Dr.M.G.R.
EDUCATIONAL AND RESEARCH INSTITUTE
UNIVERSITY
(Decl. U/S 3 of the UGC Act 19Hrs56)

DEPARTMENT OF CHEMICAL ENGINEERING

B.Tech- Chemical Engineering – Full Time
2013 Regulation

III SEMESTER						
S.NO	**Sub.Code**	**Title of Subject**	**L**	**T**	**P**	**C**
1.	BEE13034	Electrical Technology	3	0	0	3
2.	BCH13006	Chemistry II	3	0	0	3
3.	BMA13008	Mathematics –III for Chemical Engineers	3	1	0	4
4.	BCT13002	Mechanical Engineering	3	0	0	3
5.	BCE13031	Environmental Science and Engineering	3	0	0	3
6.	BBT13031	Biochemistry	3	0	0	3
7.	BCH13L03	Chemistry Lab	0	0	3	2
8.	BEE13L23	Electrical Engineering Lab	0	0	3	2
		Total	**18**	**1**	**6**	**23**

IVSEMESTER						
S.NO	**Sub.Code**	**Title of Subject**	**L**	**T**	**P**	**C**
1.	BCT13003	Computer Applications	2	0	1	3
2.	BCT13004	Introduction to Chemical Process Industries	3	0	0	3
3.	BBT13032	Industrial Microbiology	3	0	0	3
4.	BCT13005	Chemical Technology I	3	0	0	3
5.	BCT13006	Processes in Organic Synthesis	3	0	0	3
6.	BCT13007	Mechanical Operations	3	0	0	3
7.	BMA13013	Mathematics IV for Chemical Engineers	3	1	0	4
8.	BCT13L01	Technical Analysis Lab	0	0	3	2
9.	BEN13L01	Career and Confidence Building (Soft skills – I)	0	0	0	2
		Total	**20**	**1**	**5**	**26**

V SEMESTER						
S.NO	**Sub.Code**	**Title of Subject**	**L**	**T**	**P**	**C**
1.	BCT13008	Chemical Process Calculations	3	0	0	3
2.	BCT13009	Chemical Engineering Thermodynamics I	3	0	0	3
3.	BBT13033	Cell Biology	3	0	0	3
4.	BCT13010	Chemical Technology II	3	0	0	3
5.	BCT13011	Fluid Mechanics	3	0	0	3
6.	BMA13016	Mathematics – V for Chemical Engineers	3	1	0	4
7.	BBT13L21	Biochemistry Lab	0	0	3	2
8.	BCT13L02	Chemical Engineering Lab I	0	0	3	2
9.	BEN13L02	Qualitative and Quantitative skills (Soft skills-II)	0	0	0	2
		Total	**18**	**1**	**6**	**25**

VI SEMESTER						
S.NO	**Sub.Code**	**Title of Subject**	**L**	**T**	**P**	**C**
1.	BCT13012	Chemical Engineering Thermodynamics II	3	0	0	3
2.	BCT13013	Chemical Reaction Engineering I	3	0	0	3
3.	BCT13014	Mass Transfer I	3	0	0	3
4.	BCT13015	Heat Transfer	3	0	0	3
5.	BMA13019	Special Functions, Difference Equations and Z Transforms	3	1	0	4
6.	BCT13016	Chemical process equipment design	3	0	0	3
7.	BCT13L03	Matlab Programming Fundamentals	0	0	3	2
8.	BCT13L04	Chemical Engineering Lab II	0	0	3	2
		Total	**18**	**1**	**6**	**23**

VII SEMESTER						
S.NO	**Sub.Code**	**Title of Subject**	**L**	**T**	**P**	**C**
1.	BCT13017	Process Control and Dynamics	3	0	0	3
2.	BMG13006	Process Economics and Industrial Management	3	0	0	3
3.	BCT13018	Chemical Reaction Engineering II	3	0	0	3
4.	BCT13019	Mass Transfer II	3	0	0	3
5.	BBT13034	Bio process Principles	3	0	0	3
6.	BCT13020	Transport Phenomena	3	1	0	4
7.	BCT13L05	Chemical Process Equipment Design & Drawing with Simulation	0	0	3	2
8.	BCT13L06	Chemical Engineering Lab III	0	0	3	2
		Total	**19**	**1**	**6**	**23**

VIII SEMESTER						
S.NO	**Sub.Code**	**Title of Subject**	**L**	**T**	**P**	**C**
1.	BMG13002	Total Quality Management	3	0	0	3
2.	BCT13L07	Project work	0	0	20	10
3.		Elective I	3	0	0	3
4.		Elective II	3	0	0	3
		Total	**9**	**0**	**20**	**19**

I+II+III+IV+V+VI+VII+VIII=**45+**23+26+25+23+23+19**=184**
Total credits earned for the award of the degree : 184

List of Electives						
S.No	**Sub.Code**	**Course Title**	**L**	**T**	**P**	**C**
1	BCT13E01	Food Technology	3	0	0	3
2	BCT13E02	Air pollution and control	3	0	0	3
3	BCT13E03	Green chemistry and Engineering	3	0	0	3
4	BCT13E04	Environmental Engineering	3	0	0	3
5	BCT13E05	Waste water Treatment	3	0	0	3
6	BCT13E06	Drugs and Pharmaceutical Technology	3	0	0	3
7	BCT13E07	Fertilizer Technology	3	0	0	3
8	BCT13E08	Petroleum Technology	3	0	0	3
9	BCT13E09	Pulp and Paper Technology	3	0	0	3
10	BCT13E10	Polymer Technology	3	0	0	3
11	BCT13E11	Fundamentals of Nanoscience	3	0	0	3
12	BCT13E12	Frontiers of Chemical Engineering	3	0	0	3
13	BCT13E13	Professonal Ethics in Engineering	3	0	0	3
14	BCT13E14	Industrial Instrumentation	3	0	0	3
15	BCT13E15	Safety in Chemical Process Industries	3	0	0	3

BEE13034 ELECTRICAL TECHNOLOGY 30 0 3

OBJECTIVE:

- To gain knowledge on circuit systems, machines, transformers and drives

UNITI DC CIRCUITS 9Hrs

Introduction - circuit parameters - Kirchoffs laws - circuit reduction techniques - Thevenin's Theorem - Maximum power transfer theorem.

AC CIRCUITS: RMS and average velocity of periodic waves - form factor - phase and phase difference - RL, RC, RLC circuits - power and power factor - Introduction to three phase systems - solution of balanced three phase circuits.

UNIT II D.C. MACHINES 9Hrs

Construction details of DC machines - principles of operation of DC generator - EMF equation - Characteristics of DC generators - principle of DC motor - Back EMF - Torque equation - Characteristics shunt, series and compound motors - Losses and efficiency - Starters - Speed control - applications.

UNIT III TRANSFORMERS 9Hrs

Principles of ideal transformers - constructional details - EMF equation - Equivalent circuit - Voltage regulation - losses and efficiency - OC and SC tests on transformer - Autotransformer - Power supplies - basic principle of SMPS and UPS.

UNIT IV SYNCHRONOUS MACHINES AND INDUCTION MOTORS 9Hrs

CONSTRUCTION DETAILS - PRINCIPLES OF ALTERNATOR -

Construction details - principle of alternator - EMF equation - Voltage regulation - starting of synchronous motor - effect of field excitation - Induction motor - principle of operation - torque equation - torque-slip characteristics - starting methods and speed control - principle of single-phase induction motor - applications (Qualitative treatment only).

UNIT VELECTRICAL DRIVES 9Hrs

Types of Electrical drives - Factors influencing the Choice of Electrical Drives, Heating and Cooling Curves - Loading Conditions and Classes of Duty - Determination of Power Rating - Drives for textile mills, Steel rolling mills, machine tools and Cranes & Hoist Drives. (Quantitative Treatment only)

Total No. of Hrs:45

Text Books:

1. S.K.Battacharya, *"Electrical Machines*" Tata McGraw Hill Publications, 2nd Edition, 1998.
2. Sudhakar&Shyammohan, "*Circuits & Networks Analysis & Synthesis*", Tata McGrw Hill, 2001.

References:

1. J.A.Edminister, " *Theory and Problems on Electrical Circuits"* McGraw Hill, 1994.
2. .J.Nagrath&D.P.Kothari, "*Electrical Machines"*, TMH publications."*Hughes Electrical Technology*", Revised by IMcKeenzie Smith, Low Price Edition, Pearson Education, 7th Ed.

BCH13006 **CHEMISTRY-II** **3 0 0 3**

OBJECTIVE:

- To master the concepts of chemistry based on inorganic, organic and physical chemistry

UNIT I ORGANO METALLIC COMPOUNDS AND HETEROCYCLIC COMPOUNDS **9Hrs**

Grignard reagents and their synthetic utility –Organo-Silicon compounds. Furan, Thiophone, Pyrrole, Pyridine, and Indole - Their important derivatives

UNIT II DYES AND DYEING **9Hrs**

Colour and Constitution - Synthesis of some important azodyes (Methyl orange, Methyl red and Congo red) - Synthesis of Triphenylmethane dyes (Malachite green, Para RosanilineAnthraquinone dyes (Alizarin). - Phthalin dyes - Eosin preparation - Introduction to Natural and Reactive dyes

UNIT IIIPHARMACEUTICAL CHEMISTRY **9Hrs**

Synthesis of antimalarial drugs - Isopentaquine and chloroquine - Antibacterial drugs - Synthesis of sulphanilamide, sulphaphyridine.

UNIT IV COLLOIDS **9Hrs**

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

UNIT V PHOTOCHEMISTRY **9Hrs**

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

Total No. of Hrs:45

Text Books:

1. Puri B.H. and Sharma L.R., " *Principles of Physical Chemistry* ", S.NaginChandand Company, Delhi (1994).
2. Kund and Jain, " *Physical Chemistry* ", S. Chand and Company, Delhi (1996). Gordon M.Barrow, " *Physical Chemistry* ", Sixth Edition, Tata McGraw Hill (1998).
3. Tiwari, K.S., Vishnoi, N.K. and Vishnoi, S.N., " *A Text book of Organic Chemistry* ",Second Edition, Vikas Publishing House (1998), New Delhi.

References:

1. Agarwal, O.P., " *Synthetic Organic Chemistry* ", Vth Edition, 1980-81,Goel Publishing house, Meerut.Ashutoshkar, " *Medicinal Organic Chemistry* ", New Age InternationalPrivate Ltd., 1993, Chennai.
2. Bahl, B.S. and ArunBahl, " *Advanced Organic Chemistry* ",IIIrd Edition(1994), Sultan Chand and sons, New Delhi.
3. Mrs. Lakshmi, S., " *Pharmaceutical Chemistry* ", First Edition (1995),
4. Sultan Chand and Sons, New Delhi.8.Morrison, R.T. and Boyd, R.N., " *Organic Chemistry* ", VI Edition,
5. Prentice Hall Inc.(1996), USA.

BMA13008 MATHEMATICS III FOR CHEMICAL ENGINEERS 3 1 0 4

OBJECTIVE:

- The aim of this course is to introduce the concepts of partial differential equations and, analytic functions,which will be applicable to chemical chemicalEngg.

UNIT I PARTIAL DIFFERENTIAL EQUATIONS 12Hrs

Formation – Solutions of standard types of first order equations – Lagrange's equation – Linear partial differential equations of second order and higher order with constant Coefficients.

UNIT II FOURIER SERIES 12Hrs

Dirichlet's conditions – General Fourier series – Half range Sine & Cosine series – Complex form of Fourier series – Parseval's identity – Harmonic Analysis.

UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 12Hrs

Classification of second order linear partial differential equations – Solutions of one-dimensional wave equation, one-dimensional heat equation – Steady state solution of two- dimensional heat equation (Cartesian coordinates only) – Fourier series solutions.

