ANNA UNIVERSITY CHENNAI :: CHENNAI 600 025

CURRICULUM 2004

B.TECH. CHEMICAL ENGINEERING

SEMESTER – III

Code No.	Course Title	L	T	P	M
THEORY					
MA1201	Mathematics III	3	1	0	100
EE1219	Electrical Machines & Drives	3	0	0	100
CY1201	Environmental Science & Engineering	3	0	0	100
CH1201	Mechanical Operations	3	0	0	100
CH1202	Organic Chemistry	3	0	0	100
CH1203	Mechanics of Solids	3	0	0	100
PRACTICALS					
CH1204	Chemistry Laboratory III	0	0	3	100
CH1205	Mechanical Operations Lab.	0	0	3	100
EE1220	Electrical Engineering Lab.	0	0	3	100

SEMESTER – IV

Code No.	Course Title	L	T	P	M
THEORY					
MA1257	Statistics & Linear Programming	3	1	0	100
CH1251	Chemical Process Calculations	3	0	0	100
CH1252	Computer Applications in Chemical Engineering	3	1	0	100
CH1253	Instrumental Methods of Analysis	3	0	0	100
CH1254	Fluid Mechanics	3	0	0	100
CH1255	Physical Chemistry	3	0	0	100
PRACTICALS					
CH1256	Organic Chemistry Lab	0	0	3	100
CH1257	Physical Chemistry Lab	0	0	3	100
CH1258	Fluid Mechanics Lab.	0	0	3	100

SEMESTER – V

Code No.	Course Title	L	T	P	M
THEORY					
MA1301	Special Functions	3	1	0	100
CH1301	Chemical Engineering Thermo Dynamics I	3	0	0	100
CH1302	Chemical Process Industries I	3	0	0	100
CH1303	Heat Transfer Operations	3	0	0	100
CH1304	Mass Transfer I	3	0	0	100
GE1301	Professional Ethics and Human values	3	0	0	100
PRACTICALS					
CH1305	Technical Analysis Lab	0	0	3	100
CH1306	Heat Transfer Lab	0	0	3	100
GE1302	Communication Skill & Seminar**	0	2	0	-

SEMESTER – VI

Code No.	Course Title	L	T	P	M
THEORY					
MA1251	Numerical Methods	3	1	0	100
CH1351	Chemical Engineering Thermodynamics II	3	0	0	100
CH1352	Chemical Reaction Engineering I	3	0	0	100
CH1353	Chemical Process Industries II	3	0	0	100
CH1354	Mass Transfer II	3	0	0	100
CH1355	Process Instrumentation, Dynamics and Control	3	0	0	100
PRACTICALS					
CH1356	Mass Transfer Lab	0	0	3	100
CH1357	Chemical Process Equipment Design & Drawing I	0	0	3	100
CH1358	Process Control and Simulation Lab.	0	0	3	100

SEMESTER – VII

Code No.	Course Title	L	T	P	M
THEORY					
MG1402	Process Economics and Industrial Management	3	0	0	100
CH1401	Chemical Reaction Engineering II	3	0	0	100
CH1402	Chemical Process Plant Safety	3	0	0	100
CH1403	Transport Phenomena	3	0	0	100
CH1404	Bio Chemical Engineering	3	0	0	100
	Elective I	3	0	0	100
PRACTICALS					
CH1405	Process Equipment Design & Drawing II	0	1	3	100
CH1406	Chemical Reaction Engg. Lab	0	0	3	100
CH1407	Seminar / Comprehension**	0	2	0	-

SEMESTER – VIII

Code No.	Course Title	L	T	P	M
THEORY					
MG1401	Total Quality Management	3	0	0	100
	Elective II	3	0	0	100
	Elective III	3	0	0	100
PRACTICALS					
CH1451	Project work	0	0	12	200

**** No Examinations**

LIST OF ELECTIVES FOR

B.TECH. CHEMICAL ENGINEERING

ELECTIVES – I

Code No.	Course Title	L	T	P	M
CH1001	Food Technology	3	0	0	100
CH1002	Energy Management in Chemical Industries	3	0	0	100
CH1003	Bio & Enzyme Engineering	3	0	0	100
CH1004	Fluidization Engineering	3	0	0	100
CH1005	Optimisation of Chemical Processes	3	0	0	100

ELECTIVES – II

Code No.	Course Title	L	T	P	M
CH1006	Drugs & Pharmaceuticals Technology	3	0	0	100
CH1007	Fertilizer Technology	3	0	0	100
CH1008	Biomedical Engineering	3	0	0	100
CH1009	Nuclear Chemical Engineering	3	0	0	100
CH1010	Modern Separation Processes	3	0	0	100
CY1001	Environmental Engineering	3	0	0	100

ELECTIVES – III

Code No.	Course Title	L	T	P	M
ME1021	Entrepreneurship Development	3	0	0	100
ME1022	Computer Aided Design for Chemical Engineers	3	0	0	100
CH1011	Process Automation	3	0	0	100
CH1012	Process Modelling and Simulations	3	0	0	100
ME1023	Finite Element Analysis	3	0	0	100
CH1013	Advances in Pollution Control	3	0	0	100

MA1201 **MATHEMATICS III** **3 1 0 100**

(Common to all branches of Engineering and Technology)

AIM

The course aims to develop the skills of the students in the areas of boundary value problems and transform techniques. This will be necessary for their effective studies in a large number of engineering subjects like heat conduction, communication systems, electro-optics and electromagnetic theory. The course will also serve as a prerequisite for post graduate and specialized studies and research.

OBJECTIVES

At the end of the course the students would

- Be capable of mathematically formulating certain practical problems in terms of partial differential equations, solve them and physically interpret the results.
- Have gained a well founded knowledge of Fourier series, their different possible forms and the frequently needed practical harmonic analysis that an engineer may have to make from discrete data.
- Have obtained capacity to formulate and identify certain boundary value problems encountered in engineering practices, decide on applicability of the Fourier series method of solution, solve them and interpret the results.
- Have grasped the concept of expression of a function, under certain conditions, as a double integral leading to identification of transform pair, and specialization on Fourier transform pair, their properties, the possible special cases with attention to their applications.
- Have learnt the basics of Z – transform in its applicability to discretely varying functions, gained the skill to formulate certain problems in terms of difference equations and solve them using the Z – transform technique bringing out the elegance of the procedure involved.

UNIT I PARTIAL DIFFERENTIAL EQUATIONS 9 + 3

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Solution of standard types of first order partial differential equations – Lagrange's linear equation – Linear partial differential equations of second and higher order with constant coefficients.

UNIT II FOURIER SERIES 9 + 3

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Parseval's identity – Harmonic Analysis.

UNIT III BOUNDARY VALUE PROBLEMS 9 + 3

Classification of second order quasi linear partial differential equations – Solutions of one dimensional wave equation – One dimensional heat equation – Steady state solution of two-dimensional heat equation (Insulated edges excluded) – Fourier series solutions in Cartesian coordinates.

UNIT IV FOURIER TRANSFORM 9 + 3

Fourier integral theorem (without proof) – Fourier transform pair – Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

UNIT V Z -TRANSFORM AND DIFFERENCE EQUATIONS 9 + 3

Z-transform - Elementary properties – Inverse Z – transform – Convolution theorem -Formation of difference equations – Solution of difference equations using Z - transform.

TUTORIAL 15

TOTAL : 60

TEXT BOOKS

1. Grewal, B.S., “Higher Engineering Mathematics”, Thirty Sixth Edition, Khanna Publishers, Delhi, 2001.
2. Kandasamy, P., Thilagavathy, K., and Gunavathy, K., “Engineering Mathematics Volume III”, S. Chand & Company ltd., New Delhi, 1996.

REFERENCES

1. Wylie C. Ray and Barrett Louis, C., “Advanced Engineering Mathematics”, Sixth Edition, McGraw-Hill, Inc., New York, 1995.
2. Andrews, L.A., and Shivamoggi B.K., “Integral Transforms for Engineers and Applied Mathematicians,” Macmillen, New York, 1988.
3. Narayanan, S., Manicavachagom Pillay, T.K. and Ramaniah, G., “Advanced Mathematics for Engineering Students”, Volumes II and III, S. Viswanathan (Printers and Publishers) Pvt. Ltd. Chennai, 2002.

EE1219 ELECTRICAL MACHINES & DRIVES 3 0 0 100

AIM

The Subject aims in importing fundamental knowledge on Electrical circuits and Machineries used in process industries.

OBJECTIVES

By undergoing the course, the students will be in a position to decide on the size, capacity, Horse power of the motors, Torque required, kind of motors such as DC/AC and also the types of drives necessary to drive certain machineries used in process Industries.

UNIT I ELECTRIC CIRCUITS 6

Definition – ohm’s law – series parallel circuit – parallel circuit – Division of current – Kirchoffs law; Superposition and Thevenin’s Theorem; Star-delta transformation; Simplification of networks.

UNIT II A.C. CIRCUITS 10

Alternating Voltage; Need for A.C. Voltage; Sinusoidal A.C. Voltage; R.RL and RLC networks; Impedance angle; Power and Power factor; Actual and apparent power; Resonance in A.C. Circuits; Series, Parallel and series-parallel resonance; Vector Diagram (Phase Diagram); Complex algebra applied to sinusoids; Three phase circuits; Three phase loading; Balanced loads; Simple problem.

UNIT III D.C. MACHINES 10

Lenz’s law of electromagnetic induction; Fleming’s rule, Principle of operation of D.C. Machines; Kinds of D.C.machines; Emf equation of D.C. generators; Speed control of D.C. motor; Starters; Application of D.C. Machines.

UNIT IV A.C. MACHINES 15

Principle of operation of A.C. Machines: Transformer; single and three phase induction motors, Alternators; Synchronous motors; Equivalent circuit, Regulation and efficiency of single phase transformer; Slip-torque characteristics induction motors; starting of induction motors. Emf equation, Regulation and synchronization of alternators; Synchronous condenser; Hunting in synchronous motor; Single phase induction motors and their applications.

UNIT V DRIVES 4

Industrial requirements and Ward Leonard System of Drives. Servo-Motors; Basic theory and applications.

TOTAL: 45

TEXT BOOKS

1. Cotton, H., Electrical Technology, Pitman Publishers, (1975)
2. Uppal, S.L., Text Book of Electrical Engineering, Khanna Publishers, (1975)
3. Theraja, D.L. Text Book of Electrical Technology, Nirja publishers (1995)

CY1201 ENVIRONMENTAL SCIENCE AND ENGINEERING 3 0 0 100

(Common to all branches)

OBJECTIVES

To create an awareness on the various environmental pollution aspects and issues. To give a comprehensive insight into natural resources, ecosystem and biodiversity. To educate the ways and means to protect the environment from various types of pollution. To impart some fundamental knowledge on human welfare measures.

UNIT I INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES 10

Definition, scope and importance – need for public awareness – forest resources: use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their ground water, floods, drought, conflicts over water, dams-benefits and problems – mineral resources: use effects on forests and tribal people – water resources: use and over-utilization of surface and exploitation, environmental effects of extracting and using mineral resources, case studies – food resources: world food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – energy resources: growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies – land resources: land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – equitable use of resources for sustainable lifestyles.

Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT II ECOSYSTEMS AND BIODIVERSITY 14

Concept of an ecosystem – structure and function of an ecosystem – producers, consumers 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 (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – introduction to biodiversity – definition: genetic, species and ecosystem diversity – Biogeographical classification of India – 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 – hot-spots 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.

Field study of common plants, insects, birds
Field study of simple ecosystems – pond, river, hill slopes, etc.

UNIT III ENVIRONMENTAL POLLUTION 8

Definition – causes, effects and control measures of: (a) air pollution (b) water pollution (c) soil pollution (d) marine pollution (e) noise pollution (f) thermal pollution (g) nuclear hazards – solid waste management: causes, effects and control measures of urban and industrial wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides. Field study of local polluted site – urban / rural / industrial / agricultural

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 7

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: issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment production act – air (prevention and control of pollution) act – water (prevention and control of pollution) act – wildlife protection act – forest conservation act – issues involved in enforcement of environmental legislation – public awareness

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 6

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare – role of information technology in environment and human health – case studies.

TOTAL : 45

TEXT BOOKS

1. Gilbert M.Masters, Introduction to Environmental Engineering and Science, Pearson Education Pvt., Ltd., Second edition, ISBN 81-297-0277-0, 2004.
2. Miller T.G. Jr., Environmental Science, Wadsworth Publishing Co.

REFERENCES

1. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad India,
2. Trivedi R.K., Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards, Vol. I and II, Enviro Media.
3. Townsend C., Harper J and Michael Begon, Essentials of ecology, Blackwell Science.
4. Trivedi R.K. and P.K. Goel, Introduction to Air Pollution, Techno-science Publications.
5. Cunningham, W.P.Cooper, T.H.Gorhani, Environmental Encyclopedia, Jaico Publ., House, Mumbai, 2001.
6. Wager K.D., Environmental Management, W.B. Saunders Co., Philadelphia, USA, 1998.

CH1201 MECHANICAL OPERATIONS 3 0 0 100

AIM

To impart knowledge in separating solids from solids, solids from liquids, reduction of size, and mixing of solid, solid, liquid – liquid components

OBJECTIVES

The students will be in a position to understand that the industrial processes contain a coordinated series of separation operations and they will be in a position to decide the best process needed for a particular process industry.

UNIT I PARTICLE CHARACTERISTICS AND SIZE ANALYSIS 7

General characteristics of solids, their behaviour under different external forces, agglomeration, techniques for size analysis.

UNIT II SIZE REDUCTION 8

Laws of size reduction, classification of equipment, methods of size reduction, disintegration, preparation of colloids.

UNIT III MECHANICAL SEPARATIONS 9

Screening and Screening equipment, effectiveness of screens, gravity settling, sedimentation, thickening, centrifugal separation, impingement methods, industrial dust removing equipment with special reference to electrostatic and magnetic separators, heavy media separations, floatation.

UNIT IV FILTRATION 7

Theory of filtration, Batch and continuous filters, centrifuges, membrane and ultra filtration.

UNIT V MIXING AND AGITATION 7

Equipment for blending and kneading, dispersion, power for agitation, correlations.

UNIT VI STORAGE AND CONVEYING OF SOLIDS 7

Conveyors, Elevators, Pneumatic conveying, Different methods for storage of solids.

TOTAL: 45

TEXT BOOKS

1. McCabe, W.L, Smith J.C and Harriot, P., “Unit Operations in Chemical Engineering”, McGraw-Hill, Fourth Edition, 1984.
2. Coulson, J.M., Richardson, J.F., “Chemical Engineering”, Volume 2, Third Edition, Pergamon Press, 1977.

CH1202 ORGANIC CHEMISTRY 3 0 0 100

AIM

To study the type of components in which organic reaction are taking place and also to know the preparation of the essential organic compounds.

OBJECTIVES

At the end of the course students are in a position to have knowledge on various reaction, Mechanism, preparation of organic compounds classification of the compounds. This will be a pre cursor for the study on Chemical Reaction Engineering.

