiabatic
   2.2 Fluidized-bed reactors
      (i) Two-phase fluidized bed model
      (ii) Slurry reactors and
      (iii) Trickle-bed reactors.
3. Layout of chemical plant equipment, safety and hazard aspects of layout.

*Books Recommended:*


CHE 5754 FACTORY TRAINING & TOUR REPORT

Each student will be required to submit a report after each factory visit/training programme throughout the entire course. The reports will be assessed by teachers in charge of the programme.

CHE 5851 PROJECT WORK

Each student is required to submit a project report on the design of a chemical plant, selecting the best process with optimum equipment size and operating conditions. The object is to test the ability of the student to apply his entire knowledge of Chemical Engineering principles to conceptualize, analyze and solve the problems. To judge his knowledge and originality and capacity for application of laboratory data in designing chemical plants and to determine the level of his proficiency at the end of the course.

SYLLABUS FOR FIVE YEAR INTEGRATED

BACHELOR OF ENGINEERING (CHEMICAL) WITH M.B.A.

EIGHTH SEMESTER

CHE 5801 PROCESS DYNAMICS & CONTROL

Incentives for chemical process control, design aspects of a process control system. Difference between feedback and feed forward control configuration. Hardware elements of a control system, Block Diagrams.

Laplace transform and transfer functions. Difference between lumped and distributed parameter systems, Dynamic behavior of first and higher order systems, interacting and non-interacting systems, dead time.

Different modes of control actions and their basic characteristics, controllers and their characteristics, control valve.
Closed-loop transfer functions, transient response of simple control systems, Routh stability criterion, Root Locus.

Introduction to frequency response: Bode diagrams, control system design by frequency response: Ziegler-Nichols controller settings, stability using frequency response, gain margin and phase margin.

Introduction to advanced control techniques such as cascade control, feed forward control, ratio control, inferential control.

**Books Recommended**


**CHE 5802 HUMAN RESOURCE MANAGEMENT**

Objectives: The objective of the paper is to make student aware of the various functions and importance of the HR department in any organization. It is basically concerned with managing the human resources, whereby the underlying objective is to attract retain and motivate the human resources in any organization, which is the most challenging and daunting look for any organization today.
Introduction:

Meaning, scope, objectives and functions of HRM; Importance of Human Resource Management; HRM & HRD a comparative analysis;

Environment of HRM: Role of government, internal and external forces; Human Resource Management practices in India.

Human Resource Planning: Definition, objectives, process and importance; Job analysis, description, specification & job evaluation; Recruitment, selection, placement and induction process;

Human Resource Development: Concept, Employee training & development; Career Planning & development; Promotions, demotions, transfers, separation, absenteeism & turnover;

Job Compensation:

Wage & salary administration, incentive plans & fringe benefits.

Performance Management:

Concept & process, performance appraisal, Potential appraisal;

Quality of work life (QWL):

Meaning, techniques for improving QWL.

Industrial Relations:

Concept and theories, trade unions; Health, Safety & Employee welfare measures; Employee grievances
and discipline, participation & empowerment; Introduction to collective bargaining.

Books Recommended:


CHE 5803 MANAGERIAL ECONOMICS

Objectives: To provide students with an understanding of basic economic principles of production & exchange-essential tools in making business decisions in today’s global economy. The object presents the foundation to understanding how the economy works, covering microeconomic description of business applications, including pricing for profit maximization, price elasticity, market structures and modeling of business in varying economic climates. The focus is on market economics, the organization that operation there and their business strategies.

Introduction to Managerial Economics: Nature Scope and Importance of Managerial Economics, opportunity costs, incremental principle, time perspective, discounts and equi marginal principles.

Demand Concepts and Analysis:

Individual Demand, Market Demand, Kinds of Demand, Determinants of Demand,

Demand Functions, Functions, Demand Schedule and Law of Demand.

Theory of Consumer Behavior:

Cardinal Utility Approach and Ordinal Utility (Indifference Curves) Approach;

Elasticity of Demand:
Concept, Types, Measurement and importance.

Demand Forecasting:

Sources of Data-Expert Opinions, Surveys and Market Experiments; Time Series Analysis-Trend Projection; Barometric Forecasting-Leading Indicators, Composite and diffusion Indices.

Production Function:

Concept and types, Returns to Factor and Returns to Scale, Law of Variable Proportions.

Cost concepts and Analysis: Concept of Cost, Short run and Lung-run Cost Curves, Relationships among various costs, Break-even Analysis.

Revenue Curves:

Concept and Types.

Perfect Competition:

Characteristics, Equilibrium Price, Profit Maximizing output in Short Run and Long Run;

Monopoly:

Characteristics, Equilibrium Price, Profit Maximizing output in Short Run and Lung Run; Price Discrimination;

Imperfect Competition:
Monopolistic Competition, oligopoly and Barriers to Entry.

Books Recommended:

8. Mote, Paul Gupta: Managerial Economics, Vikas Publisher, New Delhi, 1st ed.
   A. Koutsoyiannis: Modern Microeconomics, Mc Millan, New Delhi, 2nd ed.