UNIT IV ANALYTIC FUNCTIONS 12Hrs

Analytic functions – Cauchy Riemann equations in Cartesian and Polar form – Properties of analytic functions – Construction of analytic functions – Simple Transformations – Standard transformations : $w = z^2$, $w = e^z$, $w = \sin z$, $w = \cosh z$ – Bilinear transformations.

UNIT V COMPLEX INTEGRATION 12Hrs

Cauchy's integral theorem (without proof) – Cauchy's integral formulae (without proof) – Taylor's and Laurent's series (without proof) – Singularities: Types – Residues – Cauchy's residue theorem (without proof) – Evaluation of real integrals by Contour Integration (excluding poles on real axis).

Total No. of Hrs: 60

Text Books :

1) Veerarajan T., *Engineering Mathematics (for first year)*, Tata McGraw Hill Publishing Co., (2007).
2) Veerarajan T., *Engineering Mathematics (for semester III)*, Tata McGraw Hill Publishing Co., (2005).
3) Singaravelu, *Engineering Mathematics III*, Meenakshi Agency, (2005).

References:

1) Kreyszig E., *Advanced Engineering Mathematics (9th ed.)*, John Wiley & Sons, (2011).
2) Grewal B.S., *Higher Engineering Mathematics*, Khanna Publishers, (2012).

BCT13002 **MECHANICAL ENGINEERING** **3 0 0 3**

OBJECTIVE:

- To get insight into thermodynamic concepts and to study about metallurgy applications.

UNIT - I LAWS OF THERMODYNAMICS **9Hrs**

Scope of Thermodynamics - work transfer - heat transfer - Specific heat - Latent heat. First law of Thermodynamics and applications - Steady Flow Process and Variable Process.Second law of Thermodynamics - Kelvin-plank and Clausius Statements - Carnot heat engine - Reversed Carnot engine- Carnot theorem Corollary of Carnot theorem. Properties of Steam - dryness fraction - Super heated Steam.

UNIT – II VAPOUR AND GAS POWER CYCLES **9Hrs**

Rankine cycle - Reheat cycle - Regenerative cycle - Binary vapour power cycle.Gas power cycles - Carnot cycle - Otto cycle - Diesel cycle - Brayton cycle.

UNIT – III STATICS AND DYNAMICS OF MECHANICS **9Hrs**

Statics - Laws of mechanism - concurrent forces in a plane - Resolution and composition of forces - Equilibrium of particle - resultant force.

Dynamics - Displacement , velocity and acceleration - their relationship - Linear and Circular motion - DeAlemberts principles

UNIT – IV METALLURGY **9Hrs**

Classification of steel and Cast Iron - Iron-Carbide equilibrium diagram.Classification of Heat Treatment process - purpose of heat treatment - Fundamental principles of heat treatment - Annealing - Normalizing - Hardening - Tempering.

UNIT – V TRANSIMISSION SYSTEMS: **9Hrs**

Belt drives - Classification - Flat, V- belts and rope drives - Power Transmitted.

Gear Terminology - Classification - Law of Gearing - Gear ratio - Length of arc and path of contact and contact ratio(Derivation not required) - Simple and Compound gear Trains.

Total No.ofHrs: 45

Text Books:

1.Smith, "*Chemical Thermodynamics*", Reinhold Publishing Co:1977.
2. Bhaskaran.K.A and Venkatesh.A. "*Engineering Thermodynamics*" TMH:1973.

References:

1.Pandya A. and Shah. Theory of Machines" Charatakar Publishers:1975
2.P.K.Nag, "*Engineering Thermodynamics*", II Edition, TMH publishing Co.Ltd.,1995

BCE13031 ENIVIRONMENTAL SCIENCE AND ENGINEERING 3 0 0 3

OBJECTIVES:

- To help to master the factors responsible for environmental degradation.
- Consequences revalent to air, water and soil pollution are included in the syllabus.

UNITI: 9Hrs

Introduction to factors influencing environment-Environmental degradation and consequential hazards- Types of air pollution-Ozone layer depletion-Acid rain-acid jolt-Green house effect and climatic changes-Carcinogenic pollutants.

UNIT II: 9Hrs

Introduction of BOD and COD – importance and experimental determination- Waste water treatment and recycling- Methods of sterilization of drinking water- Correlation between dissolved oxygen and quality of water.

UNIT III: 9Hrs

Soil pollution-Saline intrusion- Long range pollution-Consequence of indiscriminate solid waste dumping-Effect of fertilizers and Pesticide residue on the soil-blue jaundice (Cyanosis)-Preparation of bio pesticides.

UNIT IV: 9Hrs

Noise pollution-allowed decibel levels-Health hazards of exposure to noise-Abatement technologies.

UNIT V: 9Hrs

Abatement technologies to suit the pollutant-alternate non conventional energy sources-Morbidity and mortality.

Total No. of Hrs: 45

Text Books:

1. Junarkar, S.B., " *Mechanics of Structures* ", Vol. I, 21st Edition, CharacterPublishing House, India, (1995).
2. William A.Nash, " *Theory and Problems of Strength of Materials"* ,Schaum's Outline Series, McGraw Hill International Editions, Third Edition, 1994.
3. Elangovan, A., *" ThinmaVisaiIyal* " (Mechanics of Solids in Tamil),Anna University, Madras, 1995.

References:

1. *Industrial chemistry* by Dr.B.K.Sharma 7th edition.
2. *Introduction to Environmental Engineering* and Science by Gilbert M.Masters, Prentice Hall, 2004.

BBT13031 **BIOCHEMISTRY** **3 0 0 3**

OBJECTIVE:

- To enable the students to acquire a specialized knowledge on biomolecular concepts.
- To understand the selected aspect related to metabolism

UNIT I: INTRODUCTION TO BIOMOLECULES-1 **9Hrs**

Structure and properties of Mono, Di, Oligo and polysaccharides, complex carbohydrates, Structure and properties of Fatty acids, Glycerolipids, phospholipids, sphingolipids, glycolipids, steroids, Structure and properties of amino acids, Peptides, proteins and conjugated proteins.

UNIT II: INTRODUCTION TO BIOMOLECULES-2 **9Hrs**

Structure and properties of purines, pyrimidines, nucleosides, nucleotides, polynucleotides, Ribonucleic acids and deoxy ribonucleic acids,nucleoprotein complexes.

UNIT III: METABOLISM **9Hrs**

Biosyntheses and degradation of fatty acids and cholesterol, Biosyntheses and degradation of amino acids, peptides and proteins; Biosynthesis and degradation of amino acids, peptides and proteins, Biosyntheses and degradation of Purines, pyrimidines and nucleic acids.

UNIT IV: INTERMEDIARY METABOLISM **9Hrs**

TCA Cycle, glycolysis, gluconeogenesis, Pentose phosphate shunt, Embden Meyerhof pathway, urea cycle, interconnection of pathways, Metabolic regulation, Bioenergetics: Respiratory chain, TP cycle, energy rich compounds.

UNIT V: STRUCTURE FUNCTION RELATIONSHIP **9Hrs**

Complex carbohydrates, proteins and nucleic acids.

Total No. of Hrs: 45

Text Books:

1. Lehninger A.L., Nelson D.L., Cox M.M., " *Principles of Biochemistry* ", CBS Publications, 1993.

References:

1. Voet D., Voet G., " *Biochemistry*", Second Edition, John Wiley and Sons, 1994.
2. Stryer L., " *Biochemistry* ", Fourth Edition, 1994.

BCH13L03	**CHEMISTRY LAB**	**0**	**0**	**3**	**2**

1. Ore/alloy analysis
2. Pigment Analysis
3. Industrial Waste Water Analysis
4. Estimation of Phenol
5. Analysis of fertilizers
6. Sugar Analysis
7. Polymer Analysis

BEE13L23 ELECTRICAL ENGINEERING LAB 0 0 3 2

LIST OF EXPERIMENTS

1. Open circuit characteristics of D.C. shunt generator.
2. Load characteristics of D.C. shunt generator
3. Load characteristics of D.C. compound generator
4. Load test of D.C.Shunt motor
5. Study of D.C.Motor starters
6. O.C. and S.C. tests on single phase transformer
7. Load test on single phase transformer.
8. Load test on 3 phase squirrel cage induction motor
9. Study of 3 phase induction motor starters
10. Load test on 3 phase slip ring induction motor
11. O.C. and S.C. tests on 3 phase alternator
12. Synchronization and V-curves of alternator

BCT13003 **COMPUTER APPLICATIONS** **2 0 1 3**

OBJECTIVE:

- To gain knowledge based on various programming languages applied for chemical technology

UNIT I:INTRODUCTION **9Hrs**

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

UNIT II:SPREAD SHEETS **9Hrs**

Creating – opening and saving files – working with worksheets – entering data – editing – formatting – printing – formulae- charts - Application in Density, molecular weight, mole and percentage compositions, Empirical and Molecular formula calculations, Heat of mixing, Gas laws, Vapor pressure, Chemical Kinetics calculations.

UNIT III:SPREAD SHEETS (DATA ANALYSIS **9Hrs**

Application in data processing, Statistical analysis of data, Regression Analysis of variance, interpolation, Graphical representations.

UNIT IV:FORTRAN **9Hrs**

Syntax – Mathematical and logical operations – Looping – Conditional statements – functions – Sub-functions – simple application programmes.

UNIT V: C PROGRAMMING **9Hrs**

Syntax – Mathematical and logical operations – Looping – Sub-routines – file handling – simple application programmes.

Total No. of Hrs: 45

Text Books:

1. Taxali, R.K., T.K., " *dBase IV made simple* ", Tata McGraw Hill 1991.
2. Myers, A.L., Seider W.D., " *Introduction to Chemical Engineering andComputer Calculations "*

References:

1. Jerry, O., Breneman, G.L., *" Spreadsheet Chemistry* ", Prentice Hall,Englewood Cliffs, 1991.
2. Hanna, O.T., Scandell, O.C., " *Computational Methods in Chemical Engineering* ",Prentice Hall, 1995.

BCT13004 INTRODUCTION TO CHEMICAL PROCESS INDUSTRIES 3 0 0 3

OBJECTIVE:

- To introduce history, importance and components of chemical engineering for current scenario of chemical & allied process industries

UNIT I:WATER **9Hrs**

Hard and soft – Industrial water – Water treatment – R.O – Boiler feed water.

UNIT II:STEAM **9Hrs**

Properties – steam generators – solid ,gas fuel fired – fluidized beds – scaling – steam traps accessories – types of fuels.

UNIT III:REFRIGERATION **9Hrs**

Methods – refrigerants –refrigeration cycle – theory.compressed air –compressors – Humidification – equipments – cooling towers.

UNIT IV: CORROSION **9Hrs**

Theory – measurement of corrosion – corrosion protection methods.

UNIT V: MATERIALS OF CONSTRUCTION **9Hrs**

Materials of construction in process industries – importantmetals and alloys – their properties – non-metals and their properties – polymers and their properties.

Total No. of Hrs: 45

Text book:

1. Eckenfelder – "*Industrial water pollution control*" –McGraw Hill 1966
2. P.L.Balleney – "*Thermal engg" Khanna publishers 1986*

References:

1. Perry's "Chemical Engineers" Hand book.
2. P.N.Anandha Narayanan " *Basisrefrigerayion and air conditioning* " Tata McGraw hill 2007

BBT13032 INDUSTRIAL MICROBIOLOGY 3 0 0 3

OBJECTIVE:

- To explore the students about the various emerging areas of industrial micro biology

UNIT I:INTRODUCTION 9Hrs

Basic of microbial existence; history of microbiology, classificationand nomenclature of microorganism, microscopic examination of microorganisms, light and electron microscopy; principles of different staining techniques like gram staining, acid fast, capsular staining, flagellar staining.