UNIT I CARBOHYDRATES 9

Introduction – Mono and Disaccharides – Important reactions – Polysaccarides – Starch and Cellulose – Derivaters of Cellulose – Carboxy Methyl Cellulose and gun cotton – Structural aspects of cellulose

UNIT II ORGANIC REACTIONS 9

Mechanism of following Organic Reactions

1. Electrophilic reaction
   a) Friedel craft reaction
   b) Riemer Timenn Reaction
   c) Backmann rearrangements

2. Nucleophilic reactions
   a) Aldol condensation
   b) Perkin reaction
   c) Benzion condensation

3. Free radical reaction
   a) Halogenation of Alkane
   b) Addition HBR on Alkene in presence of peroxide

4. Alylic halogination
   a) Using N-Bromo succinamide (NBS)
   b) Thermal halogination of Alkane (CH3 – CH = CH)

UNIT III HETEROCYCLIC COMPOUNDS 9

Nomenclature, preparation properties and uses of (1) Furan (2) Thiophone (3) Pyrrole, (4) Pyridine, (5) Indole – Quinoline and ISO quonotive – Their important derivatives

UNIT IV DYES AND DYEING 9

Colour and constitution

a. Synthesis of some important azodyes (Methyl orange, Methyl and Congo red)
b. Synthesis of Triphenylmethane dyes (Malachite green, Para Rosaniline Anthraquinone dyes (Alizarin)
c. Phthalein dyes-Eosin preparation- Introduction to Natural and Reactive dyes

UNIT V AMINO ACIDS AND PROPERTIES 9

Classification and properties of Amino acids – composition and classification of proteins – Tests for proteins – Amino acids in Proteins – estimation of General properties and relations of proteins – Hydrolysis of proteins - polypeptides

TOTAL : 45

TEXT BOOKS

1. Organic Chemistry – VI Edition – R.T. Morrison and R.N.Boyd Prentice Hall Inc. (1996) USA
2. A text book of Organic Chemistry – K.S.Tiwari, N.K.Vishnoi and S.N.Malhotra Second Edition – Vikas Publishing House Pvt. Ltd. (1998) – New Delhi.

REFERENCES

1. Chemistry in Engineering and Technology, Vol.2, TMH Publishing Co Ltd., New Delhi, 1994.

CH1203 MECHANICS OF SOLIDS 3 0 0 100

AIM

To given them knowledge on structural, Mechanical properties of Beams, columns.

OBJECTIVES

The students will be able to design the support column, beams, pipelines, storage tanks and reaction columns and tanks after undergoing this course. This is precursor for the study on process equipment design and drawing.

UNIT I STRESS, STRAIN AND DEFORMATION OF SOLIDS

Rigid bodies and deformable solids – forces on solids and supports – equilibrium and stability – strength and stiffness – tension, compression and shear stresses – Hooke's law and simple problems – compound bars – thermal stresses – elastic constants and poission's ratio – welded joints – design.

UNIT II TRANSVERSE LOADING ON BEAMS

Beams – support conditions – types of Beams – transverse loading on beams – shear force and bending moment in beams – analysis of cantilevers, simply – supported beams and over hanging beams – relationships between loading, S.F. and B.M. In beams and their applications – S.F.& B.M. diagrams.

UNIT III DEFLECTIONS OF BEAMS

Double integration method – Macaulay's method – Area – moment theorems for computation of slopes and deflections in beams – conjugate beam method

UNIT IV STRESSES IN BEAMS

Theory of simple bending – assumptions and derivation of bending equation (M/I = F/Y = E/R) – analysis of stresses in beams – loads carrying capacity of beams – proportioning beam sections – leaf springs – flitched beams – shear stress distribution in beams – determination of shear stress in flanged beams.

UNIT V TORSION

Torsion of circular shafts – derivation of torsion equation (T/J = C/R = G0/L) – stress and deformation in circular and hollow shafts – stresses and deformation in circular and hollow shafts – stepped shafts – shafts fixed at both ends – stresses in helical springs – deflection of springs – spring constant

UNIT VI COLUMNS

Axially loaded short columns – columns of unsymmetrical sections – Euler's theory of long columns – critical loads for prismatic columns with different end conditions – effect of eccentricity.

TOTAL : 45

TEXT BOOKS

1. Junarkar, S.B., Mechanics of Structure Vol. 1, 21st Edition, Character Publishing House, Anand, Indian, (1995)
2. William A.Nash, Theory and Problems of Strength of Materials, Schaum's Outline Series. McGraw Hill International Editions, Third Edition, 1994.

REFERENCE

1. Elangovan, A., Thinma Visai Iyal (Mechanics of Solids in Tamil), Anna University, Madras, 1995.

CH1204 CHEMISTRY LABORATORY III 0 0 3 100

I. VOLUMETRIC ANALYSIS

1. Estimation of tin in stannous chloride
2. Estimation of copper using EDTA (complexometric titration)

II. GRAVITATIONAL ANALYSIS

1. Estimation of barium or bariumsulphate
2. Estimation of nickel using DMG
3. Estimation of silver as silverchloride

III. WATER ANALYSIS

1. 1. Determination of total residual chlorine in water.
2. 2. Estimation of chromium in waste water.

IV. ORE ANALYSIS

1. Estimation of manganese in pyrolusite ore.
2. Estimation of magnesium in dolomite.

V. CHEMICAL ANALYSIS

1. Determination of % of available chlorine in bleaching powder.

REFERENCES:

1. Vogel's text book of Quantitative Chemical Analysis VI edition, J. Mendham, R.C.Denney, J.D.Barnes, M.J.K. Thomas (2002).

2. Day R.A., Underwood A.L., Quantitative Analysis, V edition, Prentice – Hall of India (P) Ltd., New Delhi (1998).

3. Laboratory Manual of Engineering Chemistry, Dr. SudhaRani, Dhanpat Rai Publishing Company, New Delhi (2001).

4. Dey, B.B., Seetharaman, M.V., Laboratory Manual of Organic Chemistry, Viswanathan and Company (1989).

5. Agarwal, O.P., Advanced Practical Organic Chemistry, Goel Publishing House (1991).

CH1205 MECHANICAL OPERATIONS LAB 0 0 3 100

AIM

To impart practical knowledge and hards on experience on various separation techniques.

OBJECTIVES

LIST OF EXPERIMENTS*

1. Jaw crusher
2. Crushing rolls
3. Ball mill
4. Size analysis by sieving
5. Size analysis by sub sieving
6. Filter press
7. Leaf filter
8. Cyclone separator
9. Sedimentation
10. Elutriator
11. Rotary Drum filter
12. Effectiveness of screens

*** Minimum experiments shall be offered.**

TOTAL: 45

EE1220 *ELECTRICAL ENGINEERING LAB 0 0 3 100

AIM

To experimentally determine the load characteristics on various types of AC/DC Motors and also study on the generation and alternators circuit arrangement.

OBJECTIVES

LIST OF EXPERIMENTS*

Open circuit characteristics of D.C. shunt generator
Load characteristics of D.C. shunt generator
Load characteristics of D.C. compound generator
Load test on D.C. shunt motor
Study of D.C. motor starters
O.C. and S.C. tests on single phase transformer
Load test on single phase transformer
Load test on 3 – phase squirrel cage induction motor
Study of 3 – phase induction motor starters
Load test on 3 – phase slip ring induction motor
O.C. and S.C. tests on 3 – phase alternator
Synchronization and V – curves of alternator

*** Minimum experiments shall be offered.**

TOTAL: 45

MA1257 STATISTICS AND LINEAR PROGRAMMING 3 1 0 100

AIM

Probability and Statistics appear explicitly or implicitly in many disciplines including computer and information sciences, economics, biology, operations research and all branches of engineering, Linear Programming is a mathematical technique designed to assist an organization in allocating its limited resources. This course aims at providing necessary tools for solving engineering and management problems.

OBJECTIVES

At the end of the course, the students would

- Have a fundamental knowledge of the basic probability concepts.
- Have a well – founded knowledge of standard distributions which can describe real life phenomena.
- Be introduced to the notion of sampling distribution and would have acquired a knowledge of statistical techniques useful in making rational decision in management problems.
- Be able to identify and mathematically formulate allocation problems involving linear objective functions and linear constraints and be able to obtain the optimal solution.
- Have acquired an ability to solve certain class of allocation problems which can be modeled as a Transportation or Assignment problems.

UNIT I PROBABILITY AND RANDOM VARIABLE 9 + 3

Axioms of probability - Conditional probability - Total probability - Bayes theorem – Random variable – Probability mass function - Probability density function - Properties- Moments - Moment generating functions and their properties.

UNIT II STANDARD DISTRIBUTIONS 9 + 3

Binomial, Poisson, Geometric, Negative Binomial, Uniform, Exponential, Gamma, Weibull and Normal distributions and their properties - Functions of a random variable.

UNIT III TESTING OF HYPOTHESIS 9 + 3

Sampling distributions – Testing of hypothesis for mean, variance, proportions and differences using Normal, t, Chi-square and F distributions - Tests for Independence of attributes and Goodness of fit.

UNIT IV LINEAR PROGRAMMING 9 + 3

Formulation of linear programming problem – Graphical solution – Simplex algorithm - Artificial variable – Big M method - Two phase method.

UNIT V FURTHER TOPICS IN LINEAR PROGRAMMING 9 + 3

Duality – Primal, Dual computations - Dual simplex algorithm - Transportation and Assignment models.

TUTORIAL 15

TOTAL: 60

TEXT BOOKS

1. Johnson, R. A., “Miller & Freund’s Probability and Statistics for Engineers”, Sixth Edition, Pearson Education, Delhi, 2000. (Chapters 3, 4, 5, 7, 8 & 9).

2. Taha, H. A., “Operations Research - An Introduction”, Seventh Edition, Pearson Education Edition Asia, New Delhi, 2002.

REFERENCES

1. Walpole, R. E., Myers, R, H., Myers, S. L. and Ye. K, “Probability and Statistics for Engineers and Scientists”, Seventh Edition, Pearson Education, Delhi, 2002.
2. Gupta, S.C, and Kapur, J.N., “Fundamentals of Mathematical Statistics”, S. Chand and Co. Ninth Edition, New Delhi, 1996
3. Manmohan, P.K. and Gupta, S.C. “Operations Research”, Sultan Chand & Co. Ninth Edition, Delhi, 2001.

CH1251 CHEMICAL PROCESS CALCULATIONS 3 0 0 100

AIM

Every chemical reaction involves consumption of Materials and energy. The reactions are to be balanced with correct quantity of materials and energy to achieve good percentage of conversion for products. The aim of this course is to give fundamental knowledge on such material and energy balances.

OBJECTIVES

To make them understand different types of laws of chemistry of materials and also prepare the students to accurately calculate the Stoichiometric relations between the materials involved in a physical and chemical reaction.

UNIT I UNITS AND DIMENSIONS 5

Basic and derived units, use of model units in calculations, Methods of expression, compositions of mixture and solutions.

UNIT II GAS CALCULATIONS 7

Ideal and real gas laws - Gas constant - calculations of pressure, volume and temperature using ideal gas law. Use of partial pressure and pure component volume in gas calculations, applications of real gas relationship in gas calculation.

UNIT III MATERIAL BALANCE 7

Stoichiometric principles, Application of material balance to unit operations like distillation, evaporation, crystallisation, drying etc., - Material balance with chemical reaction - Limiting and excess reactants - recycle - bypass and purging - Unsteady state material balances.

UNIT IV HUMIDITY AND SATURATION 7

Calculation of absolute humidity, molal humidity, relative humidity and percentage humidity - Use of humidity in condensation and drying - Humidity chart, dew point.

UNIT V FUELS AND COMBUSTION 6

Determination of Composition by Orsat analysis of products of combustion of solid, liquid and gas fuels - Calculation of excess air from orsat technique, problems on sulphur and sulphur burning compounds.

UNIT VI THERMO PHYSICS 6

Heat capacity of solids, liquids, gases and solutions, use of mean heat capacity in heat calculations, problems involving sensible heat and latent heats, evaluation of enthalpy.

UNIT VII THERMOCHEMISTRY 7

Standard heat of reaction, heats of formation, combustion, solution, mixing etc., calculation of standard heat of reaction - Effect of pressure and temperature on heat of reaction - Energy balance for systems with and without chemical reaction. - Unsteady state energy balances.

TOTAL: 45

TEXT BOOKS

1. Bhatt, B.L., Vora, S.M., "Stoichiometry", Tata McGraw-Hill, 1976.
2. Himmelblau, D.M., "Basic Principles and Calculations in Chemical Engineering", EEE Sixth Edition, Prentice Hall Inc., 2003 (with CD containing programmes and problems).

REFERENCES

1. Process Calculation for Chemical Engineering, Second Revised Edition, Chemical Engineering Education Development Centre, I.I.T., Madras, 1981.
2. Process Calculations, Venkataramani, V and Anantharaman, N, Prentice Hall of India Pvt. Ltd., 2003.

CH1252 COMPUTER APPLICATIONS IN CHEMICAL ENGINEERING 3 1 0 100

AIM

To introduce computer and its application to solve problems in Chemical Engineering operation thro required software.

OBJECTIVES

To obtain skill in creating database retrieval of data and also to solve Mathematical models thro' linear and non-linear programming.

UNIT I INTRODUCTION 9

Review on Programming languages, Basic, Fortran, Review on operating system commands.

UNIT II SPREAD SHEETS 9

Application in Density, molecular weight, mole and percentage compositions, Empirical and Molecular formula calculations, Heat of mixin, Gas laws, Vapour pressure, Chemical Kinetics calculations.

UNIT III SPREAD SHEETS (DATA ANALYSIS) 9

Application in data processing, Statistical analysis of data, Regression. Analysis of variance, Interpolation, Graphical representations of various Chemical Engineering problem both in laboratory exercise and core subjects such as Mechanical operation, Reaction Engineering, Distillation etc.,

UNIT IV DATABASE 9

Design and developments of simple databases on Chemical and Physical properties of substances. Retrieval and Database in report, query and other formats, Interfacing with other softwares. Preparation of Material and energy Balances preparation of plant layout.

UNIT V MATHEMATICAL PROGRAMMING 9

Linear Programming, Transportation, Assignment, Dynamic Programming in Chemical Engineering, Formulation and solution through PC based programes.

TUTORIAL 15

TOTAL = 60

TEXT BOOKS

1. Hanna, O.T. Scandell, O.C. Computational Methods in Chemical Engineering, Prentice Hall, 1995.
2. R.K. Taxali, T.K. dBase IV made simple, Tata McGraw-Hill 1991.

REFERENCES

1. Jerry, O., Breneman, G.L. Spreadsheet Chemistry, Prentice Hall, Englewood Cliffs, 1991.
2. Myers, A.L. Seider W.D. Introduction to Chemical engineering and Computer Calculations.

CH1253 INSTRUMENTAL METHODS OF ANALYSIS 3 0 0 100

AIM

To introduce various methods of chemical analysis thro' sophisticated instruments for accuracy.

OBJECTIVES

Several chemical reaction have to be analysed for composition of raw materials, materials in progress and also the final products. Several sophiscated instruments on the basic principles involving operation and interpretation of data thro' the instruments are obtained by the students.

UNIT I INTRODUCTION TO SPECTROSCOPICAL METHODS OF ANALYSIS 9

ELECTROMAGNETIC RADIATION: Various ranges, Dual properties, Various energy levels, Interaction of photons with matter, absorbance, & transmittance and their relationship, Permitted energy levels for the electrons of an atom and simple molecules, classification of instrumental methods based on physical properties.

QUANTITATIVE SPECTROSCOPY: Beer-Lambert's Law, Limitations, Deviations (Real, Chemical Instrumental) Necesslerimetry, Duboscq colorimetry, Estimation of inorganic ions such as Fe, Ni and estimation of Nitrite using Deer-Lambert's Law.

UNIT II MOLECULAR SPECTROSCOPY 9

Various electronic transitions in organic and inorganic compounds effected by UV, visible and infra red radiations, various energy level diagrams of saturated, unsaturated and carbonyl compounds, excitation by UV and Visible radiations, Woodward-Fischer rules for the calculation of absorption maxima (dienes and carbonyl compounds) Effects of auxochromes and effects of conjugation on the absorption maxima, Instrumentation for UV, VISIBLE and IR spectrocopies (source, Optical parts and Detectors), Multicomponent analysis, Photometric titration (Experimental set-up and various types of titrations), Applications of UV, VISIBLE AND IR spectrscopies.

UNIT III ATOMIC SPECTROSCOPY 9

Atomic Absorption Spectrophotometry: Principle, Instrumentation and Application, Various interferences observed in AAS (Chemical radiation and excitation). Polarimetry and refractrometry Principle, instrumentation and Applications

UNIT IV ELECTROMETRIC METHODS OF ANALYSIS 9

Introduction of electrometric methods, difference between redox and acid- base reactions, types of cells, schematic representation of cell, single electrode potential, laboratory reference electrodes (Standard hydrogen, saturated calomel, Ag – AgCl and inert electrodes), ion-selective electrodes.