CHE 5804 CORPORATE LEGAL ENVIRONMENT

Objective: Corporate legal environment represents that external environment in which the organization has to work. The course covers the basic laws which a student must be aware of.

Information Technology Act-2000:

Objective of the act, documents excluded from the scope of the act, digital signatures, types of digital signatures in India, certifying authorities in India, regulation of certifying authorities, duties of subscribers, offences, appellate tribunal, penalties and adjudication

Company Law: Definition and nature of a company, kinds of companies, formation of a company, memorandum of association, articles of association, prospectus, membership in a company, shares, transfer and transmission of shares, meetings and proceedings.

Patents Law:

Consumer Protection Act 1986 : Definitions under the act : complaint , consumer, defect, deficiency , unfair trade practice, consumer protection councils, redressal machinery under the act, district forum, state commission, national commission

Books Recommended:


CHE 5805 Project Management and Entrepreneurship

Objective: The course aims at acquitting the students with the subject of project management and also nature, significance and problems of entrepreneur with special reference to India.

Project Formulations and Planning ,Private commercial criteria for project choice, project cycle, feasibility, marketing feasibility, Financing for Projects and financial feasibility, Project Implementation. Brief outline of social cost benefit analysis: rationale, UNIDO and little Mirrlees approaches, UNIDO-IDCAS manual, shadow prices and conversion factors, applications in India. Planning and scheduling networks, critical path, PERT model, CPM model, PERT/cost, resource leveling and allocation.

Books Recommended

4. IMD little and J.A. Mirrlees: Project Appraisal and Planning in Developing Countries, 1975.
5. Prasanna Chandra: Projects: Preparation, Appraisal Budgeting and Control, 7th edition, TMH.
8. Peter F. Drucker: Innovation and development.

CHE 5806 RESEARCH METHODOLOGY

Objectives: The main objective of this subject is to help the students to understand the nature, scope, complexities and process of defining a business, research question. The learning focus is on developing business research skills to underpin the approach taken to a work integrated project.

Introduction: Meaning, Features, Objectives/Motives & types of Research; Attributes of good Research, Research Methods and Research Methodology; Research Process, Significance of Research in Managerial decision making.

Research Design: Meaning, Characteristics and various concepts relating to research design and classification of research design, Importance.

Measurement and Scaling: Data Types Nominal, Ordinal and Ratio scale; scaling techniques.

Formulation of Hypothesis: Meaning, Characteristics and concepts relating to testing of Hypothesis (Parameter and statistic, Standard error, Level of significance, type-I and Type-II errors, Critical region, one tail and two tail tests); Procedure of testing Hypothesis. Numerical problems based on chi-square test and Ftest (variance ratio test only).
Data Collection: Sources of Data-Primary/Secondary Methods of collecting data; direct personal interview, indirect oral interview, information through local agencies, mailed questionnaire method, schedule sent through enumerators; questionnaire and its designing and characteristics of a good questionnaire.

Sampling Design: Meaning and need of Sampling, Probability and non-probability sampling design, simple random sampling, systematic sampling, stratified sampling, cluster sampling and convenience, judgment and quota sampling (non-probability), determination of sample size.

Data Analysis & Interpretation: Introduction to Multivariate analysis- Multiple and partial correlation, multiple regression analysis (with two independent variables), specification of regression models and estimation of parameters, interpretation of results. Analysis of Variance (ANOVA)-One way and Two way ANOVA. Introduction to discriminant analysis and Factor Analysis (Numerical not to be asked)

Report writing: Style/format, contents and essential steps for report writing.

Books Recommended:
2. Ranjit Kumar:Research Methodology, Pearson Education 2009-02-20
3. Donald R. CooperPamela S. Schindler: Business Research Methods, Tata McGraw Hill
5. R. Pannerselvam: Research Methodology, Parentice Hall of India Limited.
7. William G.Zikmund :Business Research Methods, Thomson South Western Publication
CHE 5807 : FINANCIAL ACCOUNTING

Objectives: The objective of this course is to develop acquaintance with basic techniques of accountancy. The course attempts to build potential to use appropriate accounting tools and techniques of financial accounting and management accounting for preparing and analyzing financial statements.

Accounting: Accounting and its functions; Accounting as an information system; Basic Accounting Concepts and Accounting Conventions; Accounting Principles; Generally Accepted Accounting Policies (GAAP); Accounting Standards.

Branches of Accounting: Financial Accounting; Cost Accounting; Management Accounting; Accounting Equation; Accounting Structure; Types of Accounts.

Rules regarding Journal Entries; Recording of Journal Entries; Ledger Posting; Cash book; Trial Balance; Preparation of Final Accounts; Trading Account; Profit & Loss Account; Balance Sheet; Treatment of Adjustments into trial balance.

Meaning of Management Accounting: Nature; Scope; Objectives; Functions of Management Accounting; Relationship between Financial and Management Accounting; Meaning of Financial Statement; Importance and Limitations of Financial Statement; Meaning and Objectives of Financial Statement Analysis; Limitation of Financial Analysis.