UNIT II:MICROBES-STRUCTURE AND MULTIPLICATION 9Hrs

Structural organization and multiplication of bacteria, viruses, algae and fungi with a special mention of life history of actinomycetes, yeast, mycoplasma and bacteriophage.

UNIT III:MICROBIAL NUTRITION, GROWTH AND METABOLISM 9Hrs

Nutritional requirements of bacteria and different media used for bacterial culture; growth curve and different methods to quantitate bacterial growth, aerobic and anaerobic bioenergetics and utilization of energy for biosynthesis of important molecules.

UNIT IV: CONTROL OF MICROORGANISMS 9Hrs

Physical and chemical control of microorganism; host-microbe interactions; anti-bacterial, anti-fungal and anti-viral agents, mode of action and resistance to antibiotics; clinically important microorganisms.

UNIT V:INDUSTRIAL AND ENVIRONMENTAL MICROBIOLOGY 9Hrs

Primary metabolites; secondary metabolites and their applications; preservation of food; production of penicillin, alcohol, vit. B-12; biogas; bioremediation; leaching of ores by microorganisms; biofertilizers and biopesticides; microorganisms and pollution control.

Total No. of Hrs:45

Text Book:

1. Pelczar MJ, Chan ECS and Krein NR, *Microbiology*, Tata McGraw Hill Edition, New Delhi, India..

Referencs:

1. Talaron K, Talaron A, Casita, PelczarAnd Reid. *Foundations In Microbiology*, W.C.Brown Publishers,1993.
2. Prescott LM, Harley JP, Klein DA, Microbiology, 3rd Edition, Wm. C. Brown publishers, 1996.

BCT13005 **CHEMICAL TECHNOLOGY– I** **3 0 0 3**

OBJECTIVE:

- Tointroducehistory, importanceandcomponentsofchemicalengineering, conceptsof unit operations and unit processes.
- Currentscenarioofchemical&alliedprocessindustries

UNIT I: INTRODUCTION **9Hrs**

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

UNIT II: FERTILISER CHEMICALS **9Hrs**

Growth elements, Function, Nitrogenous fertilizers, Ammonium sulfate, Ammonium Nitrate and Urea, Phosphatic fertilizers, single and triple superphosphate, Ammonium phosphate, Nitro phosphate, Potassium Fertilizers, Potassium Chloride, Potassium Nitrate and phosphate, Compound fertilizers and bio-fertilizers. PHOSPHORUS INDUSTRIES **:**Phosphate rock, benefaction, phosphoric acid-phosphate.NITROGEN INDUSTRIES: Synthesis ammonia and nitric acid. AGRICHEMICAL INDUSTRIES**:** Insecticides, pesticides, herbicides, plant nutrients and regulators

UNIT III: INDUSTRIAL CHEMICALS - I **9Hrs**

EXPLOSIVES AND PROPELLANTS INDUSTRIES**:** Explosives, types and characteristics, industrial and military explosives, propellants for rockets.
SURFACE COATING INDUSTRIES**:** Paints, pigments, varnishes, lacquers, industria, and marine coatings.
PHOTOGRAPHIC CHEMICALS**:** Photographic chemicals, manufacture of films, plates and papers, recovery.
INDUSTRIAL GASES: Synthetic gas, natural gas, carbon dioxide sulphur-di-oxide, acetylene, helium and argon, hydrogen, oxygen, nitrogen.

UNIT IV: INDUSTRIAL CHEMICALS - II **9Hrs**

CHOLORO - ALKALI INDUSTRIES**:** Soda ash and sodium bicarbonate, Chlorine and caustic soda; bleaching powder and related bleaching agents, hydrochloric acid.
SULPHUR AND SULPHURIC ACID INDUSTRIES**:** Mining and manufacturing of Sulphur, recovery of sulphur from polluting gases, sulphur trioxide and sulphuric acid.
ELECTROLYTIC AND ELECTROTHERMAL INDUSTRIES**:** Abrasives, Carborondum, Calcium Carbide, Aluminium and Magnesium.

UNIT V: INDUSTRIAL CHEMICALS - II **9Hrs**

WATER IN INDUSTRY: Role of water treatment methods for industrial and domestic use, recovery of waste water, water conditioning.
MARINE CHEMICALS**:** Sodium chloride, By-products of common salt industry, value added product.
NUCLEAR INDUSTRIES**:** Production of uranium, thorium and zirconium from ores and minerals, separation of isotopes, waste disposal.

Total No.of Hrs: 45

Text Books:

1. Austin, G.T. Shreve, " *Chemical Process Industries* ", Fifth Edition,McGraw Hill International Book Co., Singapore, 1984.
2. Dryden, C.E., *" Outlines of Chemicals Technology* ", Edited andRevised by Gopala Rao, M. and Sitting, M., Second Edition,Affiliated East-West Press, 1993.

References:

1. Kent, J.A.(ed), Riggel, " *Hand book of Industrial Chemistry* ",Van Nostrant Reinhold, 1974.
2. "Chemtech 1-4 *", Chemical Engineering Education Development*Centre, I.I.T., Madras 1975-1978.

BCT13006 **PROCESSES IN ORGANIC SYNTHESIS** **3 0 0 3**

OBJECTIVE:

- Provides knowledge of steps of a synthesis involved in chemical reactions and conditions for each of these reactions must be designed to give an adequate yield of pure product

UNIT I: **9Hrs**
Thermodynamic and kinetic concepts, nitration,amination by reduction ,halogenation

UNIT II: **9Hrs**
Sulfonation,amination by ammonolysis,oxidation

UNIT III:
Hydrogenation,hydrocarbon synthesis , hydroformylation **9Hrs**

UNIT IV: **9Hrs**
Esterification,hydrolysis , alkylation

UNIT IV: **9Hrs**
Polymer chemistry,polymerisation

Total No. of Hrs:45

Text Book:

1. P.H.Groggins:Tata Mc GrawHill,Fifth edition : 1995

BCT13007 **MECHANICAL OPERATIONS** **3 0 0 3**

OBJECTIVE:

- To provide knowledge of particle size analysis, size reduction, storage of solids, particle mechanics, sedimentation and floatation, flow through packed beds, fluidization, filtration, fluid-solid conveying

UNIT – I PARTICLE CHARACTERISTICS AND SIZE ANALYSIS **9Hrs**

Generalcharacteristics of solids, their behavior under different external forces, agglomeration, techniques for size analysis.

UNIT – II SIZE REDUCTION **9Hrs**

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

UNIT – III MECHANICAL SEPARATIONS **9Hrs**

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, MIXING AND AGITATION **9Hrs**

Theory of filtration, Batch and continuous filters, centrifuges, membrane and ultra filtration.Equipment for blending and kneading, dispersion, power for agitation, correlations.

UNIT – V STORAGE AND CONVEYING OF SOLIDS **9Hrs**

Conveyors, elevators, pneumatic conveying, Different methods for storage of solids.

Total No. of Hrs: 45

Text Book:

1. McCabe,W.L, Smith J.C and Harriot, P., " *UNIT Operations in Chemical Engineering ",* McGraw-Hill, Fourth Edition, 1984.

References

1. Coulson, J.M., Richardson, J.F., "*Chemical Engineering* ", Volume 2, Third Edition, Pergamon Press, 1977.

BMA13013 MATHEMATICS IV FOR CHEMICAL ENGINEERS 3 1 0 4

OBJECTIVE:

- The aim of this course is to introduce the basic concepts of Probability, Design of Experiments and, Linear programming relevant to chemical Engg.

UNIT IPROBABILITY AND RANDOM VARIABLE 12 Hrs

Axioms of probability – Conditional probability – Total probability – Baye's Theorem – Random variable – Probability mass function – Probability density function – Properties – Moments (Definition and simple problems).

UNITII STANDARD DISTRIBUTIONS 12 Hrs

Binomial – Poisson – Geometric –Uniform – Exponential – Normal distributions.

UNITIII TESTING OF HYPOTHESIS 12 Hrs

Tests of Significance – Large Sample Tests – Mean – Proportions – Small Sample Tests – t, F, Chi-square Tests: Independence of Attributes, Goodness of Fit.

UNIT IV DESIGN OF EXPERIMENTS 12 Hrs

Analysis of Variance – One way classification – Two way classification – Design of Experiments – Completely Randomized Block Design – Randomized Block Design – Latin Square Design.

UNITV LINEAR PROGRAMMING 12 Hrs

Formulation of Linear Programming Problem – Graphical method – Simplex algorithm – Artificial variable – Big M Method – Two Phase method.

Total No.ofhrs: 60

Text Books

1. Singaravelu, *Probability and Random Processes*, Meenakshi Agency, (2008).
2. Gupta S.C., Kapoor V.K., *Fundamentals of Mathematical Statistics*, S.Chand& Co., (2007).
3. Veerarajan T., *Probability, Statistics and, Random Processes*, Tata McGraw Hill Publishing Co., (2008).

References:

1. Hamdy A. Taha, *Operations Research: An Introduction (9th ed.)*, Pearson, (2010).
2. Panneerselvam R., *Operations Research (2nd ed.)*, Prentice Hall of India, (2011).

BCT13L01 TECHNICAL ANALYSIS LAB 0 0 3 2

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.**

BEN13L01 CAREER & CONFIDENCE BUILDING(SOFT SKILLS - I) 0 0 0 2

OBJECTIVES:

- **To Improve:**
  1. Behavioural Patterns and Basic Etiquette
  2. Value System
  3. Inter Personal Skills
  4. Behaving in Corporate Culture
  5. Self Awareness / Confidence
  6. Managing Self and Personality Styles including Body Language
  7. International Culture / Cross Cultural Etiquette

UNIT I : 6Hrs

Creation of awareness of the top companies / different verticals / courses for improving skill set matrix, Industry expectations to enable them to prepare for their career - Development of positive frame of mind - Avoiding inhibitions - Creation of self awareness - Overcoming of inferiority/ superiority complex

UNIT II : 6Hrs

Selection of appropriate field vis-a-vis personality / interest to create awareness of existing industries, Preparation of Curriculum Vitae - Objectives, profiles vis-a-vis companies

UNIT III : 6Hrs

Group discussions - Do's and Don'ts - handling of Group discussions – What evaluators look for! Interpersonal relationships - with colleagues - clients - understanding one's own behaviour - perception by others - How to work with persons whose background, culture, language / work style different from one's, behaviour pattern in multi-national offices

UNIT IV : 6Hrs

Interview - awareness of facing questions - Do's and Don'ts of personal interview / group interview, Enabling students prepare for different procedures / levels to enter into any company - books / websites to help for further preparation, Technical interview - how to prepare to face it, Undergoing employability skills test

UNIT V : 6Hrs

Entrepreneurship development - preparation for tests prior to the interview - Qualities and pre-requisites for launching a firm

Total No. of Hrs: 30

BCT13008 **CHEMICAL PROCESS CALCULATIONS** **3 0 0 3**

OBJECTIVE:

- This course brings together the concepts of engineering and economics for chemical plant design and optimization

UNIT – I UNITS, DIMENSIONS AND GAS CALCULATIONS **9Hrs**

Basic and derived UNITs, use of model UNITs in calcualtions, Methods of expression, compositions of mixture and solutions. 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 - IIMATERIAL BALANCE **9Hrs**

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 - IIIHUMIDITY AND SATURATION **9Hrs**

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

UNIT - IVFUELS AND COMBUSTION **9Hrs**

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 bearing compounds.

UNIT - VTHERMO PHYSICS AND THERMOCHEMISTRY **9Hrs**

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. 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 No of periods: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 Developement Centre, I.I.T., Madras, 1981.
2. *Process Calculations*, Venkataramani, V and Anantharaman, N, Prentice Hall of India Pvt. Ltd., 2003.