Potentiometry: Nernst equation, experimental set-up and measurement of pH; Conductometry-Measurement of conductance, experimental set-up and various titrations (strong and weak acid/base)

UNIT V CHROMATOGRAPHIC METHODS 9

Classification of chromatographic methods, column, Thin layer paper, Gas, High performance liquid Chromatographical methods (principle, mode of separation and technique) separation of organic compounds by column and thin layer, mixture of Cu, Co and Ni by Paper, separation of amino acids by paper, estimation of organic compounds by GC and, HPLC.

TOTAL = 45

TEXT BOOKS

1. Willard, H.H., Merritt.I.I., Dean J.A., and Settle, F.A., Instrumental methods of analysis, Sixth edition, CBS publishers, 1986.
2. Parikh V.M. Absorption spectroscopy of organic molecules Addisen –Wesley Publishing company, 1994.

REFERENCES

1. Skoog D.A. and Weswt D.MM., Fundamentals of Analytical Chemistry, Saunders – college Publishing, 1982.
2. Banwell, G.C., Fundamentals of molecular spectroscopy TMH, 1992.

CH1254 FLUID MECHANICS 3 0 0 100

AIM

To have a general idea about the Mechanism of fluid, fluid flow and flow measuring devises thro' basic concepts.

OBJECTIVES

The subject will help the students to have a knowledge on the fluid properties, their characteristics while abstatic, during flow thro' ducts, pipes and other channels. Knowledge on several machineries used to transport the fluid and their performance are assessed.

UNIT I INTRODUCTION 9

The concept of fluid, the fluid as a continum - laws of dimensional homogeneity - properties of velocity field - thermodynamic properties of a fluid - viscosity and other secondary properties - basic flow analysis techniques - flow patterns.

UNIT II PRESSURE DISTRIBUTION IN A FLUID 9

Pressure and pressure gradient - equilibrium of fluid element - hydrostatic pressure distributions - applications to manometry - Hydrostatic forces on planed and curved submerged surfaces - laws of buoyancy and stability considerations for bodies in floatation.

UNIT III DIMENSIONAL ANALYSIS AND SIMILITUDE 9

The principle of dimensional homogeneity - the Pi-theorem - non-dimensional action of the basic equations - similitude - relationship between dimensional analysis and similitude - use of dimensional analysis for scale up studies.

UNIT IV VISCOUS FLOW IN DUCTS AND BOUNDARY LAYER FLOW 9

Reynold's number regimes, internal versus external viscous flow, flow in circular pipe - head loss, minor losses in pipe systems and multiple-pipe systems - boundary layer concepts, functions and pressure drag - flow through fixed and fluidised beds.

UNIT V FLOW MEASUREMENT AND TUBRO MACHINERY 9

Constant and variable headmeters - classification of pumps - performance curves - matching pumps to system characteristics, compressors and its efficiency.

TOTAL : 45

TEXT BOOKS

1. Noel de Nevers, "Fluid Mechanics for Chemical Engineers", Second Edition, McGraw-Hill, 1991.
2. McCabe, W.L, Smith J.C and Harriot .P., "Unit Operations in Chemical Engineering", McGraw-Hill, Sixth Edition 2000.

REFERENCES

1. Shames, I.H., "Mechanics of Fluids", Third Edition, McGraw-Hill Inc., 1992.
2. White, F.M., "Fluid Mechanics", 4th Edition, McGraw-Hill Inc., 1999.
3. Daughenty, R.L., Franzini, J.B and Finnemore, E.J., "Fluid Mechanics with Engineering Applications", SI metric Edn., McGraw-Hill Book Company, 1989.
4. Darby, R. Chemical Engineering Fluid Mechanics, Marcel Dokker, 1998.
5. Vennarol, J.K., Street, R.L. Elementary Fluid Mechanics. 6th Edition John Wiley & Sons. 1982.

CH1255 PHYSICAL CHEMISTRY 3 0 0 100

AIM

To know the basic concepts of physical chemistry aspects of chemical compounds and their behaviour at different processing conditions.

OBJECTIVES

The students get knowledge on the reactors mechanism. Use of catalyst and also the reactions stages involved in a particular process operations.

UNIT I ELECTROCHEMISTRY 9

Electrical Conductance – Specific conductance – Equivalent conductance – Variation with dilution – Kohirausch's law – Transport Number – Galvanic cells – EMF and its measurement – Reference electrode – Standard Hydrogen electrode – Nemst equation – Electrochemical series – Applications of EMF measurements.

UNIT II CHEMICAL KINETICS 7

Kinetics of parallel and opposing reactions – concept of activation energy – Auhenius equation – Theory of absolute reaction rales – Kinetics of Enzymne Catalysed reactions.

UNIT III PHASE RULE 7

Definition – Derivation – Application of phase rule to water system – Thermal Analysis – Cooling curves – Two component system – Eutectic and compound formation.

UNIT IV ADSORPTION AND CATALYSIS 9

Physical and chemical adsorption – Types of adsorption isotherm, BET method, Gibbs equation, Homogeneous catalysis – Heterogeneous catalysis, acid – base catalysis, Enzyme catalysis – Applications of catalysis in industries.

UNIT V COLLOIDS 7

Introduction to colloids – properties of colloids – Electrokinetic phenomena – Donnan Membrane equilibrium – Emulsions – Gels – colloidal electrolyles.

UNIT VI PHOTOCHEMISTRYS 6

Laws of Photochemistry, Quantum efficiency, Photochemical reactions, Actinometry, Kinetics and mechanism of Hydrogen – Bromine reaction.

TOTAL : 45

TEXT BOOKS

1. Puri B.H. and Sharma L.R. Principles of Physical Chemistry, S.Nagin Chand and Company, Delhi (1994).
2. Kund and Jain, Physical Chemistry, S.Chand and Company, Delhi (1996).

REFERENCES

1. Sannel Glasstone, A Text Book in Electro Chemistry.
2. Gordon M. Barrow, Physical Chemistry, Sixth edition, Tata McGraw-Hill (1998).
3. Kuriakose, J.C. and Rajaram J, Chemistry in Engineering and Technology Vol. I, Tata McGraw-Hills. 1984

CH1256 ORGANIC CHEMISTRY LABORATORY 0 0 3 100

AIM

To determine experimental the various properties of organic compounds and also to prepare and characteristic those compounds through laboratory exercises.

OBJECTIVES

- Criteria of purity of Solid and Liquid compounds determination of Melting point, Boiling point, density, Refractive Index
- Identification of organic compounds (Aliphatic or aromatic saturated / unsaturated compounds)
- Characteristic reaction of functional groups in (Ealdehydes, Ketones, acids, phenols, nitro compounds amino compounds and amides.
- Characterisation of unknown organic compounds (Aldehydes, Kebones phenols, Acids, Esters, Amines alcohol, Carbohydrates)
- Analysis and estimation of Pigments, Sugar, Polymers.
- Organic preparation of:
    - Oxidation of benzaldehyde to benzoic acid
    - Hydrolysis of ethylbenzoalts to benzoic acid Acetylation of aniline to acetaxilide
    - Nitration of Nitrolenzene to meta dinitro Benzane

TOTAL = 45

REFERENCES

1. Laboratory Manual for organic chemistry Prof. B.B.Seetharaman, M.V.Viswanathan and Co publishers, 1989.
2. Advanced Practical organic chemistry, Agarwal, O.P., Goel Publishing House, 1991.

CH1257 PHYSICAL CHEMISTRY LABORATORY 0 0 3 100

AIM

To determine experimentally various properties of the chemical compounds and to determine and estimate kinetics values, and other properties of chemicals.

OBJECTIVES : To improve the practical knowledge on the properties and characteristics of solvents and mixtures.

LIST OF EXPERIMENTS

(1) Molecular weight determination
- (a) Rast's method
- (b) F.Pt depression
- (c) B.Pt elevation and
- (d) Transition temperature methods

(2) Partition experiments
- (a) Partition coefficient of iodine between two immiscible solvents.
- (b) Eq. Constant of KI + I2 = KI2
- (c) Association factor of an organic acid
- (d) Curramonium couples

(3) Phase rules
- (a) Two component System
- (b) Three component System
- (c) Phenol-water system

(4) Optical experiments
- (a) Polarimetry
- (b) Refractometry

(5) Conductivity experiments
- (a) Cell constant
- (b) Ostwald dilution acid
- (c) Basicity of an organic acid
- (d) Conductometric titration

(6) Kinetics

First order reaction
Second order reaction

(7) EMF
- (a) Single electro potentials
- (b) Concentration cells
- (c) Titrations (d) pH determination

(8) Miscellaneous
- (a) Surface tension
- (b) Viscosity
- (c) Adsorption

TOTAL = 45

LIST OF EQUIPMENTS

- Micro Calorimeter
- Beckman Thermometers. Glasswares,
- Thermometers 0 to 110 – 0°. Bottle Shakers .pH meters
- Pressure Glass bottles. Standard Cells. Multimeters
- Viscometers-Ostwald Cannan Ubbelholde. Voltage Stabiliser
- Stalalmometer
- Surface Tension Meter .Tape Heaters
- Mantle Heaters

- DC Power Supply. Thermostat. Cyrostats

CH1258 FLUID MECHANICS LAB 0 0 3 100

AIM

To determine experimentally the flow characteristics of fluids and also to determine the efficiency of the flow measuring devices and fluid transport machineries.

OBJECTIVES : To gain practical knowledge on the measurement of Fluid Flow and their characteristics at different operating conditions.

LIST OF EXPERIMENTS*

1. Calibration of constant and variable Head meters
2. Calibration of Weirs
3. Drag reduction studies
4. Flow through straight pipe
5. Flow through Vertical concentric pipe
6. Pressure drop studies in packed column
7. Fluidisation
8. Open drum orifice and draining time
9. Flow through helical coil and spiral
10. Characteristic curves of centrifugal pump
11. Viscosity measurement of non Newtonian fluids
12. Flow of air thro' orifice using Aircompressor

TOTAL : 45

LIST OF EQUIPMENTS REQUIRED

1. Orifice Meter with U tube manometer
2. Venturi meter with U tube Manometer
3. Vnotch and cirucular Notch wiers.
4. Straight pipes with U tube Manometers
5. Vertical double pipe (concentric pipes) with U tube Manometer
6. Packed column with U tube manometer and with difference packings
7. Glass column with small spherical particles for fluidization.
8. Open drum with on fie and manometer
9. Helical coil of different diameter (helical) or/and different height (spiral)
10. Centrifugal pump with samp and pressure gange Vertical discharge & horizontal discharge Viscometer
11. Air compresser with different orifices.

MA1301 SPECIAL FUNCTIONS 3 1 0 100

AIM

Modern engineering and physics applications demand a through knowledge of applied mathematics. In particular special functions, finds applications in the areas like heat conduction, communication systems electromagnetic theory, etc. This course will give a through knowledge on special function and useful in solving problems in engineering.

OBJECTIVE

At the end of the course, the students would

- Have acquainted a through knowledge on improper integrals such as gamma and beta functions that are useful in evaluating area and volume integrals. Also the basic concepts of ordinary point and singular point are introduced along with the series solution of second order ordinary differential equations. Also series solution procedure is useful to discuss the topics like Legendre polynomials, Bessel functions, Hermite and Laugrre polynomials and hypergeometric functions.

- Have gained the concepts on Legendre polynomials which are useful in studying the linear modeling of any physical problem for a spherical symmetry.
- Be exposed to the solution of Bessel's differential equation and its properties that can be used to study any physical problem characterized in a linear form for a cylindrical symmetry.
- Have acquired knowledge on Hermite and Lagurre polynomials that are useful to approximate functions and to study problems in wave mechanics.

Have fundamental knowledge on the solution of hypergeometric equation and the various representations that will be useful to find relation to other functions, summing series and evaluating integrals.

UNIT I IMPROPER INTEGRALS AND SERIES SOLUTIONS 9

Improper integrals-Gamma and Beta functions, Series solutions-Ordinary point, regular singular point of second order linear ordinary differential equation, series solution to a second order linear ordinary differential equation about an ordinary point and a regular singular point.

UNIT II BESSEL FUNCTIONS 9

Bessel's equation, Bessel functions, Recurrence relations, Orthogonality property, Generating function, Equations reducible to Bessel's equation, Modified Bessel functions.

UNIT III LEGENDRE POLYNOMIALS 9

Legendre's equation, Legendre Polynomials, Rodrigue's formula generating function, recurrence relations, orthogonality property,

UNIT IV HERMITE AND LAGUERRE POLYNOMIALS 9

Hermite and Leguerre equations and their solutions-Polynomials, Rodrigue's formula, generating functions, recurrence relations, orthogonality property.

UNIT V BOUNDARY VALUE PROBLEMS. 9

Solution of Boundary Value Problems involving Bessel functions & Legendre polynomials

TUTORIAL 15
TOTAL 60

TEXT BOOK

1. Andrews.L.A., "Special Function for Scientist and Engineers", McGraw-Hill, 1992.
2. Narayanan, S. Manicavachagam Pillay and Ramanaiah.G, "Advanced Mathematics for Engineering Students", Vol. II S.Viswanathan Printers Private Limited, Madras, 1985.

REFERENCES

1. Grewal, B.S., "Higher Engineering Mathematics", Khanna Publishers, Delhi, 2005.
2. Jain R.K & Iyengar, S.R.K. Advanced Engineering Mathematics, Narosa Publishing House, New Delhi, 2002.

CH 1301 CHEMICAL ENGINEERING THERMO DYNAMICS I 3 0 0 100

AIM

To present thermodynamic principles from a chemical engineering viewpoint.

OBJECTIVES

The Students will be well versed with the behaviour of fluids under PVT conditions and also apply them for practical purpose. Main advantage will be to deal with power production and refrigeration processes. The study further provides a comprehensive exposition to theory and application of solution thermodynamics.

UNIT I BASIC CONCEPTS 6

The terminologies of thermodynamics, the variables and quantities of thermodynamics, categorization of systems and processes. Energy classifications, point and path properties, energy in transition, heat and work, reversible and irreversible processes, phase rule.

UNIT II FIRST LAW OF THERMODYNAMICS 6

The first law and internal energy, statements of first law for the non flow and flow systems, enthalpy and heat capacity limitations of the first law.

UNIT III SECOND LAW OF THERMODYNAMICS 6

Statements of the second law of thermodynamics, available and unavailable energies, The entropy function, applications of the second law.

UNIT IV THERMODYNAMIC FORMULATIONS 9

Measurable quantities, basic energy relations, maxwell relations, thermodynamic formulations to calculate enthalpy, internal energy and entropy as fuction of pressure and temperature, other formulations involving C_p and C_v, complex thermodynamic formulations, thermodynamic properties of an ideal gas, entropy change in reversible and irreversible process.

UNIT V THERMODYNAMIC PROPERTIES OF REAL GASES 9

The PVT behaviour of fluids, laws of corresponding states and equation of states approaches to the PVT relationships of non ideal gas, problems; compressiblity factors, generalised equations of state, property estimation via generalised equation of state; fugacity and fugacity coefficients of real gases.

UNIT VI COMPRESSION OF FLUIDS 9

Thermodynamic aspects of compression process, classification of compression processes, basic equation for change of state of gases, the work expression for different situations, the effect of clearance volume, multistage compression, convergent divergent flow, Ejectors.

TOTAL : 45

TEXT BOOKS

1. Smith, J.M., and Van Ness, H.C., “Introduction to Chemical Engineering Thermodynamics”, Kogakushai 1976.
2. Narayanan K.V “A Text Book of Chemical Engineering Thermodynamics” Prentice Hall of India Pvt. Ltd. 2001.