Tools of financial analysis: Ratio analysis; Common size statements; Trend analysis; Fund flow and cash flow statement.

Cost Accounting: Meaning, scope and classification of costs; Absorption costing; Marginal costing and break even analysis; Use of cost data in managerial decision making.

Cost Control Techniques: Preparation of budgets and their control; Zero base budgeting; Standard costing and variance analysis; Responsibility Accounting; Target costing; Kaizen costing; Activity based costing.

Responsibility Accounting: Meaning; Steps involved in Responsibility Accounting; Responsibility Centre; Advantages of Responsibility Accounting.

Price Level Accounting: Meaning; Methods or Techniques of Price Level Accounting; Advantages; Disadvantages;

Social Accounting: Concept of Social Cost Benefit Analysis; Meaning of Social Accounting; Need; Social Accounting Approaches.

Human Resource Accounting: Meaning; Need; Methods of Human Resource Accounting; Objections Against Human Resource Accounting; HRA in India.
Books Recommended:


CHE 5852: PROCESS MODELING & SIMULATION LAB.

Functional design, property estimate as inputs for design. System concepts for computer aided design, computer aided flow sheet design. Process analysis. Process variables selection, equipment design through the selection of free parameters subject to constraints and other parameters, modular design. Simulation optimality. Dynamic design including control stability.

Typical equipments to be considered: heat exchangers, distillations columns, reactor and process equipments.

Books Recommended:

CHE 5851  PROJECT WORK

Each student is required to submit a project report on the design of a chemical plant, selecting the best process with optimum equipment size and operating conditions. The object is to test the ability of the student to apply his entire knowledge of Chemical Engineering principles to conceptualize, analyze and solve the problems. To judge his knowledge and originality and capacity for application of laboratory data in designing chemical plants and to determine the level of his proficiency at the end of the course.

CHE 5852:  PROCESS MODELING & SIMULATION LAB.

Functional design, property estimate as inputs for design. System concepts for computer aided design, computer aided flow sheet design. Process analysis. Process variables selection, equipment design through the selection of free parameters subject to constraints and other parameters, modular design. Simulation optimality. Dynamic design including control stability.

Typical equipments to be considered: heat exchangers, distillations columns, reactor and process equipments.

Books Recommended:

2. Franks, R.G. E. : Modeling and Simulation in Chemical Engineering, Wiley
CHE 5853 MASS TRANSFER LAB

1. Determination of mass transfer coefficients for naphthalene-air system.
2. To determine drying rate curves for different wet solids in a batch drier under constant drying conditions.
3. Fractional approach to equilibrium for liquid-liquid extraction from single drop.
4. Verification of Rayleigh’s equation for differential distillation.
5. Determination of flooding velocities in packed columns.
6. Determination of HETP for packed distillation columns.
7. Study and operation of a pilot sized distillation column under total reflux.
8. Study of different mass transfer equipments.

CHE 5854 PROCESS CONTROL LAB

1. U-Tube manometer
   (a) To plot the response curve for a given input to a U-tube manometer.
   (b) To determine the transfer function from the response curve obtained in part (a).
2. Time constant of a mercury thermometer
   To study the dynamics of the given thermometer and compare the theoretical value of its time constant with the experimental value.
3. Analysis of valve
   Develop a block diagram representing the dynamic behaviour of the given globe valve.
4. (a) Liquid level measurement
   With the given Bubbler System for Liquid Level Measurement, evaluate liquid height in the tank and compare it with actual values.
   (b) Calibration of Pressure Gauge
   Calibrate a pressure gauge in the range 0 psi to 60 psi.
5. Temperature control system
   To maintain the temperature of the fluid at the set point value.
6. Time constant of liquid level tank
   To study the dynamics of liquid level in a tank and compare the analytical value of the time constant with the experimental value.
7. Liquid level control
   (a) To carry out the closed loop experiment on the given liquid level control system and record its response for step change in the inlet flow.
(b) To plot the experimental response curve and comment on the response obtained.

8. Compurec
   Pressure control simulation with step input and sinusoidal input.

CHE 5855 LITERATURE SURVEY, REPORT WRITING & SEMINAR

Forms of technical reports: aims and forms according to type of readership and extent of circulation. Abstracts, extended abstracts, tables, graphs. Visual representation of data: slides, microfilms, others techniques including those of audio-visual representation. Correct use of audio equipment.

Research papers and their presentation and publication. Information retrieve direct and through abstracts.

Practical training in writing and presentation of technical reports through audio-visual means. Technique of effective public speaking organized and imprompt discussions.

Preparation of technical report on an assigned topic after survey of scientific, technical and commercial literature, using card indexes, microfilms and other information retrieval methods.

Use of Computer softwares for report writing.

Books Recommended:

2. Sottle, R.T. : The Use of Chemical Literature, Butter Worths.

CHE 5856 VIVA VOCE-II (COMPREHENSIVE)

The viva-voce examinations will be comprehensive and covering mainly chemical engineering and technology subjects covered during all the semester including the Eight Semester.