BCT13009 CHEMICAL ENGINEERING THERMODYNAMICS –I 3 0 0 3

OBJECTIVE:

- To understand the theory and applications of classical thermodynamics, thermodynamic properties, equations of state, methods used to describe and predict phase equilibria

UNIT – I **9Hrs**

Introduction – systems – surrounding – thermodynamic property – heat – work – energy forms

UNIT - II **9Hrs**

First law of thermodynamics - batch systems – open systems – applications – chemical reactions

UNIT - III **9Hrs**

Second law -carnot's principle – reversible – irreversible processes – entropy –criterion for reversible – irreversible – entropy balance

UNIT - IV **9Hrs**

Heat engines – refrigeration – cycles.

UNIT - V **9Hrs**

Fluids – state equations – ideal gas – actual gas equations – application.

Total No of periods: 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, T*hermodynamics* ", John Wiley 1970.
2. Dodge, B.F., *" Chemical Engineering Thermodynamics* ", McGraw-Hill, 1960.
3. Sandler, S.I., *" Chemical and Engineering Thermodynamics* 2nd edn. ",
4. Wiley, 1989.
5. Kyle, B.G., *" Chemical and Process Thermodynamics* 2nd edn. ", Prentice Hall of India Pvt.Ltd., 1990.

BBT13033 CELL BIOLOGY 3 0 0 3

OBJECTIVE:

- To provide knowledge of macromolecules and to understand the cellular components used to generate and utilize energy in cells

UNIT1-INTRODUCTION: 9Hrs

Introduction to cell-prokayotic and eukoryotic cell, cellular organals and their functions, cytokeletal and plant and animal cells.cell division, mitosis and meiosis, Extra cellular matrix, cell cycle and molecules that control cell cycle.

UNIT II- TRANSPORT ACROSS CELL MEMBRANES: 9Hrs

Membrane structure and function-membrane models, transport across cell membrane, passive transport, active transport, ion pumps, co-transport, exocytosis and endocytosis.Entry of viruses and toxins into cells.

UNIT III- RECEPTORS AND MODELS OF EXTRA CELLULAR SIGNALLING: 9Hrs

Cell communication, cell signaling- reception, transduction and response, signal reception and initiation of transduction, signal transduction path way, cellular response to signals**.**Autocrine, Paracrine and Endocrine models of action.

UNIT IV- SIGNAL TRANSDUCTION: 9Hrs

Signal amplification, Different models of signal amplifications, Cyclic AMP, Role of inositol phosphates as messengers, biosynthesis of inositol triphosphates, cyclic GMP and proteins role in signal transduction, Calcium ion flux and its role in cell signalling, current models of signal amplification, Phosphorylation of protein Kinases.

UNIT V-CELL CULTURE: 9Hrs

Techniques for the propagation of prokaryotic and Eukaryotic cells. Cell line, generation of cell lines, maintenance of stock cells, Characterisation of cells, Immunocytochemistry, morphological analysis techniques, in cell culture, explant cultures primary cultures, contamination, Differentiation, Three Dimensional cultures, role of matrix in cell growth.

Total No of periods: 45

Text Book:

1. *Molecular cell biology* by Harvey Lodish, Arnold Berk, S Lawrence Zipursky, Paul Matsudaira, David Baltimore, and James Darnell.v. New York: W. H. Freeman; 2000. ISBN-10: 0-7167-3136-3.

Reference:

1. Molecular Biology of the Cell: Reference Fifth Edition by Bruce Alberts , Alexander Johnson , Julian Lewis , Martin Raff , Keith Roberts , Peter Walter.

BCT13010 CHEMICAL TECHNOLOGY II 3 0 0 3

OBJECTIVE:

- To study process technologies of various organic and inorganic process industries.

UNIT – I PULP AND PAPER INDUSTRIES 9Hrs

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

UNIT– IISUGAR, STARCH INDUSTRIES AND OILS, FATS, SOAPS AND DETERGENT INDUSTRIES 9Hrs

Raw and refined sugar by products of sugar industries, Starch and starch derivatives. Vegetable oils and animal fats, their nature, analysis and extraction methods, hydrogenation of oils, fatty acids and alcohols, waxes, soaps, synthetic detergents.

UNIT – III PETROLEUM AND PETROCHEMICAL INDUSTRIES 9Hrs

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 – IV RUBBER AND POLYMERS 9Hrs

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 - V SYNTHETIC FIBRE AND FILM INDUSTRIES 9Hrs

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 No of periods: 45

Text Books

1. Austin, G.T., " *Shreve's Chemical Process Industries* ", Fifth Edition, McGraw-HillInternational 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.

References

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.

BCT13011 **FLUID MECHANICS** **3 0 0 3**

OBJECTIVE:

- Tounderstandbasicconceptoffluidflowanditsapplicationtochemicalprocessindustriesincluding pipeflow,fluidmachineryandagitation&mixing.

UNIT– IINTRODUCTION **9Hrs**

Concept of fluid - the fluid as a continuum - properties of a fluid –density -viscosity –surface tension – heat capacity – vapour pressure.

UNIT– IIFLUID STATICS **9Hrs**

Application tomanometry – Floatation – gravity settling – centrifugal separation – acceleration.

UNIT– IIIFLOW OF FLUIDS **9Hrs**

Bernoullis theorem and application – laminar flow – turbulent flow – pressure drop – Newtonian and non-newtonian flow.

UNIT– IVCOMPRESSIBLE FLUID FLOW **9Hrs**

Mach no – nozzle flow – flow of fluid through packed bed – fluidization.

UNIT– VINDUSTRIAL PIPING **9Hrs**

Valves – fluid moving machinery – pumps – characteristics of centrifugal pump – other types of pumps – compressors – work – blowers of pumps

Total No of periods: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. Chemical engineering hand book by Perry.
2. White, F.M., " *Fluid Mechanics "*, 4th Edition, McGraw-Hill Inc., 1999.

BMA13016 MATHEMATICS V FOR CHEMICAL ENGINEERS 3 1 0 4

OBJECTIVE:

- The aim of this course is to introduce the basic concepts of Numerical methods like Interpolation, Numerical differentiation, Numerical integration and, Linear programming relevant to chemical Engg.

UNIT I TRANSPORTATION AND ASSIGNMENT 12Hrs

Formulation of Transportation problem – North West corner method – Least cost method – Vogel's approximation method – Optimality test – MODI method – Degeneracy – Assignment problem: Hungarian method – Travelling salesman problem.

UNIT II INTERPOLATION 12Hrs

Newton forward and backward differences – Central differences – Stirling's and Bessel's formulae – Interpolation with Newton's divided differences – Lagrange's method.

UNIT III NUMERICAL DIFFERENTIATION AND INTEGRATION 12Hrs

Numerical differentiation with interpolation polynomials – Numerical integration by Trapezoidal and Simpson's (both 1/3 rd& 3/8 th) rules – Two and three point Gaussian Quadrature formulae – Double integrals using Trapezoidal and Simpson's rules.

UNIT IV NUMERICAL SOLUTIONS OF ORDINARY DIFFERNTIAL EQUATIONS 12Hrs

Single step methods – Taylor's series – Euler & Modified Euler method – RungeKutta method of fourth order for first & second order differential equations – Multi step methods – Milne's predictor-corrector method – Adam-Bashforth's predictor-corrector method.

UNIT V NUMERICAL SOLUTIONS OF PARTIAL DIFFERNTIAL EQUATIONS12 Hrs

Finite difference solutions for one dimensional heat equation (both implicit & explicit) – Bender-Schmidt method – Crank-Nicolson method –One dimensional wave equation – Two dimensional Laplace and Poisson equations – Liebmann's method.

Total No.ofhrs: 60

Text Books:

1. Veerarajan T., *Numerical Methods*, Tata McGraw Hill Publishing Co., (2005).
2. Sastry S.S., *Introductory Methods of Numerical Analysis*, Prentice Hall of India, (2003).

References:

1. Hamdy A. Taha, *Operations Research: An Introduction (9th ed.)*, Pearson, (2010).
2. Panneerselvam R., *Operations Research (2nd ed.)*, Prentice Hall of India, (2011).

BBT13L21 **BIOCHEMISTRY LAB** **0 0 3 2**

1. Buffer Preparation.
2. Qualitative analysis of Carbohydrate

a.Monosaccharide
b.Disaccharide
c.Polysaccharide

3. Qualitative analysis of Protein

a.Albumin
b.Peptone
c.Casein

4. Estimation of Carbohydrate by Benedict's method.
5. Estimation of Protein by Lowry's method.
6. Isolation of Protein from Milk.
7. Isolation of Starch from Potato.
8. Isolation of Cholesterol from Egg Yolk.
9. Paper Chromatography.
10. Thin layer Chromatography.

Reference:

1. Experimental Biochemistry by BeeduSashidhar Rao& Vijay Deshpande.

BCT13L02 **CHEMICAL ENGINEERING LAB-I** **0 0 3 2**

A) MECHANICAL OPERATIONS

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

B) FLUID MECHANICS

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

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

BEN13L02 QUALITATIVE AND QUANTITATIVE SKILLS (SOFT SKILLS-II) 0 0 0 2

PURPOSE

The purpose of this course is to build confidence and inculcate various Soft skills and to help Students to identify and achieve their personal potential at the end of this training program the participant will be able to, explain the concept of problem solving

- Outline the basic steps in problem solving
- List out the key elements
- Explain the use of tools and techniques in problem solving
- Discuss the personality types and problem solving techniques.
- By adapting different thinking styles in group and lean environment.
- Recognizing and removing barriers to thinking in challenging situations.
- Make better decision through critical thinking and creative problem solving.

METHODOLOGY

The entire program is designed in such a way that every student will participate in the class room activities. The activities are planned to bring out the skills and talents of the students which they will be employing during various occasions in their real life.

1. Group activities + individual activities
2. Collaborative learning
3. Interactive sessions
4. Ensure Participation
5. Empirical Learning

UNIT I :

Self Introduction- Narration – Current News Update – Numbers – Height & Distance – Square & Cube Roots

UNIT II :

Current Tech Update – Verbal Aptitude Test 1 – GD – 1 Odd man out series – Permutation & Combination – Problems on ages

UNIT III :

GD –II – Resume Writing – Mock Interview I / reading comprehension

UNIT IV :

Mock Interview II / reading comprehension – Mock Interview III / reading comprehension – GD – III – Ratio & Proportion – Clocks – H.C.F. &L.C.M

UNIT V :

GD – IV – Verbal Aptitude Test II – Review – Partnership – Puzzels – Test

Total No. of Hrs: 30

REFERENCES

1. Pushplata, Sanjay Kumar (2007) *Communicate or Collapse: A Handbook of Effective Public SpeakingGroup Discussions and Interview* , Prentice – Hall, Delhi
2. Thorpe, Edgar (2003) *Course in Mental Ability and Quantitative Aptitude*, TMHl
3. Thorpe, Edgar (2003) *Test of Reasoning* , Tata McGraw-Hill
4. Prasad, H.M (2001) *How to prepare for Group Discussion and Interview*, TMH
5. Career Press Editors (2003) *101 Great Resumes*, Jaico Publishing House
6. Agarwal, R. S.(2004) *A Modern Approach to Verbal and Non- Verbal Reasoning*, S. Chand & Co.
7. Mishra Sunita and Muralikrishna (2004) *Communication Skills for Engineers* (1st ed.) Pearson

BCT13012 CHEMICAL ENGINEERING THERMODYNAMICS-II 3 0 0 3

OBJECTIVE:

- To provide knowledge of thermodynamic properties of real fluids and mixtures to design chemical process plants.

UNIT - I **9Hrs**

Partial derivaties–exact differentials – Maxwells relations – thermodynamic – properties equation – application to actual gas equation.

UNIT - II **9Hrs**

Residual properties – fugacity – fugacity coefficient - correlation

UNIT – III **9Hrs**

Solutions – actual – ideals – excess free energy – activity – activity coefficients – correlations

UNIT - IV **9Hrs**

V.L.E correlation – data generation – result – gas – liquid system – Henry's law – liquid – liquid , liquid – solid gas – solid equilibrium.