REFERENCES

1. Hougen, O.A., Watson, K.M., and Ragatz, R.A., “Chemical Process Principles Part II, Thermodynamics”, John Wiley 1970.
2. Dodge, B.F., “Chemical Engineering Thermodynamics”, McGraw-Hill, 1960.
3. Sandler, S.I., “Chemical and Engineering Thermodynamics 2nd edn.”, Wiley, 1989.
4. Kyle, B.G., “Chemical and Process Thermodynamics 2nd edn.”, Prentice Hall of India Pvt. Ltd., 1990.

CH1302 CHEMICAL PROCESS INDUSTRIES I 3 0 0 100

AIM

To integrate various courses such as chemistry, unit operations, mechanical operation, stoichiometry etc., and to give the young chemical engineers some comprehension on various fields of production into which he will enter or with which he will be affiliated during the course of study or after completion of the study.

OBJECTIVES

To gain knowledge on various aspects of production engineering and understand the practical methods of production in a chemical factory.

UNIT I INTRODUCTION 5

Chemical processing, the role of a chemical engineers in process industries, importance of block diagrams and flow charts, unit operations, unit processes, process utilities and economics, industrial safety and pollution, outline of plant and equipment design, process control and instrumentation.

UNIT II MARINE CHEMICALS 4

Sodium chloride, By-products of common salt industry, value added product.

UNIT III CHOLORO-ALKALI INDUSTRIES 6

Soda ash and sodium bicarbonate, chlorine and caustic soda; bleaching powder and related bleaching agents, hydrochloric acid.

UNIT IV SULPHUR AND SULPHURIC ACID INDUSTRIES 5

Mining and manufacture of sulphur, recovery of sulphur from polluting gases, sulphur trioxide and sulphuric acid.

UNIT V PHOSPHORUS INDUSTRIES 5

Posphate rock, benefication, phosphoric acid-phosphate.

UNIT VI NITROGEN INDUSTRIES 4

Synthesis ammonia and nitric acid.

UNIT VII FERTILISER INDUSTRIES 12

Growth elements, functions, nitrogenous fertilizers ammonium sulphate, ammonium nitrate and urea phosphotic fertilizers, single and triple super phosphate, ammonium phosphate, nitro phosphate, potassic fertilizers, potassium chloride, potassium nitrate and phosphate, compound fertilizers and bio-fertilisers.

UNIT VIII AGRICHEMICAL INDUSTRIES 4

Insecticides, pesticides, herbicides, plant nutrients and regulators.

TOTAL : 45

TEXT BOOKS

1. Austin, G.T., Shreve's Chemical Process Industries, Fifth Edition, McGraw-Hill International Book Co, Singapore, 1984
2. Dryden, C.E., Outlines of Chemicals Technology, Edited and Revised by Gopala Rao, M. and M.Sittig., Second Edition, Affiliated East-West press, 1993.

REFERENCES

1. Hougen, O.A., Watson, K.M., and Ragatz, R.A., “Chemical Process Principles Part II, Thermodynamics”, John Wiley 1970.
2. Kent, J.A., (ed), Riggel’s Hand book of Industrial Chemistry, Van Nostrant Reinhold, 1974.
3. CHEMTECH 1-4, Chemical Engineering Education Development Centre, I.I.T., Madras 1975-78.
4. Dodge, B.F., “Chemical Engineering Thermodynamics”, McGraw-Hill, 1960.
5. Sandler, S.I., “Chemical and Engineering Thermodynamics 2nd edn.”, Wiley, 1989.
6. Kyle, B.G., “Chemical and Process Thermodynamics 2nd edn.”, Prentice Hall of India Pvt. Ltd., 1990.

CH 1303 HEAT TRANSFER OPERATIONS 3 0 0 100

AIM

To provide fundamental instruction is various methods of heat transfer thro’ different media.

OBJECTIVES

To gain knowledge in various heat transfer methodology in process engineering and to design heat transfer equipments such as furnace, boilers, heat exchangers evaporation etc.,

UNIT I BASIC PRINCIPLES 4

Importance of heat transfer in Chemical Engineering operations - Modes of heat transfer - Mean temperature difference.

UNIT II CONDUCTION 8

Concept of heat conduction - Fourier's law of heat conduction - one dimensional steady state heat conduction equation for flat plate, hollow cylinder, hollow sphere - Heat conduction through a series of resistances - Analogy between flow of heat and flow of electricity - Thermal conductivity measurement; effect of temperature on thermal conductivity; conduction through liquids.

UNIT III FILM COEFFICIENTS AND THEIR APPLICATION 8

Individual and overall heat transfer coefficients and the relationship between them - Conduction with heat source - Two dimensional steady state conduction - Analytical and graphical methods - Transient heat conduction.

UNIT IV CONVECTION 8

Concept of heat transfer by convection - Natural and forced convection - Application of dimensional analysis for convection - Equations for forced convection under laminar, transition and turbulent conditions - Equations for natural convection - Heat transfer from condensing vapours, heat transfer to boiling liquids - Influence of boundary layer on heat transfer - Heat transfer to molten metals - Heat transfer in packed and fluidised beds.

UNIT V HEAT EXCHANGERS 8

Parallel and counter flow heat exchangers - Log mean temperature difference - Single pass and multipass heat exchangers; plate heat exchangers; use of correction factor charts; heat exchangers effectiveness; number of transfer unit - Chart for different configurations - Fouling factors and wilson's plot - Design of various types of heat exchangers - Design of furnaces - Design of condensers, - Design of tubular reactors.

UNIT VI RADIATION 4

Concept of thermal radiations - Black body concept - Stefan Boltsman's law -concept of grey body – radiation between surfaces.

UNIT VII EVAPORATION 5

Types of evaporation - single effect and multiple effect evaporation - Design calculation for single and multiple effect evaporation.

TOTAL : 45

TEXT BOOKS

1. McCabe, W.L., Smith, J.C., and Harriot, P., "Unit Operations in Chemical Engineering", McGraw-Hill Recent Edn.
2. Binay K.Dutta "Heat Transfer Principles and Applications", Prentice Hall of India, 2001.

REFERENCES

1. Coulson, J.M., Richardson, J.F., "Chemical Engineering", Vol. I., Pergamon and ECBS, 1970.
2. Kern, D.Q., "Process Heat Transfer", McGraw-Hill - Revised adition - 1999.

CH1304 MASS TRANSFER I 3 0 0 100

AIM

To impart knowledge on how certain substances undergo the change in composition, change in phases and exhibit the properties according to the changed environment.

OBJECTIVES

Students develop a sound knowledge on the types of Mass Transfer thro' a driving force in the same fashion as temperature differences as driving force for heat transfer. The students shall have an elementary knowledge on fluid flow, heat transfer and stoichiometry.

UNIT I DIFFUSION 8

Molecular and eddy diffusion in gases and liquids, steady state diffusion under stagnant and laminar flow conditions Diffusivity measurement and prediction, multicomponent diffusion, diffusion in solids and its applications.

UNIT II MASS TRANSFER COEFFICIENTS 12

Concept of mass transfer coefficients, mass transfer under laminar and turbulent flow past solids, boundary layers, mass transfer at fluids surfaces correlation of mass transfer coefficients, JD, HTU, and NTU concepts, theories of mass transfer and their applications, interphase mass transfer and over all mass transfer coefficients in binary and multicomponent systems, application to gas-liquid and liquid-liquid systems.

UNIT III HUMIDIFICATION AND AIR CONDITIONING 8

Basic concepts, psychrometric chart construction, Humidification and dehumidification operations, design calculations, cooling tower principle and operation, types of equipment, design calculation.

UNIT IV DRYING 9

Theory and mechanism of drying, drying characteristics of materials, batch and continuous drying, calculation for continuous drying, drying equipment, design and performance of various drying equipments.

UNIT V CRYSTALLISATION 8

Nuclei formation and crystal growth, theory of crystallisation, growth coefficients and the factors affecting these in crystallisation, batch and continuous industrial crystallisers, principle of design of equipment.

TOTAL : 45

TEXT BOOKS

1. McCabe, W.L., Smith, J.C., and Harriot, P., “Unit Operations in Chemical Engineering”, McGraw-Hill Edn., 1993.
2. Coulson, J.M., Richardson, J.F., “Chemical Engineering”, Vol. I, Pergamon Press, 1977.

REFERENCES

1. Treybal, R.E., “Mass Transfer Operations”, McGraw-Hill Kogakusha, 1980.
2. Foust, A.S.Wenzel, L.A., Clump, C.W., Naus, L., and Anderson, L.B., “Principles of Unit Operations”, Second Edition, Wiley, 1980.
3. Roman Zarzytci, Andrzai Chacuk, “Absorption: Fundamentals and Application”, Pergamon Press, 1993.
4. Skelland, A.H.P., “Diffusional Mass Transfer”, Krieger, Malabar FL (1985).
   Strigle (jr), R.F., “Packed Tower Design and Applications”, Second Edition, Gulf Publishing Company, USA, 1994.

GE1301 PROFESSIONAL ETHICS AND HUMAN VALUES 3 0 0 100

AIM

To impart – knowledge on moral issues

OBJECTIVE

To create an awareness on Engineering Ethics and Human Values. To instill Moral and Social Values and Loyalty. To appreciate the rights of others

UNIT I HUMAN VALUES 10

Morals, Values and Ethics – Integrity – Work Ethic – Service Learning – Civic Virtue – Respect for Others – Living Peacefully – caring – Sharing – Honesty – Courage – Valuing Time – Co-operation – Commitment – Empathy – Self-Confidence – Character – Spirituality.

UNIT II ENGINEERING ETHICS 9

Senses of 'Engineering Ethics' - variety of moral issued - types of inquiry - moral dilemmas - moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy – Models of Professional Roles - theories about right action - Self-interest - customs and religion - uses of ethical theories.

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION 9

Engineering as experimentation - engineers as responsible experimenters - codes of ethics - a balanced outlook on law - the challenger case study.

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS 9

Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk - the three mile island and chernobyl case studies.

Collegiality and loyalty - respect for authority - collective bargaining - confidentiality - conflicts of interest - occupational crime - professional rights - employee rights - Intellectual Property Rights (IPR) - discrimination.

UNIT V GLOBAL ISSUES 8

Multinational corporations - Environmental ethics - computer ethics - weapons development - engineers as managers-consulting engineers-engineers as expert witnesses and advisors -moral leadership-sample code of Ethics (Specific to a particular Engineering Discipline).

TOTAL : 45

TEXT BOOKS

1. Mike Martin and Roland Schinzinger, “Ethics in engineering”, McGraw-Hill, New York 1996.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, “ Engineering Ethics”, Prentice Hall of India, New Delhi, 2004.

REFERENCES

1. Charles D. Fleddermann, “Engineering Ethics”, Pearson Education / Prentice Hall, New Jersey, 2004 (Indian Reprint now available)
2. Charles E Harris, Michael S. Protchard and Michael J Rabins, “Engineering Ethics – Concepts and Cases”, Wadsworth Thompson Leatning, United States, 2000 (Indian Reprint now available)
3. John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi, 2003.
4. Edmund G Seebauer and Robert L Barry, “Fundamentals of Ethics for Scientists and Engineers”, Oxford University Press, Oxford, 2001.

CH1305 TECHNICAL ANALYSIS LAB 0 0 3 100

AIM : To determine experimentally the various properties of the oils, soaps, fats, chemicals etc.,

OBJECTIVES : To have a thorough understanding on the behaviors and characteristics of sub materials at different operating conditions

LIST OF EXPERIMENTS

1. Oil Analysis: (3 experiments)
   a) Acid value
   b) Saponification value
   c) Iodine value
2. Soap Analysis: (2 experiments)
   a) Alkali Content
   b) Fatty acid content of Soap
3. Estimation of purity of glycerol: by Dichromatic method
4. Analysis of water:
   Determination chlorine demand in water : Estimation of residual chlorine in water by Volumetric method
5. Cement Analysis (3 experiments)
   a) Estimation of silica content
   b) Estimation of calcium oxide content
   c) Estimation of mixed oxide content
6. Fertilizer Analysis:
   Estimation of Nitrozen in Urea by Kjeldals method

*** Minimum 10 experiments shall be offered**

TOTAL : 45

CH1306 HEAT TRANSFER LABORATORY 0 0 3 100

AIM : To determine experimentally the heat transfer coefficient of different fluid in different equipments.

OBJECTIVES : To have a wide knowledge on the conductive, convective and radiative type of heat transfer under different operative conditions and also the selection of instruments to measure the heat.

LIST OF EXPERIMENTS

1. Laminar Flow
2. Condenser (Vertical)
3. Condenser (Horizontal)
4. Convective Heat Transfer
5. Transient Heat Conduction
6. Agitated vessel
7. Natural Convection
8. Jacketed Kettle
9. Calculation of Graetz Number
10. Open Pan Evaporator
11. Temperature Control Loop
12. Characteristics of Temperature Measuring Device
13. Characteristics of Temperature Measuring Device

TOTAL = 45

LIST OF EQUIPMENTS

1. Data Loger
2. Heat Exchanger
3. Condenser
4. Stirrers
5. Jacketed Kettle
6. Pan Evaporator
7. Mini Boiler
8. Controllers for Temperature
9. Temperature Measuring Devices

GE1302 COMMUNICATION SKILLS AND TECHNICAL SEMINAR 0 2 0 -

OBJECTIVE

During the seminar session each student is expected to prepare and present a topic on engineering/technology, for a duration of about 8 to 10 minutes. Three periods per week are to be allotted and 15 students are expected to present the seminar, a faculty guide is to be allotted and he/she will guide and monitor the progress of the student and maintain attendance also.

Students are encouraged to use various teaching aids such as over head projectors, power point presentation and demonstrative models.

This will enable them to gain confidence in facing the placement interviews.

MA1251 NUMERICAL METHODS 3 1 0 100

AIM

With the present development of the computer technology, it is necessary to develop efficient algorithms for solving problems in science and engineering. This course gives a complete procedure for solving different kinds of problems occur in Engineering numerically.

OBJECTIVES

At the end of the course, the students would be acquainted with the basic concepts in numerical methods. The uses of numerical methods are summarized as follows:

- The roots of nonlinear (algebraic or transcendental) equations which arise in engineering applications can be obtained numerically where analytical methods fail to give solution. Solutions of large system of linear equations are also obtainable using the different numerical techniques discussed. The Eigenvalue problem is one of the important concepts in dynamic study of structures.
- When huge amounts of experimental data are involved in some engineering application, the methods discussed on interpolation will be useful in constructing approximate polynomial to represent the data and to find the intermediate values.
- The numerical differentiation and integration find application when the function in the analytical form is too complicated or the huge amounts of data are given such as series of measurements, observations or some other empirical information.
- Many physical laws are couched in terms of rate of change of quantity. Therefore most of the engineering problems are characterized in the form of nonlinear ordinary differential equations. The methods introduced in the solution of ordinary differential equations will be useful in attempting any engineering problem.
- When the behavior of a physical quantity is expressed in terms of rate of change with respect to two or more independent variables, the problem is characterized as a partial differential equation. The knowledge gained may be used in solving any problem that has been modeled in the form of partial differential equation.

UNIT I SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 9+3

Linear interpolation methods (method of false position) – Newton's method - Fixed point iteration: x=g(x) method - Solution of linear system by Gaussian elimination and Gauss-Jordon methods- Iterative methods: Gauss Jacobi and Gauss-Seidel methods- Inverse of a matrix by Gauss Jordon method – Eigenvalue of a matrix by power method.

UNIT II INTERPOLATION AND APPROXIMATION 9+ 3

Lagrangian Polynomials – Divided differences – Interpolating with a cubic spline – Newton's forward and backward difference formulas.

UNIT III NUMERICAL DIFFERENTIATION AND INTEGRATION 9+ 3

Derivatives from difference tables – Divided differences and finite differences –Numerical integration by trapezoidal and Simpson's 1/3 and 3/8 rules – Romberg's method – Two and Three point Gaussian quadrature formulas – Double integrals using trapezoidal and Simpsons's rules.

UNIT IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS 9+ 3

Single step methods: Taylor series method – Euler and modified Euler methods – Fourth order Runge – Kutta method for solving first and second order equations – Multistep methods: Milne's and Adam's predictor and corrector methods.