UNIT - V **9Hrs**

Chemical reaction equilibrium – equilibrium constant – calculations

Total No of Hrs: 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..
2. Dodge, B.F., "*ChemicalEngineering Thermodynamics* ", McGraw-Hill, 1
3. Sandler, S.I., "*Chemical and Engineering Thermodynamics* ", 2nd Edition., Wiley.

BCT13013 CHEMICAL REACTION ENGINEERING-I 3 0 0 3

OBJECTIVES:

- To apply knowledge from calculus,differential equationsthermodynamics, general chemistry, and material and energy balances to solve reactor design problems.
- To simulateseveral types of reactors in order tochoose the most appropriate reactor for a given need.
- To design chemical reactors with associated cooling/heating equipment

UNIT - I REACTION KINETICS 9Hrs

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 9Hrs

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 9Hrs

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

UNIT - IV HEAT EFFECTS IN REACTORS 9Hrs

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 AND REACTION EQUILIBRIA 9Hrs

Criteria for stability of reactors, limit cycles and oscillating reaction, parameter sensitivity. 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 No of Hrs: 45

Text Books:

1. Smith.J.M.,*"Chemical Engineering Kinetics "*, McGraw-Hill Third Edition.

References:

2. Levenspiel.O, "*Chemical Reaction Engineering* ", John Wiley, Second Edition.

BCT13014 MASS TRANSFER-I 3 0 0 3

OBJECTIVE:

- Thepurposeofthiscourseistointroducetheundergraduatestudentswith themostimportantseparationequipmentsinthe processindustry.
- To provideproper understandingofUNIToperations.

UNIT - I DIFFUSION 9Hrs

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 9Hrs

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 9Hrs

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

UNIT - IV DRYING 9Hrs

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 9Hrs

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 No of periods: 45

Text Books

1. Treybal, R.E., *" Mass Transfer Operations* ", McGraw-Hill Kogakusha, 1980.
2. McCabe, W.L., Smith, J.C., and Harriot, P., "*UNIT Operations in Chemical Engineering* ", McGraw-Hill Edn, 1993.

References

1. Roman Zarzytci, AndrzaiChacuk, " *Absorption: Fundamentals and Application* ", Pergamon Press, 1993.
2. 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.
3. Coulson, J.M., Richardson, J.F., "*Chemical Engineering*" Vol. I, Pergamon Press, 1977.
4. Foust, A.S.Wenzel, L.A., Clump, C.W.,Naus, L., and Anderson, L.B., "*Principles of UNIT Operations*",Second Edition, Wiley, 1980.

BCT13015 **HEAT TRANSFER** **3 0 0 3**

OBJECTIVE:

- Tounderstandthefundamentalsofheattransfermechanismsinfluidsandsolidsandtheirapplicationsin variousheattransferequipmentinprocessindustries

UNIT - I BASIC PRINCIPLES AND CONDUCTION 9Hrs

Importance of heat transfer in Chemical Engineering operations - Modes of heat transfer - Mean temperature difference. 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 - II FILM COEFFICIENTS AND THEIR APPLICATION 9Hrs

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 - III CONVECTION 9Hrs

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 - IV HEAT EXCHANGERS 9Hrs

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 - V RADIATION AND EVAPORATION 9Hrs

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

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

Total No of Hrs: 45

Text Books

1. McCabe, W.L., Smith, J.C., and Harriot, P., "*UNIT Operations in Chemical Engineering* ", McGraw-Hill Recent Edn.
2. BinayK.Dutta "*Heat Transfer Principles and Applications*", Prentice Hall of India, 2001.
3. Kern, D.Q., *" Process Heat Transfer ", McGraw-Hill* - Revised adition

References

1. Coulson, J.M., Richardson, J.F., "*Chemical Engineering* ", Vol.I.,Pergamon and ECBS.

BMA13019 SPECIAL FUNCTIONS, DIFFERENCE EQUATIONS AND Z-TRANSFORMS **3 1 0 4**

OBJECTIVE:

- The aim of this course is to introduce the concepts of Bessel's & Legendre's equations and Z-Transforms to chemical students

UNIT – I IMPROPER INTEGRALS AND SERIES SOLUTIONS **9Hrs**

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 **9Hrs**

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

UNIT – III LEGENDRE POLYNOMIALS **9Hrs**

Legendre's equation, Legendre Polynomials, Rodrigue's formula generating function, recurrence relations, orthogonality property, Applications to boundary value problems.

UNIT IV HERMITE AND LAGUERRE POLYNOMIALS **9Hrs**

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

UNIT VDIFFERENCE EQUATIONS AND Z-TRANSFORM **9Hrs**

Linear difference equation with constant coefficients, elementary properties of z transform applications of z transform, application of z transform to difference equations.

Total No of Hrs: 45

Text Book

1. Andrews.L.A., " Special Function for Scientist and Engineers ", McGraw-Hill, 1992.

References

1. Narayanan, S.ManicavachagamPillay and Ramanaiah.G, " *Advanced Mathematics for Engineering* Students "Vol II and III S.Viswanathan Printers Private Limited, Madras, 1985.
2. Grewal, B.S., " *Higher Engineering Mathematics* ", Khanna Publishers, Delhi, 1989.
3. Andrews, L.C., and Shivamoggi, B.K., " *Integral Transforms for Engineers and applied Mathematicians* ", MacMillan, New York, 1988.

BCT 13016 CHEMICAL PROCESS EQUIPMENT DESIGN 3 0 0 3

OBJECTIVE

- To acquire basic understanding of design parameter, complete knowledge of design procedures for commonly used process equipment and their attachments (e.g. internal and external pressure vessels, tall vessels, high pressure vessels, supports etc.), and different types of equipment testing methods.

UNIT – I 9Hrs

Design of storage vessels for non-volatile and volatile fluids – design of pressure vessels – design of vessel supports.

UNIT – II 9Hrs

Design of Heat Exchangers – Double pipe – shell & tube – finned tube – plate heat exchangers – design of evaporators – single & multi effect.

UNIT – III 9Hrs

Design of mass transfer operation equipment – Absorber – Distillation column – Plate and packed columns.

UNIT – IV 9Hrs

Design of Dryers – Rotary – Spray dryers – cooling towers

UNIT – V 9Hrs

Design of Agitated vessels – filters – cyclones

Total No. of Hrs: 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.

BCT13L03 MATLAB PROGRAMMING FUNDAMENTALS 0 0 3 2

Introduction - Data types - Common system commands and Mathematical operators.

ARRAYS AND STRUCTURES
Handling of arrays - Cell arrays and structures - Matrices - Strings.

CONTROL STRUCTURES
M-File Scripts - Input/Output function - conditional control statements - Loop control statements.

FUNCTIONS
Workspace - Arguments - Variables - Nested functions.

FILE I/O HANDLING MATLAB
fopen and fclose function - fprintf and fscanf function - Writing, Reading and Loading data.

LIST OF EXERCISES
Writing Programs and Sub Programs using MATLAB for Solving

- Quadratic Equations
- Linear Algebraic Equations - Gauss Seidel, Gauss Jordan, Gauss Elimination
- Jacobi Methods, Cramer's Rule- Multiple Effect Evaporator and Similar Problems
- Polynomial root finding Techniques- Newton Raphson Method, Secant Method
- Regula Falsi Method, Power Method to find dominant Eigen Value
- Phase Equilibrium Problems, Equation of State Determination of Bubble and Dew Point Differential Distillation- Minimum Reflux Ratio Calculations
- Numerical Integration-Trapezoidal Rule, Simpsons 1/3 and 3/8 rule, Weddles Rule
- Mass Transfer Problems- Rayleigh's Equation, NTU in Absorption, Determination of Drying time from batch drying data- Determination of reactor size
- Milne's Method, Laplace Equation, Predictor-Corrector Methods
- Heat conduction problems and chemical reaction Engineering problems

TEXT BOOK

1. Kirani Singh Y. and Chaudhuri B.B., *MATLAB Programming*, Prentice-Hall of India, 2007

REFERENCES

1. Etter, Delores M., *Engineering Problem solving with MATLAB*, Prentice-Hall, 1993

2. Lindfield, George and John Penny, *Numerical Methods Using MATLAB*, Prentice-Hall, 2000

BCT13L04 **CHEMICAL ENGINEERING LAB-II** **0 0 3 2**

A) HEAT TRANSFER

List of Experiments

1. Thermal Conductivity measurement
2. Emissivity mesurement
3. Stefan-Boltzmann Constant verification
4. Thermocouple calibration
5. Natural Convection
6. Forced Convection
7. Parallel Flow Double Pipe Heat Exchanger
8. Counter Flow Double Pipe Heat Exchanger

B) MASS TRANSFER LAB

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. RDC
10. Adsorption
11. Surface Evaporation

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

BCT13017 **PROCESS CONTROL AND DYNAMICS** **3 0 0 3**

OBJECTIVE:

- Togaintheknowledge ofprocessinstruments.
- Tounderstand dynamicmodelingof aphysicalprocessusing firstprinciples.
- Todesignvariouscontrolschemes,andToapply thecontrol systeminvariousprocesses.

UNIT- I **9Hrs**

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 **9Hrs**

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 **9Hrs**

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 **9Hrs**

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 **9Hrs**

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 No of Hrs: 45

Text Books

1. Patranabis .D, *Principles of Process control, II* edition, Tata McGraw Hill Publishing Co Ltd., 1981.
2. PeterHarriott, *Processcontro*l, Tata McGraw Hill Publishing Co., Reprint 2004.

References

1. Thomas, E.Marlin, *Process Control, 2nd*Edn, McGraw Hills International Edn 2000.George Stephanopoulos, Chemical Process Control, Prentice Hall of India 2003.
2. Norman H.CEAGLSKE, *Automatic process control for chemical engineers*, John Wiley & Sons, Japan

BMG13006 PROCESS ECONOMICS AND INDUSTRIAL MANAGEMENT 3 0 0 3

OBJECTIVEs:

- Gives an idea about the process sequences that thrive to get quality raw material to arrive at lowest final product

UNIT - I PRINCIPLES OF MANAGEMENT AND ORGANISATION 9Hrs

Planning, organisation, staffing, coordination, directing, controlling, communicating, organisation as a process and a structure; types of organisations.

UNIT - II PRODUCTION AND MANAGEMENT 9Hrs

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.

UNIT - III INTEREST, INVESTMENT COSTS AND COST ESTIMATION 9Hrs

Time Value of money; capital costs and depreciation, estimation of capital cost, manufacturing costs and working capital, invested capital and profitability. Estimationof project profitability, sensitivity analysis; investment alternatives; replacement policy; forecasting sales; inflation and its impact.

UNIT - IV ANNUAL REPORTS AND ANALYSIS OF PERFORMANCE9Hrs

Principles of accounting; balance sheet; income statement; financial ratios; analysis of performance and growth.Different UNIT operations with single and multiple variables.

UNIT – V QUALITY CONTROL 9Hrs

Elements of quality control, role of control charts in production and quality control. Final product Quality control.

Total No of Hrs: 45

Text Book

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.
3. Shukla, M.C., " *BusinessOrganisation and Management* ", Sultan Chand and Sons, 1975.

References

1. Davis, G.S, "*Chemical Engineering Economics and Decision Analysis* ", CENDC, I.I.T., Madras, 1981.

BCT13018 CHEMICAL REACTION ENGINEERING - II 3 0 0 3

OBJECTIVE:

- Toapplytheknowledgeofmaterial energy balances,masstransferand chemicalreactionengineering– Iforsolving problemsinvolvingheterogeneousreactionsystems .
- Tounderstandandapplytheprinciplesof non-idealflowinthedesignofreactors.

UNIT - I NON-IDEAL REACTORS 9Hrs

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 9Hrs

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 9Hrs

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 9Hrs

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 9Hrs

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 No of Hrs: 45

Text Book

1. Fogler. H.S., "*Elements of Chemical reaction engineering*" 3rd edition, Prentice Hall of India Pvt. Ltd., 1999 (Indians Reprint 2003)

References

1. Levenspiel , O; " *Chemical Reaction Engineering* ", 2nd Edition, John Wiley, 1972.
2. Smith J.M., "*Chemical Engineering Kinetics*", 3rd edition, McGraw-Hill, New York, 1981.

BCT13019 **MASS TRANSFER-II** **3 0 0 3**

OBJECTIVE:

- Toteachthestudentsdifferent separationtechniques and also toknowthedesignofa distillationcolumn.
- To understand the calculationsinvolvedInliquid-liquidextractionand solidliquidextraction.

UNIT - I ABSORPTION **9Hrs**

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 **9Hrs**

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 **9Hrs**

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) **6Hrs**

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

UNIT - V ADSORPTION, ION EXCHANGEAND MISCELLANEOUS SEPARATION PROCESSES **6Hrs**

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

Total No. of Hrs: 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.

BBT13034 **BIOPROCESS PRINCIPLES** **3 0 0 3**

OBJECTIVE:

- To provide broader aspect of bio process calculations, basic principles of bioprocess operations, medium design optimization and bioreactor handling

UNIT - I OVERVIEW OF FERMENTATION PROCESSES 9Hrs

Overview of fermentation industry, general requirements of fermentation processes, basic configuration of fermentor and ancillaries, main parameters to be monitored and controlled in fermentation processes.

UNIT - II RAW MATERIALS AND MEDIA DESIGN FOR FERMENTATION PROCESS 9Hrs

Criteria for good medium, medium requirements for fermentation processes, carbon, nitrogen, minerals, vitamins and other complex nutrients, oxygen requirements, medium formulation of optimal growth and product formation, examples of simple and complex media, design of various commercial media for industrial fermentations – medium optimization methods

UNIT - III STERILIZATION KINETICS 9Hrs

Thermal death kinetics of microorganisms, batch and continuous heat sterilization of liquid media, filter sterilization of liquid media, air sterilization and design of sterilization equipment - batch and continuous.

UNIT - IV METABOLIC STOICHIOMETRY AND ENERGETICS 9Hrs

Stoichiometry of cell growth and product formation, elemental balances, degrees of reduction of substrate and biomass, available electron balances, yield coefficients of biomass and product formation, maintenance coefficients energetic analysis of microbial growth and product formation, oxygen consumption and heat evolution in aerobic cultures, thermodynamic efficiency of growth.

UNIT - V KINETICS OF MICROBIAL GROWTH AND PRODUCT FORMATION 9Hrs

Modes of operation - batch, fed batch and continuous cultivation. Simple unstructured kinetic models for microbial growth, Monod model, growth of filamentous organisms, product formation kinetics - leudeking-piret models, substrate and product inhibition on cell growth and product formation.

Total No. of Hrs: 45

Text Books:

1. Bailey and Ollis, " *Biochemical Engineering Fundamentals*", McGraw Hill (2nd Ed.), 1986.
2. Shule and Kargi, " *Bioprocess Engineering* ", Prentice Hall, 1992.

References:

1. Pauline Doran, Bioprocess Engineering Calculation, Blackwell Scientific Publications.
2. Peter F. Stanbury, Stephen J. Hall & A. Whitaker, Principles of Fermentation Technology, Science & Technology Books.
3. Harvey W. Blanch, Douglas S. Clark, Biochemical Engineering, Marcel Dekker, Inc

BCT13020 TRANSPORT PHENOMENA 3 1 0 4

OBECTIVE:

- This course will provide the fundamentals to solve real life problems involving transports of momentum, energy and mass in biological, mechanical and chemical systems using a unified approach.

UNIT – I PHILOSOPHY AND FUNDAMENTALS OF TRANSPORT PHENOMENA 12Hrs

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 – IITRANSPORT BY MOLECULAR MOTION 12Hrs

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) 12Hrs

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 12Hrs

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 ANALOGIES BETWEEN TRANSPORT PROCESSES 12Hrs

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. ANALOGIES BETWEEN TRANSPORT PROCESSES:Importance of analogy; development and applications of analogies between momentum and mass transfer; Reynolds, Prandtl, Von Karman and Colbum analogies.

Total No of Hrs:60

Text Book

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.

Reference

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.

BCT13L05 CHEMICAL PROCESS EQUIPMENT DESIGN & DRAWING WITH SIMULATION

0 0 3 2

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

1. Fundamental principles, equations, general design and drawing considerations of cooling towers, evaporators and driers.
2. Heat exchangers, condensers and reboilers.
3. Distillation columns- sieve tray, and bubble cap tray columns and packed column.
4. Equipments for absorption and adsorption of gases.
5. Equipments for liquid-liquid extraction and solid-liquid extraction.

BCT13L06 CHEMICAL ENGINEERING LAB-III 0 0 3 2

CHEMICAL RECATION ENGINEERING

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
7. Combined Reactor
8. Packed Bed Reactor
9. Adiabatic Reactor
10. Catalytic Reactor
11. Kinetics in Semi-batch Reactor

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

BMG13002 TOTAL QUALITY MANAGEMENT 3 0 0 3

OBJECTIVE:

- To introduce the main principles of business and social excellence.
- To generate knowledge and skills of students to use models and quality management methodology for the implementation of total quality management in any sphere of business and public sector.

UNIT – I INTRODUCTION 9Hrs

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 9Hrs

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) 9Hrs

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 9Hrs

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 9Hrs

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 No. of Hrs:45

Text Book

1. Dale H.Besterfiled, et at., *Total Quality Management, P*earson Education Asia, 1999 (Indian reprint 2002).

References

1. JaesR.Evans& William M.Lidsay, The Management and Control of Quality, (5th Edition), South-Western (Thomson Learning), 2002 (ISBN 0-324-06680-5).
2. Feigenbaum.A.V. *"Total Quality Managemen*t, McGraw Hill, 1991.
3. Oakland.J.S. "*Total Quality Management Butterworth* – Hcinemann Ltd., Oxford. 1989.
4. Narayana V. and Sreenivasan, N.S. Quality Management – Concepts and Tasks, New Age International 1996.
5. Zeiri. "*Total Quality Management for Engineers* Wood Head Publishers, 1991.

BCT13L07	**PROJECT WORK**	**0**	**0**	**20**	**10**

Project:

Project works are to be done by the students whose duration will be larger than one week.

Criteria for Project Design:

1. Projects suggested by the staff on the basis of collected industrial problem.
2. Projects to cater to development of infrastructure of the department.
3. Projects to cater to preparation for application for funding agents.
4. Projects to cater to obtaining relevant data for doctoral programme.
5. Projects to recalibrate and standardize existing equipment.
6. Projects to establish relevant instrumentation and analytical procedures.
7. Projects to give students an opportunity if they suggest an innovative / alternate approach to the existing solution.

BCT13E01 **FOOD TECHNOLOGY** **3 0 0 3**

OBJECTIVE:

- To enable the students to learn to design processingequipments for Food Industries

UNIT I AN OVERVIEW 5Hrs

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

UNIT II FOOD CONSTITUENTS, QUALITY AND DERIVATIVE FACTORS 14Hrs

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

UNIT III GENERAL ENGINEERING ASPECTS AND PROCESSING METHODS 9Hrs

Preliminary processing methods; conversion and preservation operations.

UNIT IV FOOD PRESERVATION METHODS 12Hrs

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

UNIT V PRODUCTION AND UTILISATION OF FOOD PRODUCTS 14Hrs

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

Total No. of Hrs: 45

TEXT BOOKS:

1. Heid J.L. Joslyn M.A., Fundamentals of Food Processing Operation, TheAVI 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 AVIPublishing Co., Westport, 1963.

BCT13E02AIR POLLUTION AND CONTROL 3 00 3

OBJECTIVE:

- To enable the students to learn about Air Pollution, effects of air pollution.
- Sampling of pollutants, Meteorology and air pollution, atmospheric stability, Plume rise and dispersion and Prediction of air quality

UNIT I INTRODUCTION 9Hrs

Air Pollution Regulatory Framework Histroy – Air Pollution RegulatoryFramework - Regulatory System – Laws and Regulations – Clean air Act – Provisions for Recent Developments.

UNIT II AIR POLLUTION GASES 9Hrs

Measurement fundamentals – chemicals and physical properties – Phase 77 –Equelbonemconsecoation laws – Incinerators – Design and Performance –Operation and Maintainance - Absorbers – Design operation and improving performances Absorbers.

UNIT III PARTICULATE AIR POLLUTION 9Hrs

Particle Collection mechanisms– Fluid particle Dynamics – Particle size Distribution – Efficency – Gravity Setling chambers Cyclones- Electrostatic precepatorsBannouses

UNIT IV HYBRID SYSTEM 9Hrs

Heat electrostatic precepitation – Genizing Heat Scrubbers – Dry Scrubbers –Electrostatically Augmented Fabric Fillration

UNIT V AIR POLLUTION CONTROL EQUIPMENT 9Hrs

Introduction – Installation – Cost Model.

Total No. of Hrs: 45

Text books:

1. Air Pollution Control Engg, Noel de nevey – Mcgrew Hill.

References:

1. Air Pollution Control Equipment Louis Theodore, Burley Intuscence 2008.
2. Air Pollution Control CD Cooper and FC.AlleyWairland Press III Edition2002.

BCT13E03GREEN CHEMISTRY AND ENGINEERING 3 0 0 3

OBJECTIVE:

- To make the students aware of global environmental issues, concepts behindpollution prevention, environmental risks, green chemistry, methods to evaluateenvironmental costs and life cycle assessments.

UNIT I **9Hrs**

Overview of Major Environmental Issues, Global Environmental Issues.AirQuality Issues. Water Quality Issues, Ecology, Natural Resources, Description of Risk. Value of Risk Assessment in the Engineering Profession.Risk-Based Environmental Law. Risk Assessment Concepts. Hazard Assessment. Dose-Response. Risk Characterization.

UNIT II **9Hrs**

Pollution Prevention- Pollution Prevention Concepts and Terminology.ChemicalProcess Safety.Responsibilities for Environmental Protection.EnvironmentalPersistence. Classifying Environmental Risks Based on Chemical Structure. Exposure Assessment for Chemicals in the Ambient Environment.

UNIT III 9Hrs

Green Chemistry.Green Chemistry Methodologies. Quantitative/Optimization- Based Frameworks for the Design of Green Chemical Synthesis Pathways. Green Chemistry Pollution Prevention in Material Selection for UNIT Operations. Pollution Prevention for Chemical Reactors.Pollution Prevention for SeparationDevices.Pollution Prevention Applications for Separative Reactors.PollutionPrevention in Storage Tanks and Fugitive Sources.

UNIT IV **9Hrs**

Process Energy Integration.Process Mass Integration.Case Study of a Process Flow sheet- Estimation of Environmental Fates of Emissions and Wastes.

UNIT V 9Hrs

Magnitudes of Environmental Costs.A Framework for Evaluating EnvironmentalCosts.Hidden Environmental Costs.Liability Costs. Internal Intangible Costs. External Intangible Costs. Introduction to Product Life Cycle Concepts.Life- Cycle Assessment.Life-Cycle Impact Assessments. Streamlined Life-Cycle Assessments.Uses of Life-Cycle Studies.

Total No. of Hrs:45

Textbooks:

1. MukeshDoble and Anil Kumar Kruthiventi, Green Chemistry andEngineering, Elsevier, Burlington, USA, 2007.

References:

2. Allen, D.T., Shonnard, D.R, Green Engineering: Environmentally Conscious Design of Chemical Processes. Prentice Hall PTR 2002.