UNIT V BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS 9+ 3

Finite difference solution of second order ordinary differential equation – Finite difference solution of one dimensional heat equation by explicit and implicit methods – One dimensional wave equation and two dimensional Laplace and Poisson equations.

TUTORIAL 15

TOTAL : 60

TEXT BOOKS

1. Gerald, C.F, and Wheatley, P.O, "Applied Numerical Analysis", Sixth Edition, Pearson Education Asia, New Delhi, 2002.
2. Balagurusamy, E., "Numerical Methods", Tata McGraw-Hill Pub. Co. Ltd., New Delhi, 1999.

REFERENCES

1. Kandasamy, P., Thilagavathy, K. and Gunavathy, K., "Numerical Methods", S.Chand Co. Ltd., New Delhi, 2003.
2. Burden, R.L and Faires, T.D., "Numerical Analysis", Seventh Edition, Thomson Asia Pvt. Ltd., Singapore, 2002.

CH1351 CHEMICAL ENGINEERING THERMODYNAMICS II 3 0 0 100

AIM

To present thermodynamic principles from a chemical engineering viewpoint.

OBJECTIVES

The Students will be well versed with the behaviour of fluids under PVT conditions and also apply them for practical purpose. Main advantage will be to deal with power production and refrigeration processes. The study further provides a comprehensive exposition to theory and application of solution thermodynamics.

UNIT I PROPERTIES OF SOLUTIONS 7

Partial molar properties, ideal and non-ideal solutions, standard states definition and choice, Gibbs-Duhem equation, excess properties of mixtures.

UNIT II PHASE EQUILIBRIA 10

Criteria for equilibrium between phases in multi component non-reacting systems in terms of chemical potential and fugacity, application of phase rule, vapour-liquid equilibrium, phase diagrams for homogeneous systems and for systems with a miscibility gap, effect of temperature and pressure on azeotrope composition, liquid-liquid equilibrium, ternary liquid-liquid equilibrium.

UNIT III CORRELATION AND PREDICTION OF PHASE EQUILIBRIA 10

Activity coefficient-composition models, thermodynamic consistency of phase equilibria, application of the correlation and prediction of phase equilibria in systems of engineering interest particularly to distillation and liquid extraction processes.

UNIT IV CHEMICAL REACTION EQUILIBRIA 10

Definition of standard state, standard free energy change and reaction equilibrium constant, evaluation of reaction equilibrium constant, prediction of free energy data, equilibria in chemical

reactors, calculation of equilibrium compositions for homogeneous chemical reactors, thermodynamic analysis of simultaneous reactions.

UNIT V REFRIGERATION 8

Principles of refrigeration, methods of producing refrigeration, liquefaction process, co-efficient of performance, evaluation of the performance of vapour compression and gas refrigeration cycles.

TOTAL : 45

TEXT BOOKS

1. Smith, J.M., Van Ness, H.C., "Introduction to Chemical Engineering Thermodynamics", Kogakushai 1976.
2. Kyle, B.G., "Chemical and Process Thermodynamics 2nd edn.", Prentice Hall of India Pvt. Ltd., 1990.

REFERENCES

1. Hougen, O.A., Watson, K.M., and Ragatz, R.A., "Chemical Process Principles Part II", Thermodynamics, John Wiley, 1970.
2. Dodge, B.F., "Chemical Engineering Thermodynamics", McGraw-Hill, 1960.
3. Sandler, S.I., "Chemical and Engineering Thermodynamics", 2nd Edition, Wiley, 1989.

CH1352 CHEMICAL REACTION ENGINEERING I 3 0 0 100

AIM : To present reaction kinetic principles and different type of reactors to achieve the required reaction.

OBJECTIVES : To gain knowledge on the selection of right type of reactor for the required reaction.

UNIT I REACTION KINETICS 8

Law of mass action, rate equation, elementary, non-elementary reactions and their mechanisms, theories of reaction rate and temperature dependency, analysis of experimental reactor data, evaluation of rate equation, integral and differential analysis for constant variable volume system, fitting of data complex reaction mechanism.

UNIT II IDEAL REACTORS 8

Design for homogeneous systems, batch, stirred tank and tubular flow reactor, design of reactors for multiple reactions, combination reactor system, size comparison of reactors.

UNIT III CHOICE OF REACTORS 8

Factors affecting choice, optimum yield and conversion, selectivity, reactivity and yield problems, consecutive, parallel and mixed reactions, recycle.

UNIT IV HEAT EFFECTS IN REACTORS 8

Isothermal and nonisothermal homogeneous reactor systems, adiabatic reactors, rates of heat exchanges for different reactors, design for constant rate heat input and constant heat transfer coefficient, operation, batch and continuous reactors, optimum temperature progression.

UNIT V REACTOR STABILITY 5

Criteria for stability of reactors, limit cycles and oscillating reaction, parameter sensitivity.

UNIT VI REACTION EQUILIBRIA 8

Equilibrium in chemically reactive systems, evaluation of reaction equilibrium constant, effect of temperature on equilibrium, application to system involving gaseous components, computation of equilibrium composition.

TOTAL : 45

TEXT BOOKS

1. Levenspiel.O, “Chemical Reaction Engineering”, John Wiley, Second Edition, 1972.
2. Smith.J.M., “Chemical Engineering Kinetics”, McGraw-Hill Third Edition, 1981.

CH 1353 CHEMICAL PROCESS INDUSTRIES II 3 0 0 100

AIM

To integrate various courses such as chemistry, unit operations, mechanical operation, stoichiometry etc., and to give the young chemical engineers some comprehension on various fields of production into which he will enter or with which he will be affiliated during the course of study or after completion of the study.

OBJECTIVES

To gain Knowledge on various aspects of production engineering and understand the practical methods of production in a chemical factory.

UNIT I PULP AND PAPER INDUSTRIES 5

Wood and Wood extracts – Wood Chemicals - Cellulose derivatives, Manufacture of pulp – different processes of pulping – Manufacture of paper – Manufacture of Boards

UNIT II SUGAR AND STARCH INDUSTRIES 4

Raw and refined sugar, by products of sugar industries, Starch and starch derivatives.

UNIT III OILS, FATS, SOAPS AND DETERGENT INDUSTRIES 9

Vegetable oils and animal fats, their nature, analysis and extraction methods, hydrogenation of oils, fatty acids and alcohols, waxes, soaps, synthetic detergents.

UNIT IV PETROLEUM AND PETROCHEMICAL INDUSTRIES 9

Petroleum refining, physical and chemical conversion products, lubricating oils, petrochemical precursors, methane, olefines, acetylenes and aromatics and products obtained from them by various unit processes.

UNIT V RUBBER AND POLYMERS 9

Monomers – Thermosetting and Thermoplastic materials – General properties and Applications of Resins – Polymerisation processes – different types - Natural rubber; Synthetic rubber such as SBR, NBR, CR - Fundamental methods of processing of synthetic Rubbers.

UNIT VI SYNTHETIC FIBRE AND FILM INDUSTRIES 9

Natural and synthetic fibres – properties of - Poly amides – manufacture of Nylon 6. 6. Polyesters Fibres – manufacturer of – Cellulosic Fibres – Viscose Rayon production manufacture of films - cellulose Acetate, PVC, Polyesters - polyethylene

TOTAL : 45

TEXT BOOKS

1. Austin, G.T., “Shreve's Chemical Process Industries”, Fifth Edition, McGraw-Hill International Book Co, Singapore, 1984.
2. Dryden, C.E., “Outlines of Chemical Technology”, Edited and Revised by Gopala Rao. M. and M.Sittig, Second edition, Affiliated East-West press, 1993.

REFERENCE

1. Kent, J.A.(ed), “Riggel's Hand Book of Industrial Chemistry”, Van Nostrant Reinhold, 1974.
2. CHEMTECH 1-4, “Chemical Engineering Education Development Centre”, I.I.T., Madras 1975-78.

CH1354 MASS TRANSFER II 3 0 0 100

AIM

To impart knowledge on how certain substances undergo the change in composition, change in phases and exhibit the properties according to the changed environment.

OBJECTIVES

Students develop a sound knowledge on the types of Mass Transfer thro’ a driving force in the same fashion as temperature differences as driving force for heat transfer. The students shall have an elementary knowledge on fluid flow, heat transfer and stoichiometry.

UNIT I ABSORPTION 9

Equilibrium and operating line concept in absorption calculations; types of contactors, design of packed and plate type absorbers; Operating characteristics of stagewise and differential contactors, concepts of NTU, HTU and overall volumetric mass transfer coefficients; multicomponent absorption; mechanism and model of absorption with chemical reaction; thermal effects in absorption process.

UNIT II DISTILLATION 9

Vapour-liquid equilibria, Raoult's law and deviations from ideality, methods of distillation; fractionation of binary and multicomponent system; design calculations by McCabe-Thiele and ponchon-Savarit, methods; continuous contact distillation tower (packed tower) design; extractive and azeotropic; distillation low pressure distillation; steam distillation.

UNIT III LIQUID-LIQUID EXTRACTION 9

Equilibrium in ternary systems; equilibrium stagewise contact calculations for batch and continuous extractors, differential contact extraction equipment - spray, packed and mechanically agitated contactors and their design calculations; pulsed extractors, centrifugal extractors.

UNIT IV SOLID-LIQUID EXTRACTION (LEACHING) 6

Solid-liquid equilibria; leaching equipment-batch and continuous types; calculation of number of stages.

UNIT V ADSORPTION AND ION EXCHANGE 6

Theories of adsorption of gases and liquids; industrial adsorbents, adsorption equipment for batch and continuous operation; design calculation of ion-exchange resins; principle of ion-exchnage; industrial equipment.

UNIT VI MISCELLANEOUS SEPARATION PROCESSES 6

Membrane separation process; solid and liquid membranes; concept of osmosis; reverse osmosis; electrodialysis; their applications; foam separation process; Thermal and sweep diffusion process.

TOTAL : 45

TEXT BOOKS

1. R.E.Treybal, “Mass Transfer Operations”, McGraw-Hill, Kogakusha, 1980.
2. W.L McCabe J.C.Smith, and Harriot. P., “Unit Operations of Chemical Engineering”, sixth edition McGraw-Hill, International Edition, 2001.

REFERENCES

1. C.Judson King “Separation Processes”, Tata McGraw-Hill 1974.
2. A.H.P.Skelland, “Diffusional Mass Transfer”, Krieger, Malapur, FL (1985).
3. Roman Zarfyki and Andrzej Chacuk, “Absorption Fundamentals and Applications", Pergamon Press, 1993.
4. P.Wankat “Equilibrium Stage Separations”, Prentice Hall, 1993.
5. R.F.Strigle (jr), Packed Tower Design and Application, 2nd Edn. Gulf Publishing Company U.S.A. 1994.

CH 1355 PROCESS INSTRUMENTATION, DYNAMICS AND CONTROL 3 0 0 100

AIM

To introduce control equipments used to control the production process of a chemical factory and to introduce the control mechanism thro’ automation and computers.

OBJECTIVES

Gains knowledge in designing a control system and identifying the alternative control configuration for a given process plant or entire plant. He will be familiar with the control mechanism before attempting to tackle process control problems.

UNIT I 9

Laplace transformation, transform of standard functions, derivatives and integrals, inversion, theorems in Laplace transformation, application.Open-loop systems, first order systems and their transient response for standard input functions, first order systems in series, linearization and its application in process control, second order systems and their dynamics, transfer function for chemical reactors and dynamics.

UNIT II 9

Closed loop control systems, development of block diagram for feed-back control systems, servo and regulator problems, Transfer function for controllers and final control element, principles of pneumatic and electronic controllers, transportation lag, transient response of closed-loop control systems and their stability.

UNIT III 9

Introduction to frequency response of closed-loop systems, control system design by frequency, Bode diagram, stability criterion, Nyquist diagram; Tuning of controller settings.

UNIT IV **9**

Controller mechanism,introduction to advanced control systems, cascade control, feed forward control, control of distillation towers and heat exchangers, introduction to microprocessors and computer control of chemical processes.

UNIT V **9**

Principles of measurements and classification of process control instruments, measurements of temperature, pressure, fluid flow, liquid weight and weight flow rate, viscosity and consistency, p^H, concentration, electrical and thermal conductivity, humidity of gases, composition by physical and chemical properties and spectroscopy.

TOTAL : 45

TEXT BOOKS

1. Coughnowr and Koppel, “Process Systems Analysis and Control”, McGraw-Hill, New York, 1986.
2. George Stephanopolous, “Chemical Process Control”, Prentice-Hall of India Pvt. Ltd., New Delhi, 1990.
3. Patranabis.D, Principles of Process control, II edition, Tata McGraw-Hill Publishing Co. Ltd., 1981.
4. Peter Harriott, Processcontrol, Tata McGraw-Hill Publishing Co., Reprint 2004.

REFERENCES

1. Thomas, E.Marlin, Process Control, 2nd Edn, McGraw-Hills International Edn. 2000.
2. George Stephanopoulos, Chemical Process Control, Prentice Hall of India 2003.
3. Norman H.CEAGLSKE, Automatic process control for chemical engineers, John Wiley & Sons, Japan.
4. Emenule, S.Savas, “Computer Control of Industrial Processes”, McGraw-Hill, London, 1965.
5. Eckman, D.P., “Industrial Instrumentation”, Wiley, 1978.

CH1356 MASS TRANSFER LAB **0 0 3 100**

AIM : To determine experimentally certain physical properties of fluids and solids

OBJECTIVES : To gain knowledge on the determination of important data for the design and operation of the process equipments.

LIST OF EXPERIMENTS

1. Simple distillation
2. Steam distillation
3. Packed column distillation
4. Bubble cap distillation
5. Diffusivity measurements
6. Liquid-liquid extraction
7. Vacuum Dryer
8. Tray dryer
9. Rotary dryer
10. Surface Evaporation

*** Minimum 10 experiments shall be offered.**

TOTAL : 45

CH1357 CHEMICAL PROCESS EQUIPMENT DESIGN & DRAWING – I 0 0 3 100

AIM

To integrate the various courses such as Chemistry, Engineering mechanism, Engineering Graphics, unit operation, Mechanics of solids Materials Technology for a comprehension approach to the design of the process equipments.

OBJECTIVES

To develop skill to design and install process equipments used widely in a chemical industry.

All Tables/ Chemical Engineers' Handbook/Data Books/Graph Sheets are permitted during the Examination/

UNIT I **9**

Design and drawing considerations of bolt, nut and screws, welded and riveted joints, flanged joints, nozzles and reinforcements. Pipe fittings.

UNIT II **9**

Design and drawing considerations of vessel supports such as bracket, saddle, skirt, etc. Storage Tanks for solids, liquids and gases.

UNIT III **9**

General design and drawing consideration of vessels subjected to internal pressure, and external pressure. High pressure vessels.

UNIT IV **9**

Fundamental principles, equations, general design and drawing considerations of cyclone separators centrifuges, thickeners and filtration equipments.

UNIT V **9**

General design and drawing considerations of crystallizers, agitated vessel, jacketed and coil heated vessels.

TOTAL = 45

TEXT BOOKS

1. R.S. Khurmi, "Machine design".
2. M.V. Joshi and V.V. Mahajan, "Process Equipment Design", MacMillan India Ltd.

REFERENCES

1. S.D. Dawande, "Process Design of Equipments", Central Techno Publications, Nagpur, 2000.
2. Indian Standard Specifications IS-803, 1962; IS-4072, 1967; IS-2825, 1969. Indian Standards Institution, New Delhi.
3. R.H. Perry, "Chemical Engineers' Handbook", McGraw-Hill.
4. W.L. McCabe, J.C. Smith and P. Harriot, "Unit Operation of Chemical Engineering", McGraw-Hill, 2001.
5. Robert Treybal, "Mass Transfer Operations", McGraw-Hill.
6. J.M. Coulson and J.Richardson, "Chemical Engineering", Vol. 6, Asian Books Printers Ltd.

CH1358 PROCESS CONTROL AND SIMULATION LAB 0 0 3 100

AIM : To determine experimentally the methods of controlling the processes including measurements using process simulation techniques.

OBJECTIVES : To gain knowledge on the development and use of right type of control dynamics for process control under different operative conditions.

LIST OF EXPERIMENTS

1. ON-OFF control of thermal process
2. Simulation of Proportional Controller
3. Flow control loop and Flow Transmitter
4. Level Control loop and Level Transmitter
5. Pressure control loop and Pressure Transmitter
6. Control valve characteristics
7. Verifying the inherent characteristics of control valve
8. Flow co-efficient of control valve
9. Range ability of control valve
10. Verifying the response of Non-Interacting level System
11. Verifying the response of Interacting level System
12. Effect of PI controller on flow control System
13. The effect of a P controller on level process for set point and load changes
14. Effect of P, PI, PID Controller on Pressure Control Loop
15. Optimum controller setting using Zigler's Nichols Methods
16. Optimum Controller Tuning on Level Process Station

***Minimum 10 experiments shall be offered.**

TOTAL : 45

MG1402 PROCESS ECONOMICS AND INDUSTRIAL MANAGEMENT 3 0 0 100

AIM

To introduce the industrial management principles to the Chemical Engineers.

OBJECTIVES

The chemical Engineers are the managers of the industry both processwise and economywise. They gain adequate knowledge in managing Men, Materials, Machineries Money and Market. They also gain knowledge on quality control and waste control thro' industrial engineering principles.

UNIT I PRINCIPLES OF MANAGEMENT AND ORGANISATION 10

Planning, organisation, Types of organisation, staffing, coordination, directing, controlling, communicating.

UNIT II PRODUCTION AND MANAGEMENT & QUALITY CONTROL 10

Method study; work measurement techniques; basic procedure; motion study; motion economy; principles of time study; elements of production control; forecasting; planning, routing; scheduling; despatching; costs and costs control, inventory and inventory control. Elements of quality control, role of control charts in production and quality control.

UNIT III INTEREST, INVESTMENT COSTS AND COST ESTIMATION 15

Time Value of money; capital costs and depreciation, estimation of capital cost, manufacturing costs and working capital.

UNIT IV **9**

Venture capital and profitability. Estimation of project profitability, sensitivity analysis; investment alternatives; replacement policy; forecasting sales; inflation and its impact.

UNIT V ANNUAL REPORTS AND ANALYSIS OF PERFORMANCE **9**

Income statement; financial ratios; analysis of performance and growth using Financial Ratios.

TOTAL : 45

TEXT BOOKS

1. Holand, F.A., Watson, F.A and Wilkinson, J.K., "Introduction to process Economics", John Wiley, 1974.
2. Sumanth, D.T., "Production Engineering and Management", McGraw-Hill, 1984.

REFERENCES

1. Davis, G.S, "Chemical Engineering Economics and Decision Analysis", CENDC, I.I.T., Madras, 1981.
2. Shukla, M.C., "Business Organisation and Management", Sultan Chand and Sons, 1975.

CH1401 CHEMICAL REACTION ENGINEERING - II **3 0 0 100**

AIM

To introduce various types of Reactions and Reactors that are commonly used in Chemical Engineering operations.

OBJECTIVES

Get ability in deciding and designing the type of Reactors that are necessary for a particular type of reaction in an Industry. They also learn mechanism and control of several type of reactions.

UNIT I NON-IDEAL REACTORS **9**

The residence time distribution as a factor performance; residence time functions and relationship between them in reactor; basic models for non-ideal flow; conversion in non-ideal reactors.

UNIT II HETEROGENEOUS PROCESS AND SOLID CATALYSIS **9**

Rate equations for heterogeneous reactions nature of catalysis, adsorption isothermal and rates of adsorption, desorption and surface reaction analysis of rate equation and rate controlling steps, surface area and pore-volume distribution, catalyst preparation.

UNIT III GAS-SOLID CATALYTIC REACTORS **9**

Diffusion within catalyst particle effective thermal conductivity mass and heat transfer within catalyst pellets; effective factors, Thiele Modulus, fixed bed reactors.

UNIT IV GAS-SOLID NON-CATALYTIC REACTORS **9**

Models for explaining the kinetics; volume and surface models; controlling resistances and rate controlling steps; time for complete conversion for single and mixed sizes, fluidised and static reactors.

UNIV V GAS-LIQUID REACTIONS 9

Absorption combined with chemical reactions; mass transfer coefficients and kinetic constants; application of film penetration and surface renewal theories; Hatta number and enhancement factor for first order reaction, tower reactor design.

TOTAL : 45

TEXT BOOKS

1. Fogler. H.S., "Elements of Chemical reaction engineering" 3rd edition, Prentice Hall of India Pvt. Ltd., 1999 (Indians Reprint 2003)
2. Levenspiel , O; "Chemical Reaction Engineering", 2nd Edition, John Wiley, 1972.

REFERENCE

1. Smith J.M., "Chemical Engineering Kinetics", 3rd edition, McGraw-Hill, New York, 1981.

CH1402 CHEMICAL PROCESS PLANT SAFETY 3 0 0 100

AIM

To get awareness on the important of total plant safety in a Chemical Industry.

OBJECTIVES

Become a skill and person in hazopard hazarel analysis and able to find out the root cause of an accident. Gain knowledge in devising safety policy and procedures to be adopted to implement total safety in a plant

UNIT I INTRODUCTION 4

Safety in industries; need for development; importance safety consciousness in Indian chemical industry; social environmental setup; tolerance limit of the society; psychological attitude towards safety programmes.

UNIT II SAFETY PROGRAMMES 4

Elements of safety programme; effective realization; economic and social benefits; effective communication training at various levels of production and operation.

UNIT III INDUSTRIAL SAFETY 8

Chemical process industries; potential hazards; chemical and physical job safety analysis; high pressure; high temperature operation; dangerous and toxic chemicals; highly radioactive materials; safe handling and operation of materials and machineries; planning and layout.

UNIT IV SAFETY PERFORMANCE 7

Appraisal; effective steps to implement safety procedures; periodic inspection and study of plant layout and constant maintenance; periodic advice and checking to follow safety procedures; proper selection and replacement of handling equipments; personal protective equipments.

UNIT V ACCIDENTS 6

Industrial accidents – accident costs – identification of accident spots; remedial measures; identification and analysis of causes of injury to men and machines – accident prevention – accident proneness – vocational guidance, fault free analysis. Fire prevention and fire protection.

UNIT VI POLLUTION 6

Atmospheric pollution – chemicals and dust – toxicity toxic materials and gases – environmental pollution by effluent and industrial wastes – treatment.

UNIT VII HEALTH HAZARDS AND LEGAL ASPECTS 6

Health hazards – occupational – industrial health hazards – health standards, and rules – safe working environments – parliamentary legislations – factories act – labour welfare act – ESI Act – Workmen Compensation Act.

UNIT VIII PROMOTION OF INDUSTRIAL SAFETY 4

Role of Government, safety organizations, management and trade unions in promoting industrial safety.

TOTAL : 45

TEXT BOOKS

1. William Handley, Industrial Safety Hand Book McGraw-Hill Book Company 2nd Edition, 1969.
2. Fawatt, H.H. and Wood, W.S.Safety and Accident Prevention in Chemical Operation, Interscience, 1965.

REFERENCES

1. Heinrich, H.W. Dan Peterson, P.E. and Nester Rood. Industrial Accident Prevention, McGraw-Hill Book Co., 1980
2. Blake, R.P., Industrial Safety, Prentice Hall Inc., New Jersy – 3rd Edn. 1963.

CH1403 TRANSPORT PHENOMENA 3 0 0 100

AIM

To have an in depth study on fluid transport

OBJECTIVES

Different types of Fluids, their flow characteristics and different mathematical models are analysed and applied to actual situations. This subject helps the students to understand the mechanism of fluids in motion under different conditions.

UNIT I PHILOSOPHY AND FUNDAMENTALS OF TRANSPORT PHENOMENA 3

Importance of transport phenomena; analogous nature of transfer process; basic concepts, conservation laws; continuous concept, field, reference frames, substantial derivative and boundary conditions; methods of analysis; differential, integral and experimental methods.

UNIT II TRANSPORT BY MOLECULAR MOTION 5

Phenomenological laws of transport properties Newtonian and non Newtonian fluids; rheological models; theories of transport properties of gases and liquids; effect of pressure and temperature.

UNIT III ONE DIMENSIONAL TRANSPORT IN LAMINAR FLOW (SHELL BALANCE) 12

General method of shell balance approach to transfer problems; Choosing the shape of the shell; most common boundary conditions; momentum flux and velocity distribution for flow of Newtonian and non-newtonian fluids in pipes for flow of Newtonian fluids in planes, slits and annulus heat flux and temperature distribution for heat sources such as electrical, nuclear viscous and chemical; forced and free convection; mass flux and concentration profile for diffusion in stagnant gas, systems involving reaction and forced convection.

UNIT IV EQUATIONS OF CHANGE AND THEIR APPLICATIONS 14

Conservation laws and equations of change; Development of equations of continuity motion and energy in single multicomponents systems in rectangular co-ordinates and the forms in curvilinear co-ordinates; simplified forms of equations for special cases, solutions of momentum mass and heat transfer problems discussed under shell balance by applications of equation of change, scale factors; applications in scale-up

UNIT V TRANSPORT IN TURBULENT AND BOUNDARY LAYER FLOW 7

Turbulents phenomena; phenomenological relations for transfer fluxes; time smoothed equations of change and their applications for turbulent flow in pipes; boundary layer theory; laminar and turbulent hydrodynamics thermal and concentration boundary layer and their thicknesses; analysis of flow overflat surface.

UNIT VI ANALOGIES BETWEEN TRANSPORT PROCESSES 4

Importance of analogy; development and applications of analogies between momentum and mass transfer; Reynolds, Prandtl, Von Karman and Colbum analogies.

TOTAL : 45

TEXT BOOKS

1. R.B. Bird, W.E. Stewart and E.W. Lighfoot, “Transport Phenomena”, John Wiley, 1978
2. Robert, S Brodkey, Harry C. Hershey, “Transport Phenomena”, McGraw-Hill International Edn. 1988.

REFERENCES

1. L.S.Sissom, and D.R.Pitts, “Elements of Transport Phenomena”, McGraw-Hill, New York, 1972.
2. R.W.Fahien, “Elementary Transport Phenomena”, McGraw-Hill, New York, 1983.
3. J.R. Welty, R.W. Wilson, and C.W.Wicks, “Fundamentals of Momentum Heat and Mass Transfer”, 2nd Edn. John Wiley, New York, 1973.

CH1404 BIOCHEMICAL ENGINEERING 3 0 0 100

AIM : To impart knowledge on the role of micro organism in different types of Bio-chemical reaction.

OBJECTIVES: To design Bio-chemical reactors with proper knowledge on Enzyme Engineering.

UNIT I CONVENTIONAL CHEMICAL PROCESSES AND BIOCHEMICAL PROCESS 4

An overview of industrial biochemical processes with typical examples, comparing chemical and biochemical processes, development and scope of biochemical engineering as a discipline.

UNIT II ROLE OF MICROORGANISMS 3

Industrially important microbial strains; their classification; structure; cellular genetics; typical examples of microbial synthesis of biologicals.

UNIT III ENZYMES AND ENZYME KINETICS 8

Enzyme used in industry medicine and food, Their classification with typical examples of industrially important enzymes; mechanism of enzymatic reactions; michaelis-menten kinetics; enzymes inhibition; factors affecting the reaction rates; industrial production purification and immobilization; enzyme reactors with typical examples.

UNIT IV MICROBIAL KINETICS 8

Typical growth characteristics of microbial cells; factors affecting growth; Monod model; modeling of batch and continuous cell growth; immobilized whole cells and their characteristics; free cell and immobilized cell reactors; typical industrial examples; transport in cells.

UNIT V TRANSPORT IN MICROBIAL SYSTEMS 6

Newtonian and Non-Newtonian behaviour of broths; agitation and mixing; powr consumption; gas/liquid transport in cells; transfer resistances; mass transfer coefficients and their role in scaleup of equipments; enhancement of o_2 transfer; heat transfer correlation; sterilization cycles and typical examples of heat addition and during biological production.

UNIT VI BIOREACTORS 8

Batch and continuous types; immobilized whole cell and enzyme reactors; high performance bioreactors; sterile and non-sterile operations; reactors in series with and without recycle; design of reactors and scaleup with typical examples.

UNIT VII DOWNSTREAM PROCESSES AND EFFLUENT TREATMENT 8

Different unit operations in down streaming with special reference to membrane separations; extractive fermentation; anerobic treatment of effluents; typical industrial examples for downstream processing and effluent disposal.

TOTAL : 45

TEXT BOOKS

1. Bailey J.E., Ollis, D.F. Biochemical Engineering Fundamentals, McGraw-Hill, International Edition, 2nd Edition, New York, 1986.
2. Aiba, S; Humphrey, A.E., Milli, N.R., Biochemical Engineering 2nd ed., Academic Press, 1973.

REFERENCES

1. Web, F.C., Biochemical Engineering, Van Nostrand, 1964.
2. Atkinsono, B., Biochemical Reactors, Pion Ltd., 1974

CH1405 PROCESS EQUIPMENT DESIGN & DRAWING II 0 1 3 100

(All Tables/Chemical Engineers' Handbook/Data Books/Graph Sheets are permitted during the Examination.)

AIM : To gain practical knowledge on the shape and drawing of the process equipments

OBJECTIVES : To become a design engineers on process equipments design and drawing consideration of the following:-

UNIT I 9

Fundamental principles, equations, general design and drawing considerations of cooling towers, evaporators and driers.

UNIT II 9

Heat exchangers, condensers and reboilers.

UNIT III **9**

Distillation columns- sieve tray, and bubble cap tray columns and packed column.

UNIT IV **9**

Equipments for absorption and adsorption of gases.

UNIT V **9**

Equipments for liquid-liquid extraction and solid-liquid extraction.

TOTAL :45

TEXT BOOKS

1. M.V.Joshi and V.V. Mahajan, "Process Equipment Design", MacMillan India Ltd.
2. S.D.Dawande, "Process Design of Equipments", Central Techno Publications, Nagpur, 2000.

REFERENCES

1. Indian Standard Specifications IS-803, 1962; IS-4072, 1967; IS-2825, 1969. Indian Standards Institution, New Delhi.
2. R.H. Perry, "Chemical Engineers' Handbook", McGraw-Hill.
3. W.L.McCabe, J.C.Smith and Harriet, "Unit Operation of Chemical Engineering", McGraw-Hill.
4. Robert Treybal, "Mass Transfer Operations", McGraw-Hill.
5. J.M. Coulson and J.Richardson, "Chemical Engineering", vol. 6, Asian Books Printers Ltd.

CH1406 CHEMICAL REACTION ENGINEERING LAB 0 0 3 100

AIM : To determine experimentally the kinetics and rate constants of reactions in different types of reactors.

OBJECTIVES : To gain knowledge in the design of reactors.

LIST OF EXPERIMENTS*

1. Kinetic studies in a batch reactor
2. Kinetics in a plug flow reactor
3. Kinetics in a PFR followed by a CSTR
4. RTD in a PFR
5. RTD in a packed bed
6. RTD in CSTRs in series

***Minimum experiments shall be offered.**

TOTAL = 45

CH1407 SEMINAR AND COMPREHENSION 0 2 0 -

The Objective of the comprehension test is to assess the overall level of proficiency and the scholastic attainment of the student in the various subjects studied during the degree course.

TOTAL :

MG1401 TOTAL QUALITY MANAGEMENT 3 0 0 100

OBJECTIVE

- To understand the Total Quality Management concept and principles and the various tools available to achieve Total Quality Management.
- To understand the statistical approach for quality control.
- To create an awareness about the ISO and QS certification process and its need for the industries.