BCT13E04ENVIRONMENTAL ENGINEERING 3 0 0 3

OBJECTIVE:

- To provide technical expertise in Environmental Engineering which will enable **t**hem to have a career and professional accomplishment in the public or private sector

UNIT I ENVIRONMENT AWARENESS9Hrs
Environment – friendly chemical Process; Hazard and risk analysis; Environmental Audit.

UNIT IICHEMICAL ENGINEERING PROCESSES 9Hrs
UNIT Operations – application of - Abatement of water pollution; Current strategies to control air pollution; Disposal of solid wastes

UNIT IIIRECYCLING METHODOLOGY 9Hrs
Economic recovery and recycling of waste;Transport fuel- Bio-diesel for a cleaner environment.

UNIT IV CLEANTECHNOLOGY 9Hrs
Towards Eco- friendly products of chemical industry; Pesticides –Their transferand Transformation in the environment, Biological and electrochemical
technology for effluent treatments

UNITV POLLUTION PREVENTION 9Hrs
Mass exchange network synthesis for pollution control and minimizationImplications of environmental constraints for process design, policies for regulation of environmental impacts, Concept of common effluent treatment; Environmental legislations, Role of Government and Industries

TOTAL No. of Hrs: 45

TEXTBOOKS:

1. Rao, C.S Environmental Pollution control Engineering, Wiley- Eastern Ltd.1991.
2. Peavy H.S. Rowe D.R., and George Technologious, EnvironmentalEngineering, Mc Graw Hill Book Company, Ny, 1985.
3. Rao M.N and H.V.N. Rao. “Air pollution” ,Tata McGraw Hill Publishing Co.Ltd.1989.Theodore L and Buomlore A.J Air pollution control equipments. Prentice
4. Hall Inc, NY. 1982.

REFERENCES:

1. Coulson, J.M. Richardson, J.F and R.K Sinnott, Chemical Engineering Vol.6, Pergomon Press, 1989.
2. Gilbert M.Mastrs, Introduction to Environmental Engineering and Science,Prentice - Hall of India, New Delhi, 1994.
3. Wahi S.K., Agnihotri A.K and Sharmma J.S (Editors) EnvironmentalManagement in Petroleum Industry, Wiley Eastern Ltd., New Delhi 1996.
4. Smith, R., “Chemical Process Design”, McGraw Hill, New York, 1995.
5. Paul L Bishop (2000) “Pollution Prevention Fundamentals and Practice”, McGraw Hill, International.

BCT13E05 WASTEWATER TREATMENT 3 0 03

OBJECTIVE:

- To focus on the wastewater transport system and the theory and designtechnique for the wastewater treatment process.

UNITI WASTE WATER TREATMENTAN OVERVIEW 9Hrs

Terminology – Regulatios – Health and Environment Concerns in wastewater management – Constituents in waste water inorganic – Organic andmetallic constituents.

UNIT II PROCESS ANALYSIS AND SELECTION 9Hrs

Components of waste water flows – Analysis of Data – Reactors used in wastewater treatment – Mass Balance Analysis – Modeling of ideal and non ideal flowin Reactors – Process Selection.

UNIT III CHEMICAL UNIT PROCESSES 9Hrs

Role of UNIT processes in waste water treatment chemical coagulation –Chemical precipitation for improved plant performance chemical oxidation –Neutralization – Chemical Storage.

UNIT IV BIOLOGICAL TREATMENT9Hrs

Overview of biological Treatment – Microbial metabolism – Bacterial growth andenergatus – Aerobic biological oxidation – Anaerobic fermentation and oxidation– Trickling filters – Rotating biological contractors – Combined aerobicprocesses – Activated sludge film packing.

UNIT V ADVANCED WASTE WATER TREATMENT9Hrs

Technologies used in advanced treatment – Classification of technologiesRemoval of Colloids and suspended particles – Depth Filtration – SurfaceFiltration – Membrane Filtration Absorption – Ion Exchange – Advanced oxidation process.

TOTAL No. of Hrs: 45

Text books:

1. Waste water Engineering Treatment and Reuse: Mc Graw Hill, G.Tchobanoglous, FI Biston, 2002.
2. Industrial Waste Water Management Treatment and Disposal by WasteWater Mc Graw Hill III Edition 2008.

BCT13E06 DRUGS AND PHARMACEUTICAL TECHNOLOGY 3 0 0 3

OBJECTIVE:

- To give the students an understanding of the polytechnical nature ofengineering and drug discovery in the pharmaceutical industry involvingChemical Engineering.

UNIT I INTRODUCTION 9Hrs

Development of drugs and pharamaceutical industry; organic therapeuticagents uses and economics.

UNIT II DRUG METABOLISM AND PHARMACO KINETICS &MICROBIOLOGICAL AND ANIMAL PRODUCTS 9Hrs

Drug metabolism; physico chemical principles; pharma kinetics-action of drugson human bodies. Antibiotics-gram positive, gram negative and broad spectrumantibiotics; hormones

UNIT III IMPORTANT UNIT PROCESSES AND THEIR APPLICATION 9Hrs

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

UNIT IV MANUFACTURING PRINCIPLES & PACKING AND QUALITYCONTROL 9Hrs

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

UNIT V PHARMACEUTICAL PRODUCTS & PHARMACEUTICALANALYSIS 9Hrs

Vitamins; cold remedies; laxatives; analgesics; nonsteroidal contraceptives;external antiseptics; antacids and others. Analytical methods and tests forvarious drugs and pharmaceuticals – spectroscopy, chromatography, fluorimetry, polarimetry, refractometry, pHmetry

TOTAL No. of Hrs: 45

TEXT BOOK:

1. Rawlines, E.A.; " Bentleys Text book of Pharmaceutics ", III Edition, BailliereTindall, London, 1977.

REFERENCES:

1. Yalkonsky, S.H.; Swarbick. J.; " Drug and Pharamaceutical Sciences ", Vol.I, II, III, IV, V, VI and VII, Marcel Dekkar Inc., New York, 1975.
2. "Remingtons Pharmaceutical Sciences ", Mack Publishing Co., 1975.

BCT13E07 **FERTILIZER TECHNOLOGY** **3 0 0 3**

OBJECTIVE:

- To enable the students to learn the fertilizer manufacturing including new ormodified fertilizer products and new techniques

UNIT I NITROGENOUS FERTILISERS **9Hrs**

Methods of production of nitrogenous fertilizer-ammonium sulphate, nitrate,urea and calcium ammonium nitrate; ammonium chloride and their methods ofproduction, characteristics and specifications, storage and handling.

UNIT II PHOSPHATIC FERTILISERS **9Hrs**

Raw materials; phosphate rock, sulphur; pyrites etc., processes for theproduction of sulphuric and phosphoric acids; phosphates fertilizers – groundrock phosphate; bone meal-single superphosphate, triple superphosphate, triplesuperphosphate, thermal phosphates and their methods of production,characteristics and specifications.

UNIT III POTASSIC FERTILISERS **9Hrs**

Methods of production of potassium chloride, potassium sulphatetheircharacteristics and specifications.

UNIT IV COMPLEX AND NPK FERTILISERS **9Hrs**

Methods of production of ammonium phosphate, sulphatediammoniumphosphate, nitrophosphates, urea, ammonium phosphate, mono-ammoniumphosphate and various grades of NPK fertilizers produced in the country.

UNIT V MISCELLANEOUS FERTILISERS **9Hrs**

Mixed fertilizers and granulated mixtures; biofertilisers, nutrients, secondarynutrients and micro nutrients; fluid fertilizers, controlled release fertilizers,controlled release fertilizers.

TOTAL No. of Hrs: 45

TEXT BOOKS:

1. "Handbook of fertilizer technology", Association of India, New Delhi, 1977.
2. Menno, M.G.; "Fertilizer Industry - An Introductory Survey", HigginbothamsPvt. Ltd., 1973.

REFERENCES:

1. Sauchelli, V.; "The Chemistry and Technology of Fertilizers", ACSMONOGRAPH 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.

BCT13E08 **PETROLEUM TECHNOLOGY** **3 0 0 3**

OBJECTIVE:

- To make the students understand petroleum engineering principles, theirapplication to petroleum and natural gas manufacturing problems.

UNIT I INTRODUCTION **9Hrs**

Refinery products – Refinery Feeds – Crude distillation – Coking andthermalprocess.

UNIT II CATALYTIC CRACKING **9Hrs**

Catalytic Cracking - Catalytical hydro cracking – Hydroprocessing and Reusedprocessing hydro treating.

UNIT III CATALYTICAL **9Hrs**

Reforming and isomerization alkylation and polymerization – Product blending –Supporting processes.

UNIT IV LUBRICIATING **9Hrs**

Lubriciating oil blending stocks petrochemical feedstocks.

UNIT V COST EVALUATION **9Hrs**

Cost Evaluation – Economic evaluation of petroleum reused and refineries.

TOTAL No. of Hrs: 45

Text books:

1. Petroleum Refining : Technology and economics CRC Press V Edition 2007J.CH Garry ,Hardward G.E and M.J.Kaiser.

References:

1. Modern Petroleum Technology Upstream Vol I A.G. Lucas Hurley Edition, 2002

BCT13E09PULP AND PAPER TECHNOLOGY 3 0 0 3

OBJECTIVE:

- Focused on papermaking science and technology and is intended to beespecially valuable to students majoring in programs leading to careers incorporate or government positions which would interface with the paper relatedindustries.

UNIT I INTRODUCTION **9Hrs**

Introduction Basic pulp and paper technology – Wood haves dry – Wood as araw material.

UNIT II WOODYARD OPERATION **9Hrs**

Woodyard operation - Mechanical pulping – Chemical pulping – Secondary fibrepulp processing.

UNIT III PAPER MACHINE **9Hrs**

Paper Machine wet and addition paper machine dry and operation –Paper machine - Wet and operation.

UNIT IV PAPER AND PAPERBOARD **9Hrs**

Paper and paperboard frames and products – Surface treatments – Finishingoperation– End uses.

UNIT V PROPERTIES AND TESTING OF PULP AND PAPER **9Hrs**

Properties and Testing of pulp and paper Process control – Quality assurance –Water and air pollution control.

TOTAL No. of Hrs: 45

TEXTBOOK:

1. Pulp and paper chemistry and Technology Monica ER Monica, GoranGellerstcdt Gunnar Hennksson De Gneyter 2009.

BCT13E10 POLYMER TECHNOLOGY 3 00 3

OBJECTIVE:

- To enable the students to compute molecular weight averages from themolecular weight distribution, Condensation polymerization and transition inpolymers

UNIT I INTRODUCTION 6Hrs

History of Macromolecules – structure of natural products like cellulose,rubber, proteins – concepts of macro molecules – Staudinger's theory ofmacromolecules – difference between simple organic molecules andmacromolecules.

UNIT II ADDITION POLYMERIZATION 12Hrs

Chemistry of Olefins and Dienes – double bonds – Chemistry of free radicals –monomers – functionality – Polymerization: Initiation – types of initiation – freeradical polymerization – cationic polymerization – anionic polymerization –coordination polymerization – industrial polymerization – bulk, emulsion,suspension and solution polymerization techniques – Kinetics –Copolymerization concepts.

UNIT III CONDENSATION POLYMERIZATION 9Hrs

Simple condensation reactions – Extension of condensation reactions topolymer synthesis – functional group reactivity – polycondensation – kinetics ofpolycondensation- Carother's equation – Linear polymers by polycondensation– Interfacial polymerization – crosslinked polymers by condensation – gel point.

UNIT IV MOLECULAR WEIGHTS OF POLYMERS 9Hrs

Difference in molecuar weights between simple molecules and polymers –number average and weight average molecular weights – Degree ofpolymerization and molecular weight – molecular weight distribution- Polydispersity – molecular weight determination.Different methods – GelPermeation Chromatography – Osmometry, Light Scattering.

UNIT V TRANSITIONS IN POLYMERS 9Hrs

First and second order transitions – Glass transition, Tg – multiple transitions inpolymers – experimental study – significance of transition temperatures –crystallinity in polymers – effect of crystallization – in polymers – factorsaffecting crystallization crystal nucleation and growth – relationship between Tgand Tm – Relationship between properties and crystalline structure.

TOTAL No. of Hrs: 45

Textbooks:

1. Billmeyer.F.W.,Jr, Text Book of Polymer Science, Ed. Wiley-Interscience,1984.
2. Seymour.R.B., and Carraher.C.E., Jr., Polymer Chemistry, 2nd Ed., MarcelDekker, 1988.
3. Gowariker.V.T., Viswanathan.N.V., and Sreedar.J., Polymer Science, WileyEastern Ltd., 1988.

References:

1. Joel,R.F; Polymer Science and Technology, Eastern Economy Edition,1999.
2. Rodriguez, F., Cohen.C.,Oberic.K and Arches, L.A., Principles of PolymerSystems, 5th edition, Taylor an

BCT13E11FUNDAMENTALS OF NANOSCIENCE 3 0 0 3

OBJECTIVE:

- To enable the students to learn about basis of nanomaterial science,preparation method, types and application

UNIT I INTRODUCTION **8Hrs**

Nanoscale Science and Technology- Implications for Physics, Chemistry,Biology and Engineering-Classifications of nanostructured materials- nanoparticles- quantum dots, nanowires-ultra-thinfilms-multilayered materials.Length Scales involved and effect on properties: Mechanical, Electronic,
Optical, Magnetic and Thermal properties.Introduction to properties andmotivation for study (qualitative only).

UNIT II GENERAL METHODS OF PREPARATION **9Hrs**

Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication,Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition,MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic LayerEpitaxy, MOMBE.

UNIT III NANOMATERIALS **12Hrs**

Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube,Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes(MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes,Plasma CVD), structure-property Relationships applications- Nanometal oxides-ZnO, TiO2,MgO, ZrO2, NiO, nanoalumina, CaO, AgTiO2, Ferrites, Nanoclays9Hrs0functionalization and applications-Quantum wires, Quantum dots-preparation,properties and applications

UNIT IV CHARACTERIZATION TECHNIQUES **9Hrs**

X-ray diffraction technique, Scanning Electron Microscopy –environmental echniques, Transmission Electron Microscopy including high-resolutionimaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMSNanoindentation

UNIT V APPLICATIONS 7

NanoInfoTech: Information storage- nanocomputer, molecular switch, superchip, nanocrystal, Nanobiotechlogy: nanoprobes in medical diagnostics andbiotechnology, Nano medicines, Targetted drug delivery, Bioimaging–MicroElectro Mechanical Systems (MEMS), Nano Electro Mechanical Systems
(NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition,Nanoparticles for sunbarrier products - In Photostat, printing, solar cell, battery

TOTAL No. of Hrs: 45

Textbooks:

1. A.S. Edelstein and R.C. Cammearata, eds., “Nanomaterials: Synthesis,Properties and Applications”, Institute of Physics Publishing, Bristol andPhiladelphia, 1996.
2. N John Dinardo, “Nanoscale charecterisation of surfaces & Interfaces”, 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000

References:

1. G Timp (Editor), “Nanotechnology”, AIP press/Springer, 1999.
2. AkhleshLakhtakia (Editor),“The Hand Book of Nano
Technology,Nanometer Structure, Theory, Modeling and Simulations”.
Prentice-Hall of India (P) Ltd, New Delhi, 2007.

BCT13E12 FRONTIERS OF CHEMICAL ENGINEERING 3 00 3

OBJECTIVE:

- To enable the students to understand the chemical product design andavailable renewable energy resources

UNIT I PROCESS INTENSIFICATION 9Hrs

Novel reactor configurations; combination of reaction and separation; use ofdifferent energy fields, lab on a chip.

UNIT II CHEMICAL PRODUCT DESIGN 9Hrs

Scope and importance; identification of needs and specifications; sources ofideas and screening ideas; selection of product idea; process development forproduct manufacture; specialty chemical manufacture; economic aspects.

UNIT III RENEWABLE ENERGY 9Hrs

Hydrogen production, Hydrogen economy, Fuel Cell Technology, biofuel cellsand bio-hydrogen, solar energy

UNIT IV MATERIALS ENGINEERING 9Hrs

Polymers and composites, ceramics and glasses, colloidal dispersions andnanoparticles, thin films and electronic materials

UNIT V BIOENGINEERING 9Hrs

Biomechanics, biotransport and biomaterials, biomolecular and cellularengineering, drug discovery and development.

TOTAL No. of Hrs: 45

Text Books:

1. Keil, F. J., Modeling of Process Intensification Wiley-VCH Verlag GmbH &Co. KGaA2007
2. Cussler, E.l. and Moggridge, G.D., "Chemical product design" CambridgeUniversity Press, Cambridge, 2001
3. Hoffmann,P, Tomorrow's energy: hydrogen, fuel cells, and the prospects forcleaner planet, MIT Press, Sabon, 2002

References:

1. Mitchell, B.S., An introduction to materials engineering and science for chemical and materials engineers, John Wiley and Sons Inc., New Jersey, 2004

BCT13E13 PROFESSIONAL ETHICS IN ENGINEERING 3 0 0 3

OBJECTIVE:

- To enable the students to create an awareness on Engineering Ethics andHuman Values, to instill Moral and Social Values and Loyalty and to appreciate the rights of others.

UNIT I HUMAN VALUES 10Hrs

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civicvirtue – Respect for others – Living peacefully – Caring – Sharing – Honesty –Courage – Valuing time – Cooperation – Commitment – Empathy – Selfconfidence – Character – Spirituality – Introduction to Yoga and meditation forprofessional excellence and stress management.

UNIT II ENGINEERING ETHICS 9Hrs

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry –Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory –Consensus and Controversy – Models of professional roles - Theories aboutright action – Self-interest – Customs and Religion – Uses of Ethical Theories

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION 9Hrs

Engineering as Experimentation – Engineers as responsible Experimenters –Codes of Ethics – A Balanced Outlook on Law.

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS 9Hrs

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis andReducing Risk - Respect for Authority – Collective Bargaining – Confidentiality– Conflicts of Interest – Occupational Crime – Professional Rights – EmployeeRights – Intellectual Property Rights (IPR) – Discrimination

UNIT V GLOBAL ISSUES 8Hrs

Multinational Corporations – Environmental Ethics – Computer Ethics –Weapons Development – Engineers as Managers – Consulting Engineers –Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility

TOTAL No. of Hrs: 45

Text Books:

1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGrawHill, New Delhi, 2003.
2. Govindarajan M, Natarajan S, SenthilKumar V. S, "Engineering Ethics",Prentice Hall of India, New Delhi, 2004.

References:

1. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, NewJersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "EngineeringEthics – Concepts and Cases", Cengage Learning, 2009
3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education,New Delhi, 2003
4. Edmund G Seebauer and Robert L Barry, "Fundametals of Ethics forScientists and Engineers", Oxford University Press, Oxford, 2001
5. Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making forPersonal Integrity and Social Responsibility" Mc Graw Hill education, IndiaPvt. Ltd.,New Delhi 2013.\
6. World CommUNITy Service Centre, ' Value Education', Vethathiripublications,Erode, 2011

BCT13E14INDUSTRIAL INSTRUMENTATION 3 0 0 3

OBJECTIVE:

- To impart knowledge on measuring of process variables, analyticalinstrumentation, automatic process controls.

UNIT I **5Hrs**

Introduction – Variables, UNITs & standards of measurement, Measurementterms – characteristic. Data Analysis.

UNIT II **12Hrs**

Process Variables Measurement–Temperature systems– Thermocouples,Thermo resistive system, Filled-system thermometers, Radiation thermometry,Location of temperature measuring devices in equipments, Pressure system –Mechanical pressure elements Pressure Transducers and Transmitters,Vacuum measurement, Resonant wire pressure Transducer, Flow system –Differential producers, Variable area flow meters, Velocity, vortex, mass,ultrasonic & other flow meters, positive displacement flow meters, Open –channel flow measurements, Force systems, Strain gauges Humidity Moisturesystem, Humidity Measurement, Moisture measurement system, Rheological system, Viscosity measurement, Radiation system, Nuclear radiationinstrumentation.

UNIT III **12Hrs**

Analytical instrumentation – Analysis instruments, Sample conditioning forprocess analyzers, X-ray Analytical methods, Quadrupole mass spectrometry,Ultra violet Absorption Analysis, Infra red process analyzers, Photometricreaction product analysers Oxygen analyzers, Oxidation – reduction potential lmeasurements, pH measuring systems, Electrical conductivity and Resistivitymeasurements, Thermal conductivity, gas analysis, Combustible, Total hydrocarbon, and CO analyzer, Chromatography.

UNIT IV **9Hrs**

Fundamentals of Automatic process control – Control algorithms-Automaticcontrollers – Electronic controllers -Electric controllers (Traditional) – Hydrauliccontrollers – Fluidics - Programmable controllers.

UNIT V **7Hrs**

Sensors, Transmitters and control valves - Pressure, Flow, Level, Temperatureand Composition sensors, Transmitters, Pneumatic and electronic controlvalves, Types, Actuator, accessories, Instrumentation symbols and Labels.

TOTAL No. of Hrs: 45

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Textbooks:

1. Fribance, “Industrial Instrumentation Fundamentals” ,Mc Graw Hill Co. Inc.New York 1985
2. Eckman D.P. “Industrial Instrumentation”, Wiley Eastern Ltd., 1989.
3. Considine D M and Considine G D “Process Instruments Controls”Handbook 3rd Edition, McGraw – Hill Book Co., NY, 1990.
4. Scborg D E,.Edgar T.F and Mellichamp D.A, “Process Dynamics andControl” John Wiley 1989.

References:

1. Ernest Doebelin, Measurement systems, McGraw – Hill Book, Co., NY,1975.
2. Astrom K.J., Bjonwittenmark, Computer controlled systems, Prentice- Hallof India, New Delhi 1994.
3. Cartis Johnson, Process Control Instrumentation Technology, Prentice-Hallof India, New Delhi 1993.

BCT13E15 SAFETY IN CHEMICAL PROCESS INDUSTRIES 3 0 03

OBJECTIVES

- To impart the principles of safety in chemical process operations.
- To educate the students the importance of safety procedures and safety regulations in chemical industries.

UNIT I :INTRODUCTION **9Hrs**

Safety in industries – need for development – importance of safety consciousness in Indian Chemical Industry – social environmental setup – Tolerance limit of the society – Psychological attitude towards safety programmes

UNIT II: SAFETY PROGRAMMES **9Hrs**

Elements of safety programmes – Effective realization – Economic and social benefits – Effective communication training at various levels of production and operation.

UNIT III : SAFETY PERFORMANCE **9Hrs**

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 equipment.

UNIT IV: ACCIDENTS **9Hrs**

Industrial accidents – accident costs – identification of accident spots – remedial measure – 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 V: HEALTH HAZARDS AND LEGAL ASPECTS **9Hrs**

Health hazards – occupational – Industrial health hazards – health Standards and rules – safe working environments – parliamentary legislation – Factories act – Labor Welfare Act – ESI Act – Workmen Compensation Act.

Total No of Hrs:45

Text Book

1. William Handley, *Industrial Safety Hand Book*, Mc Graw-Hill Book Company, 2nd edition, 1969.
2. Fawatt, H.H and Wood, W.S., *Safety and Accident Prevention in Chemical operation*, Inter-science, 1965.

Reference

1. Heinrich, H.W, Dan Perterson, P.E and Nester Rood, *Industrial Accident Prevention*, McGraw- Hill, 1980.
2.Blake, R.P., *Industrial Safety*, PHI, III ed, 1963.