UNIT I INTRODUCTION 9

Definition of Quality, Dimensions of Quality, Quality Planning, Quality costs - Analysis Techniques for Quality Costs, Basic concepts of Total Quality Management, Historical Review, Principles of TQM, Leadership – Concepts, Role of Senior Management, Quality Council, Quality Statements, Strategic Planning, Deming Philosophy, Barriers to TQM Implementation.

UNIT II TQM PRINCIPLES 9

Customer satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement – Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits, Continuous Process Improvement – Juran Trilogy, PDSA Cycle, 5S, Kaizen, Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures – Basic Concepts, Strategy, Performance Measure.

UNIT III STATISTICAL PROCESS CONTROL (SPC) 9

The seven tools of quality, Statistical Fundamentals – Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Process capability, Concept of six sigma, New seven Management tools.

UNIT IV TQM TOOLS 9

Benchmarking – Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, FMEA – Stages of FMEA.

UNIT V QUALITY SYSTEMS 9

Need for ISO 9000 and Other Quality Systems, ISO 9000:2000 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, QS 9000, ISO 14000 – Concept, Requirements and Benefits.

TOTAL : 45

TEXT BOOKS

1. Dale H.Besterfiled, et at., Total Quality Management, Pearson Education Asia, 1999. (Indian reprint 2002).
2. James R.Evans & William M.Lidsay, The Management and Control of Quality, (5th Edition), South-Western (Thomson Learning), 2002 (ISBN 0-324-06680-5).

REFERENCES

1. Feigenbaum.A.V. “Total Quality Management, McGraw Hill, 1991.
2. Oakland.J.S. “Total Quality Management Butterworth – Hcinemann Ltd., Oxford. 1989.
3. Narayana V. and Sreenivasan, N.S. Quality Management – Concepts and Tasks, New Age International 1996.
4. Zeiri. “Total Quality Management for Engineers Wood Head Publishers, 1991.

CH1001 FOOD TECHNOLOGY 3 0 0 100

AIM : To create awareness on the need for processing and preservatives of Foods.

Objective : To design processing equipments for Food Industries.

UNIT I AN OVERVIEW 1

General aspects of food industry; world food needs and Indian situation.

UNIT II FOOD CONSTITUENTS, QUALITY AND DERIVATIVE FACTORS 9

Constituents of food; quality and nutritive aspects; food additives; standards; deteriorative factors and their control.

UNIT III GENERAL ENGINEERING ASPECTS AND PROCESSING METHODS 4

Preliminary processing methods; conversion and preservation operations.

UNIT IV FOOD PRESERVATION METHODS 16

Preservation by heat and cold; dehydration; concentration; drying irradiation; microwave heating; sterilization and pasteurisation; fermentation and pickling; packing methods.

UNIT V PRODUCTION AND UTILISATION OF FOOD PRODUCTS 15

Cereal grains; pulses; vegetables; fruits; spices; fats and oils; bakery; confectionery and chocolate products; soft and alcoholic beverages; dairy products; meat; poultry and fish products.

TOTAL : 45

TEXT BOOKS

1. Heid J.L. Joslyn M.A., Fundamentals of Food Processing Operation, The AVI publishing Co., West port 1967.
2. Potter N.N., Food Science, The AVI publishing Co., Westport, 1963.

REFERENCES

1. Heldman D.R., Food Process Engineering, The AVI publishing co., 1975.
2. Charm S.E., The Fundamentals of Foods Engineering, The AVI Publishing Co., Westport, 1963.

CH1002 ENERGY MANAGEMENT IN CHEMICAL INDUSTRIES 3 0 0 100

AIM : To get awareness on the various sources of Energy needed / used in chemical industries.

OBJECTIVE : To design suitable energy saving devices and also become expert in co-generation aspects.

UNIT I ENERGY RESOURCES - A GLOBAL VIEW 6

Energy sources; coal oil, natural gas; nuclear energy; hydro electricity, other fossil fuels; geothermal; supply and demand; depletion of resources of resources; need for conservation; uncertainties; national and international issues.

UNIT II PLANNING FOR ENERGY NEEDS 6

Forecasting techniques; energy demand; magnitude and pattern; input and output analysis; energy modelling and optimal mix of energy sources.

UNIT III ENERGY AND ENVIRONMENT 6

Energy; various forms; energy storage; structural properties of environment; bio-geo-chemical cycles; society and environment population and technology.

UNIT IV ENERGY AND TECHNOLOGICAL SOCIETY 6

Energy and evolution; growth and change; patterns of consumption in developing and advances countries; commerical generation of power requirements and benefit.

UNIT V MANAGEMENT OF ENERGY CONSERVATION IN CHEMICAL INDUSTRIES 8

Chemical industries; classification; conservation in unit operation such as separation; cooling tower; drying; conservation applied to refineries, petrochemical, fertilisers, cement, pulp and paper, food industries, chloroalkali industries; conservation using optimisation techniques.

UNIT VI ENERGY ALTERNATIVES 6

Sources of continuous power; wind and water; geothermal; tidal and solar power; MHD, fuel cells; hydrogen as fuel.

UNIT VII ECONOMIC BALANCE IN ENERGY CONSUMPTION 7

Cost analysis; capacity; production rate; system rate; system cost analysis; corporate models; production analysis and production using fuel inventories; input-output analysis; economics; tariffs.

TOTAL : 45

TEXT BOOKS

1. Jerrold H.Krentz; “Energy Conservation and Utilisation”, Allyn and Bacur Inc., 1976.
2. Gemand M.Gramlay; “Energy”, Macmillon Publishing Co., New York, 1975.

REFERENCES

1. Rused C.K., “Elements of Energy Conservation”, McGraw-Hill Book Co., 1985.
2. Judson King; “Separation Processes”, McGraw-Hill Book Co., 1985.

CH1003 BIO & ENZYME ENGINEERING 3 0 0 100

UNIT I 9

Types of Microorganism: Structure and function of microbial cells. Fundamentals of microbial growth, batch and continuous culture. Isolation and purification of enzymes from cells. Cell and Enzyme Immobilization.

UNIT II 9

Fermentation – Types of mechanisms, Continuous fermentation – aeration and agitation, kinetics of fermentation – Processes

UNIT III 9

Introduction of Bioreactor design: Continuously stirred aerated tank bioreactors. Mixing power correlation. Determination of volumetric mass transfer rate of oxygen from air bubbles and effect of mechanical mixing and aeration on oxygen transfer rate, heat transfer and power.

UNIT IV **9**

Enzyme and Enzyme Kinetics
Introduction to Biochemistry, Function and applications. Nature and function of enzyme. Coenzyme / Cofactor. Classfication of enzymes. Assay methods and units. Examples of applications of enzymes in industry, analytical technique medicine and Pharmaceuticals.

UNIT V **9**

Industrial Bioreactors Utilizing Isolated enzymes and biosensors development and applications. Designs of reactor, Batch and continue type; analysis for immobilized enzyme reactors. Sterile and non sterile operations; reactors in series with and without recycle.

Total = 45

TEXT BOOKS

1. Technological Applications of Bio-catalysts, BIOTOL series, Butter worth, 1995.
2. Cornish. A -Bowden, Analysis of Enzyme Kinetic Data, Oxford University Press, 1996.

REFERENCES

1. Wiseman. A and Blakeborough N and Dunnill P, Enzymic and nonenzymic catalysis, Ex. Vol.5 Ellis and Harwood, U.K. (1981).
2. Wiseman A (Ed.), Topics in enzyme and fermentation Bio-technology, Ellis and Harwood, U.K. Vol-5.

CH1004 FLUIDIZATION ENGINEERING 3 0 0 100

UNIT I **9**

Pressure drop velocity relationship in packed beds. Correlations of kezenycarman, leva and Ergun. Fluidization phenomena – properties of fluidized beds. Development of fluidized condition from fixed bed.

UNIT II **9**

Limiting conditions of stability of a fixed bed-minimum fluidizing condition, correlations for minimum fluidizing velocity.

UNIT III **9**

Liquid solid gas solid fluidization – sludgging and channeling correlation for bed expansion in liquid-soilid-and gas solid fluidization.

UNIT IV **9**

Factors affecting rate of elutriation of fines fluidized bed. Continuous air classification.
Pneumatic transportation of solids in vertical and horizontal lines. Prediction of pressure drop. Minimum chocking velocity and minimum saltation velocity.

UNIT V **9**

Single stage and multi stage continuous fluidization its flow of solids by gravity and collection of fine using cyclones.

TOTAL = 45

TEXT BOOK

1. Fluidization Engineering, O.Levenspiel and D.Kunil, John Wilsey, 1972.

REFERENCES

1. Gar-Liquid-Solid Fluidisation Engineering, Liang-Shih Fan, Butter Worths, 1989.
2. Fluidization idealized and Bubbleless with Applications, Monsoon Kwauk, Science Press, 1992.

CH1005 OPTIMISATION OF CHEMICAL PROCESSES 3 0 0 100

UNIT I OPTIMISATION 15

Introduction; formulation of objective functions; fitting models to data; classification of functions; necessary and sufficient conditions for optimum; unimodal, multimodal functions; analytical methods lagrange multiplier methods.

UNIT II NUMERICAL METHODS 15

Unimodel functions; newton's quasi newton, secant methods; region elimination methods, polynomial approximation; quadratic and cubic interpolation techniques for optimum. Multimodal functions; direct methods; random, grid. hooke's nelder and mead methods; powell's technique; indirect methods; gradient and conjugate gradient methods; secant methods.

UNIT III LINEAR AND NON-LINEAR PROGRAMMING APPLICATIONS 15

Review on basic concepts of LP formulations; Simplex methods; Integer, quadratic, geometric and dynamic programming.

Heat transfer and energy conservation; separation processes; fluid flow systems; reactor design and operation; large scale systems.

Total = 45

TEXT BOOKS

1. Edgar, T.F., Himmelblau, D.M., “Optimisation of Chemical Processes”, McGraw-Hill Book Co., New York, 1985.
2. Reklaitis, G.V., Ravindran, A., Ragsdell, K.M. “Engineering Optimisation”, John Wiley, New York, 1980.

REFERENCES

1. Biles, W.E., Swain, J.J.; “Optimisation and Industrial Experimentation”, Inter Science, New York, 1980.
2. Seinfeld, J.H.; Lapidus, L; “Process Modelling, Estimation and Identification”, Prentice Hall, Englewood Cliffs, New Jersey, 1974.
3. Beveridge, C.S.; Schechter, R.S.; “Optimisation: Theory and Practice”, McGraw-Hill Book Co., New York, 1970.

CH1006 DRUGS AND PHARMACEUTICAL TECHNOLOGY 3 0 0 100

UNIT I INTRODUCTION 2

Development of drugs and pharamaceutical industry; organic therapeutic agents uses and economics.

UNIT II DRUG METABOLISM AND PHARMACO KINETICS 5

Drug metabolism; physico chemical principles; radio activity; pharma kinetics-action of drugs on human bodies.

UNIT III IMPORTANT UNIT PROCESSES AND THEIR APPLICATIONS 9

Chemical conversion processes; alkylation; carboxylation; condensation and cyclisation; dehydration, esterification, halogenation, oxidation, sulfonation; complex chemical conversions fermentation.

UNIT IV MANUFACTURING PRINCIPLES 8

Compressed tablets; wet granulation; dry granulation or slugging; direct compression, tablet presses formulation; coating pills; capsules sustained action dosage forms; parential solutions, oral liquids; injections; ointments; standard of hygiene and manufacturing practice.

UNIT V PHARMACEUTICAL PRODUCTS 8

Vitamins; cold remedies; laxatives; analgesics; nonsteroidal contraceptives; external antiseptics; antacids and others.

UNIT VI MICROBIOLOGICAL AND ANIMAL PRODUCTS 6

Antibiotics; biologicals; hormones; vitamins; preservation.

UNIT VII PHARMACEUTICAL ANALYSIS 5

Analytical methods and tests for various drugs and pharmaceuticals.

UNIT VIII PACKING AND QUALITY CONTROL 2

Packing; packing techniques; quality control.

TOTAL : 45

TEXT BOOKS

1. Rawlines, E.A.; "Bentleys Text book of Pharmaceutics", III Edition, Bailliere Tindall, London, 1977.
2. Yalkonsky, S.H.; Swarbick. J.; "Drug and Pharamaceutical Sciences", Vol. I, II, III, IV, V, VI and VII, Marcel Dekkar Inc., New York, 1975.

REFERENCE

1. "Remingtons Pharmaceutical Sciences", Mack Publishing Co., 1975.

CH1007 FERTILIZER TECHNOLOGY 3 0 0 100

UNIT I AN OVERVIEW 3

Role of organic manures and chemical fertiliser, types of chemical fertiliser, growth of fertiliser in India; their location; energy consumption in various fertiliser processes; materials of various fertiliser processes; materials of consumption in fertiliser industry.

UNIT II NITROGENOUS FERTILISERS 15

Feed stock for production of ammonia-natural gas, associated gas, coke-oven gas, naphtha, fuel oil, petroleum heavy stock, coal, electricity etc; processes for gasification and methods of production of ammonia and nitric acid; nitrogenous fertiliser-ammonium sulphate, nitrate, urea and calcium ammonium nitrate; ammonium chloride and their methods of production, characteristics and specifications, storage and handling.

UNIT III PHOSPHATIC FERTILISERS 12

Raw materials; phosphate rock, sulphur; pyrites etc., processes for the production of sulphuric and phosphoric acids; phosphates fertilisers - ground rock phosphate; bone meal-single superphosphate, triple superphosphate, triple superphosphate, thermal phosphates and their methods of production, characteristics and specifications.

UNIT IV POTASSIC FERTILISERS 5

Methods of production of potassium chloride, potassium schoenite, their characteristics and specifications.

UNIT V COMPLEX AND NPK FERTILISERS 5

Methods of production of ammonium phosphate, sulphate diammonium phosphate, nitrophosphates, urea, ammonium phosphate, mono-ammonium phosphate and various grades of NPK fertilisers produced in the country.

UNIT VI MISCELLANEOUS FERTILISERS 5

Mixed fertilisers and granulated mixtures; biofertilisers, nutrients, secondary nutrients and micro nutrients; fluid fertilisers, controlled release fertilisers, controlled release fertilisers.

TOTAL : 45

TEXT BOOKS

1. "Handbook of fertiliser technology", Association of India, New Delhi, 1977.
2. Menon, M.G.; "Fertiliser Industry - An Introductory Survey", Higginbothams Pvt. Ltd., 1973.

REFERENCES

1. Sauchelli, V.; "The Chemistry and Technology of Fertilisers", ACS MONOGRAPH No. 148, Reinhold Publishing Cor. New York, 1980.
2. Fertiliser Manual, "United Nations Industrial Development Organisation", United Nations, New York, 1967.
3. Slack, A.V.; Chemistry and Technology of Fertilisers, Interscience, New York, 1966.

CH1008 BIOMEDICAL ENGINEERING 3 0 0 100

UNIT I INTRODUCTION TO PHYSIOLOGY 5

Cell and its function; nervous system; cardio vascular system; respiratory system; renal physiology.

UNIT II BIOELECTRIC PHENOMENA 5

Basis of bipotentials; principles of ECG, EEG, EMG.

UNIT III ANALYSIS OF SOME MONITORING-DIAGNOSTIC THERAPEUTIC PROCEDURES 3

Introduction to biochemical; biodynamic models and its application; cardiac assist devices; biomechanics of head injury.

UNIT IV MEDICAL INSTRUMENTATION 3

Amplifier constraints and specification; recording systems; electrial grounding and patient safety; transducers; electrodes for recording biopotentials.

UNIT V ANALYSIS OF BIOELECTRICAL SIGNALS 3

Introduction; data acquisition; extraction of signals from noise; introduction to pattern recognition.

UNIT VI PHYSIOLOGICAL CONTROL SYSTEMS 3

Regulation of body temperature; recognition and control in the CV system.

UNIT VII MEDICAL PHYSICS 8

Rheology of blood; radiation dosimetry; neutron activation analysis; safety procedures for radiation diagnostics; ultra sound effects.

UNIT VIII BIOPOLYMERS 8

Introduction; nature and composition of polymers used as prosthetic devices with special reference to heart valves; artificial bones; denatures; autures etc.

UNIT IX TRANSPORT PHENOMENA IN HUMAN BIOLOGY 7

Introduction to renal and respiratory system; lung oxygenator and their design characteristics; artificial kidney and their deign features.
Role of computer in medical data logging and diagnosis; CAT and NMR scanning; transplants; introduction to aviation and space medicine specially drugs and their mode of action.

TOTAL : 45

TEXT BOOKS

1. Brown, E, ; "Biomedical Engineering", Davis Philadelphia USA, 1971.
2. Kennedy, K, ; "Advances in Biomedical Engineering", Academic Press, 1970.

CH1009 NUCLEAR CHEMICAL ENGINEERING 3 0 0 100

UNIT I 9

Chemical Engineering aspects of nuclear power.

UNIT II 9

Nuclear reactions – fuel cycles in thermal nuclear reactors.

UNIT III 9

Production of uranium feed materials zirconium, thorium and Beryllium – Solvent extraction of metals.

UNIT IV 9

Properties of irradiated fuel separation of reactor products

UNIT V 9

Uses of stable isotopes and methods of isotopes separation principles of isotope separation – Separation of isotopes of ** elements – separation of isotope of heavy elements.

TOTAL = 45

TEXT BOOKS

1. Principles of Activation Analysis – Paul Kranger, John Wiley Edu. Interscience Publications, 1971.
2. Nuclear and Radio chemistry, J.W. Kennedy, J.M.Miller and G Rried lander, John Wiley Edu., 1964.

CH1010 MODERN SEPARATION PROCESSES 3 0 0 100

UNIT I GENERAL 12

Review of conventional processes, Recent advances in separation techniques based on size, surface properties, ionic properties and other special characteristics of substances, Process

concept, Theory and equipment used in cross flow filtration, cross flow electrofiltration, dual functional filter, Surface based solid – liquid separations involving a second liquid, Sirofloc filter.

UNIT II MEMBRANE SEPARATIONS 8

Types and choice of membranes, Plate and frame, tubular, spiral wound and hollow fibre membrane reactors and their relative merits, Commerical, pilot plant and laboratory membrane permeators involving dialysis, reverse osmosis, Nanofiltration, ultrafiltration, Microfiltration and Donnan dialysis, Economics of membrane operations, Ceramic membranes

UNIT III SEPARATIONS BY ADSORPTION TECHNIQUES 8

Mechanism, Tyes and choice of adsorbents, Normal adsorption techniques, Affinity chromatography and immuno Chromatography, Types of equipment and commercial process, Recent advances and process economics.

UNIT IV IONIC SEPARATIONS 8

Controlling factors, Applications, Types of equipment employed for electrophoresis, Dielectrophoresis, ion exchange chromatography and electrodialysis, Commercial processes.

UNIT V OTHER TECHNIQUES 9

Separations involving lyophilisation, Pervaporation and permeation techniques for soilis, liquids and gases, Industrial viability and examples, zone melting, Addluctive crystallization, Other separation processes, Supercritical fluid extraction, Oil spill Management, Industrial effluent treatment by modern techniques.

TOTAL : 45

TEXT BOOKS

1. Lacey, R.E. and S.Looeb – Industrial Processing with Membranes Wiley – Inter Science, N.Y.1972.
2. King, C.J. Separation Processes, Tata McGraw–Hill Publishing Co. Ltd., 1982.

REFERENCES

1. Schoew, H.M. – New Chemical Engineering Separation Techniques, Interscience Publishers, 1972.
2. Ronald W. Roussel – Handbook of Separation Process Technology, John Wiley, New York, 1987.
3. Kestory, R.E. – Synthetic polymeric membranes, Wiley. Interscience, N.Y. 1985.
4. Osadar, Varid Nakagawal – Membrane Science and Technology, Marcel Dekkar (1992).

CY1001 ENVIRONMENTAL ENGINEERING 3 0 0 100

UNIT I POLLUTION DYNAMICS 9

Air pollutant's transportation, Introductory treatment of atmospheric dispersion of pollutants, Diffusion of stack effluents.

UNIT II EQUIPMENT SELECTION 9

Choice of Techniques, Selection of Equipment for the treatment of gaseous, particulate and liquid effluents of chemical, petrochemical and ceramic industries.

UNIT III TREATMENT AND DESIGN 9

Waste disposal and treatment for the recovery of valuable chemicals, Design of pollution control devices, Design of chimneys, Stacks for pollution control.

UNIT IV CONTROL TECHNIQUES AND EQUIPMENTS 9

Counter current wet scrubber, Venturi scrubber, Absorption system design, Adsorption and combusion devices, Bag filters, Electrostatic precipitation, Reverse osmosis, Recycle systems and sustainable development.

UNIT V CONTROL PROCEDURE 9

Sampling procedures, Analytical methods, Odours and their control, Noise pollution and abatement, High voltage transmission and safety, Legislative aspects of management.

TOTAL : 45

TEXT BOOKS

1. Theodore L. and Buomlore A.J. Air pollution Control Equipments, Prentice Hall Inc. N.Y. 1982.
2. Coulson, J.M. Richardson, J.F. and R.K. Sinott, Chem. Engg., Vol.6 Pergamon Press, 1989.

REFERENCES

1. Rao, C.S. Enviornmental Pollution Control Engineering, Wiley – Eastern Ltd., 1991.
2. Rao, M.N. and H.V.N.Rao, Air Pollution, Tata McGraw-Hill Pub. Co. Ltd., 1989.

ME1021 ENTERPRENEURSHIP DEVELOPMENT 3 0 0 100

UNIT I 9

Introduction – productivity in India – resources – availability and mobilization – land, labour and capital – industrial growth in five year plan period – Human resource development.

UNIT II 12

Technology and investment – industrial climate in India – Technological investment transfer of technology, factors influencing technical investment, NRI, capital market in India, technocrats, role of educational institutions – psychology of Indian technocrats as entrepreneur, characteristics of entrepreneur.

UNIT III 12

Leadership – attitudes and apitudes – qualities and development – risk taking and decision making – personal involvement value engineering techniques – value added products – value adding techniques – cost reduction techniques – waste control – alternate product application, functional value of the product – improvement and expansion.

UNIT IV 12

Marketing – India and International markets – market surveys – strategies and development of markets – need based marketing techniques. Business laws and regulations – company laws of India – taxation laws – labour laws – factories act – ESI act – workman compensation act

Total = 45

TEXT BOOKS

1. Meredith G, Nelson R.E., and P.A. Nech. The Practice of Enterpreneurship, I.L.O Published Geneva, 1982.
2. R.Dirk Larkran, Profit Improvement Technology, College Book Publishing Company, Canada, 1981.

REFERENCES

1. Sukumar Battacharya, Indian Direct, Taxes Wadhwa and Co., 1983.
2. K.D. Srivasthava, Commentaries on workmen compensation act and ESI act.
3. K.D. Srivasthave, Factories Act, 1948.
4. How to start your own industry, circular by ITCOT and SIDCO Greams Road, Madras 600 006.

ME1022 COMPUTER AIDED DESIGN FOR CHEMICAL ENGINEERS 3 0 0 100

UNIT I ELEMENTS OF COMPUTER SYSTEM 20

Central Processors, Data Storage, Alphanumeric input and output, Graphical 1/0 Basic software, Operating system, Models of operation, Time sharing, Real time operation, Data and file management systems.

UNIT II PROPERTIES ESTIMATION 25

Physical properties of compounds, Thermodynamic properties of gases and binary mixtures, Viscosity, Vapour pressure, Latent heat, Bubble point and dew point calculations, Phase equilibria, Vapour-liquid equilibria, Liquid phase activity coefficients, K-values, Liquid- Liquid equilibria, Gas solutions.

TOTAL = 45

TEXT BOOKS

1. Rohatgi, A.K. Safety handling of Hazardous chemicals Enterprises, Bombay (1986)
2. Shukla. S.K.- Enviro hazards and Techno Legal aspects, Shashi Publications, Jaipur-India (1993).

REFERENCES

1. Wells G.L. and R.M.C. Seagrave-Flow sheeting for safety, I.Ch.E.London. K.(1977).
2. Learning from accidents – Trevur Kletz Butterworths London U.K. (1988).
3. Chemical reaction Hazards – A guide to safety, Institution of Chem. Engineering London U.K. Ed by John Barton and Richards Rogers (1997).

CH1011 PROCESS AUTOMATION 3 0 0 100

UNIT I INTRODUCTION 9

Principles of measurement and classification of process control instruments; temperature, pressure fluid flow, liquid level, velocity, fluid density, viscosity, conductivity etc., instrument scaling; sensors; transmitters and control valves; instrumentation symbols and labels.

UNIT II PROCESS AUTOMATION 9

Basic concepts; terminology and techniques for process control; control modes; Tuning process controllers.

UNIT III ADVANCED CONTROL 9

Advanced control techniques, feed forward and ratio control; controller design; adaptive control system; statistical process control; expert system; multivariable control techniques; supervisory control.

UNIT IV DIGITAL CONTROL 9

Digital control techniques; z transforms; sampling and filtering; response of discrete time systems; sampled data control systems; design of digital controllers.

UNIT V OPTIMAL CONTROL 9

Optimisation and simulation; optimisation techniques; single and multivariable constrained optimisation; dynamic simulation of distillation columns and reactors.

TOTAL : 45

TEXT BOOKS

1. Nakara, B.C.; Choudary, K.K.; "Instrumentation and Analysis", Tata McGraw-Hill, New Delhi, Eigth Reprint, 1993.
2. Stephanopoulos, G.; "Chemical Process Control", Tata McGraw-Hill, New Delhi, 1993.

REFERENCES

1. Karl J.Astrom, Bjorn Willermans; "Computer Controlled Systems", Prentice Hall of India Pvt. Ltd., 1994.
2. Chemical Engineering Refresher Series on "Process Automation", McGraw-Hill Publications, New York, 1991.

CH1012 PROCESS MODELLING AND SIMULATIONS 3 0 0 100

UNIT I BASIC MODELLING 8

Introduction to modeling; uses of mathematical models; scope of coverage; principles of formation; review on algeberic, ordinary and partial differential equations; solutions of the above equations; linearisation; probabilization models; development of models by experiment and statics; regression and correlation analysis.

UNIT II MATRIX MODELS 7

Elementary matrix concepts; simple array models; multi-component distillation; dynamic simulation of distillation column; solution techniques for matrix differential equations; matrix formation of distributed parameter system; flow pattern in stirred tanks; design of mixers.

UNIT III LUMPED PARAMETER MODEL 8

Introduction to lumped parameter system; mathematical description of multiphase transfer process; non isothermal reactors etc.; Axial dispersion in packed beds; reactor design from response curves; reactor effectiveness factor; computer aided modeling of reaction networks.

UNIT IV DISTRIBUTED PARAMATER MODEL 8

Formation and solution of one dimensional unsteady state problem in heat transfer and mass transfer systems; multidimensional problems; application in heat and mass transfer equipments.

UNIT V OPTIMISATION AND SIMULATIONS 14

Introduction; application; analytical and numerical techniques for multivariable problems; techniques for constrained optimization; simulation; introduction; discrete event and continuous simulation; dynamic simulation of reactors, distillation columns, absorbers, evaporators and crystallizers; simulation in process control.

TOTAL : 45

TEXT BOOKS

1. Ramirez, W.; “Computational Methods in Process Simulation”, Butterworths Publishers, New York, 1989.
2. Edgar, T.F.; Himmelblau, D.M.; “Optimisation of Chemical Processes”, McGraw-Hill Book Co., New York, 1989, Wiley inter science, New York, 1972.

REFERENCES

1. Luyben, W.L., “Process Modelling Simulation and Control”, McGraw-Hill Book Co., 1973.
2. Myers, A.L., Seider, W.D.; “Introduction to Chemical Engineering and Computer Calculations”, Prentice Hall Inc., Englewood Cliffs, New Jersey, 1976.
3. Chemical Engineering Refresher Series on “Process Dynamics”, McGraw-Hill Publications, 1983.
4. Mickley, H.S.; Sherwood, T.S.; Reed C.E.; “Applied Mathematics for Chemical Engineers”, Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 1989.

ME1023 FINITE ELEMENT ANALYSIS 3 0 0 100

UNIT I **9**

Basic concepts of Engineering Analysis and an Introduction to the Finite Element Method.

Solution of Discrete – System mathematical models – Eigen Value Problem, Propagation Problems. Solutions of Continuous System Mathematical models – Weighted Residual methods; Ritz method. Finite Difference Differential and energy methods.

UNIT II **9**

Formulation of the Finite Elements Method – Linear Analysis in solid and structural mechanics. Covergence of Analysis Results – The Model problem and a Definition of Convergence. Rate of Convergence. Calculation of stresses and the assessment of error.

Incompatible and Mixed Finite Element Models:

Incompatible Displacement – Based models, mixed formulation, Mixed Interpolation – Displacement / Pressure Formulation for Incompressible Analysis.

UNIT III **9**

Formulation and Calculation of Isoparametric Finite Element Matrices Introduction, Isoparametric Derivation of Bar Elements Stiffness Matrix. Formulation of Continuous Elements – Quadrilateral Elements, Triangular Elements, Convergence considerations, Element Matrices in Global Co-ordinate sytem.

Numerical Integration: Interpolation using a Polynomial, The Newton Cotes Formulas (One Dimensional Integration). The Gauss Formulas (One – Dimensional Integration). Integration in Two and Three Dimensions. Appropriate order of Numerical Integration.

UNIT IV **9**

Finite Element Nonlinear Analysis in Solid and Structural Mechanics.

Introduction to Non Linear Analysis, Formulation of the Continuum Mechanics Incremental Equation of motion. Structure Elements – Beam and Assymmetric Shell Elements. Plate and General Shell Elements.

UNIT V **9**

Solution of Equilibrium equation in Dynamic Analysis.

Introduction – Direct Integration methods, Central Difference method, The Houbold method, The Wilson Q method, Newmark method, The coupling of Different Integration Operators.

Analysis of Direct Integration methods:
Direct Integration Approximation and Load operators. Stability Analysis, Accuracy Analysis,

Solutions of Non-Linear Equation in Dynamic Analysis – Explicit Integration, Implicit Integration, Solutions using mode superposition

TOTAL = 45

TEXT BOOKS

1. Klaus – Jurgen Bathe, Finite Element Procedure Prentice Hall of India Ltd
2. Cook R.D., Concepts and Application of Finite Element Analysis - Wiley

REFERENCES

1. Larry J Segerland, Applied Finite Element Analysis John Willey and Sons
2. Zoemloewoez O.C., The Finite Element Method Engineering Science – McGraw-Hill.
3. Reddy J.N. Introduction to the Finite Element Method McGraw-Hill.

CH1013 ADVANCES IN POLLUTION CONTROL 3 0 0 100

UNIT I POLLUTANTS AND ITS EFFECTS 12

Sources of air pollution; effect of air pollution on the environment; on materials, on human health, on animals; meteorological effects; visibility factors.

UNIT II LEGISLATIVE ASPECTS AND MANAGEMENT 12

Legislative and regulatory trends; air pollutants; waste water treatment and recycle.

UNIT III INDUSTRIAL WASTE AND EFFLUENT TREATMENT 12

Gaseous, solid, liquid waste disposal, air pollution considerations in soild and liquid waste disposal.

UNIT IV ANALYSIS AND CONTROL 9

Analytical techniques in air pollution; design aspects of pollution control systems.

TOTAL = 45

TEXT BOOKS

1. Ross, G.R.D.; “Air Pollution and Industry”, VanNostrand Reinhold Co., New York, 1972.
2. Kozirowski, B; Kucharske, J; “Industrial Waste Disposal”, Pergamon Press, 1972.

REFERENCE

1. Stern A.C.; Boubce R.W.; Lowry W.P. “Fundamentals of Air Pollution”, Academic Press, 1973.