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DEPARTMENT OF CHEMICAL ENGINEERING

B.Tech- Chemical Engineering – Part Time
2013 Regulation

I SEMESTER						
S.NO	**Sub.Code**	**Title of Subject**	**L**	**T**	**P**	**C**
1.	BMA 13024	Mathematics-I	3	1	0	4
2.	BPH 13005	Physics	3	0	0	3
3.	BCH 13005	Chemistry – I	3	0	0	3
4.	BME 13044	Engineering Graphics	1	0	3	4
		Total	**10**	**1**	**3**	**14**

II SEMESTER						
S.NO	**Sub.Code**	**Title of Subject**	**L**	**T**	**P**	**C**
1.	BMA 13025	Mathametics II for civil and chemical Engineers	3	1	0	4
2.	BEE 13031	Basic Electrical and Electronics	3	0	0	3
3.	BCT 13001	Mechanical Engineering	3	0	0	3
4.	BCE13030	Mechanics of Solids	3	0	0	3
5.	BCH 13006	Chemistry II	3	0	0	3
		Total	**15**	**1**	**0**	**16**

III SEMESTER						
S.NO	**Sub.Code**	**Title of Subject**	**L**	**T**	**P**	**C**
1.	BCT 13003	Computer Application	2	1	1	3
2.	BEE 13034	Electrical Technology	3	0	0	3
3.	BCT 13004	Introduction to chemical process Industries	3	0	0	3
4.	BCT 13005	Chemical Technology	3	0	0	3
5.	BCT 13006	Process in organic synthesis	3	0	0	3
		Total	**14**	**1**	**1**	**15**

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IV SEMESTER						
S.NO	**Sub.Code**	**Title of Subject**	**L**	**T**	**P**	**C**
1.	BCT 13008	Chemical Process Calculation	3	0	0	3
2.	BCT 13009	Chemical Engineering Thermodynamics - I	3	0	0	3
3.	BCT 13011	Fluid Mechanics	3	0	0	3
4.	BCT 13010	Chemical Technology II	3	0	0	3
5.	BCT 13007	Mechanical Operations	3	0	0	3
		Total	**15**	**0**	**0**	**15**

V SEMESTER						
S.NO	**Sub.Code**	**Title of Subject**	**L**	**T**	**P**	**C**
1.	BCT 13012	Chemical Engineering Thermodynamics –II	3	0	0	3
2.	BCT 13013	Chemical Reaction Engineering – I	3	0	0	3
3.	BCT 13014	Mass Transfer – I	3	0	0	3
4.	BCT 13015	Heat Transfer	3	0	0	3
5.	BCT 13017	Process Control and Dynamics	3	0	0	3
		Total	**15**	**0**	**0**	**15**

VI SEMESTER						
S.NO	**Sub.Code**	**Title of Subject**	**L**	**T**	**P**	**C**
1.	BCT 13018	Chemical Reaction Engineering – II	3	0	0	3
2.	BCT 13019	Mass Transfer – II	3	0	0	3
3.	BCT 13020	Transport Phenomena	3	0	0	3
4.	BCT 13021	Safety in Chemical Process Industries	3	0	0	3
5.	BCE 13031	Environmental Science and Engineering	3	0	0	3
		Total	**15**	**0**	**0**	**15**

VII SEMESTER						
S.NO	**Sub.Code**	**Title of Subject**	**L**	**T**	**P**	**C**
1.	BCT 13016	Chemical Process Equipment Design	3	0	0	3
2.	BMG 13002	Elective-I	3	0	0	3
3.	BCT 13L07	Industrial projects with computer simulation	0	0	6	9
		Total	**6**	**0**	**6**	**15**

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I+II+III+IV+V+VI+VII=14+16+15+15+!5+15+!5= **105**
Total credits earned for the award of the degree : 105

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 Nano Science	3	0	0	3
12	BCT13E12	Frontiers of Chemical Engineering	3	0	0	3
13	BCT13E13	Professional Ethics in Engineering	3	0	0	3
14	BCT13E14	Industrial Instrumentation	3	0	0	3
15	BMG13002	Total Quality Management	3	0	0	3

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DEPARTMENT OF CHEMICAL ENGINEERING

SEMESTER I

BMA13024 MATHEMATICS I 3 1 0 4

OBJECTIVE:

- The aim of this course is to introduce the concepts of Matrices, Analytic functions and, Fourier series to chemical students.

UNIT I MATRICES 12 Hrs

Characteristic equation – Eigen values and Eigen vectors of a real matrix – Properties of Eigen values – Cayley - Hamilton theorem (without proof) – Orthogonal reduction of a symmetric matrix to Diagonal form.

UNIT II DIFFERENTIAL EQUATIONS 12Hrs

Linear differential equations of second order with constant coefficients – Euler's equation – Simultaneous equations of first order with constant coefficients.

UNIT III 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 IV 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)

UNIT V FOURIER SERIES 12Hrs

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

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).

Refernces:

1. Singaravelu, *Transforms and Partial Differential Equations*, Meenakshi Agency, (2009).
2. Kreyszig E., *Advanced Engineering Mathematics (9 th ed.)*, John Wiley & Sons, (2011).
3. Grewal B.S., *Higher Engineering Mathematics*, Khanna Publishers, (2012).

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DEPARTMENT OF CHEMICAL ENGINEERING

BPH13005 **PHYSICS** **3 0 0 3**

OBJECTIVE:

- To introduce the basic physics concepts relevant to different branches of Engineering and Technology

UNIT I PROPERTIES OF MATTER 9Hrs

Elasticity – Stress-Strain diagram – Factors affecting elasticity – Twisting couple in a wire – Torsion Pendulum – Determination of Moment of Inertia and Rigidity Modulus – Bending Moment – Depression of a Cantilever – Determination of Young's Modulus by uniform and non-uniform bending – I shaped girders.

UNIT II ACCOUSTICS AND ULTRASONICS 9Hrs

Classification of sound – Characteristics of musical sound – Units of Loudness – decibel and phone – intensity of sound – Acoustic Pressure – Acoustics of Building – Reverberation time – Sabine's formula – absorption coefficient – sound absorbing materials – sound insulation in machines – ultrasonic – production, properties and applications.

UNIT III OPTICS AND LASERS 9Hrs

Principles of interference – coherent sources – Young's double slit experiment – Expression for band width – Fresbek's biprism – Fresnel and Fraunhofer diffraction – Plane diffraction grating – Theory and determination of wave lengths – Polarization – Double refraction – Nicol Prism – Production and analysis of different polarized lights – Optical activity – Polarimeter – Principle and characterization of LASER – He-Ne LASER – Application of LASER

UNIT IV MODERN PHYSICS 9Hrs

Quantum nature of energy – Dual nature of Matter – Einstein's Mass – Energy relation – Nuclear fission – Controlled chain reaction – Nuclear power reactor – Nuclear fusion – Crystalline and Non-Crystalline solids – Unit cell and Bravais Lattices – Miller indices – Packing factors of SC, BCC and FCC.

UNIT V NON-DESTRUCTIVE TESTING 9Hrs

Different steps involved in Non-destructive testing – Principles of X-ray radiographic techniques – Comparison between X-ray radiography and Gamma ray radiography – Liquid penetrant method – Ultrasonic method – Magnetic and electrical methods.

Total no. of Hrs: 45

Text Books:

1. Arumugam. M., "Engineering Physics", Anuradha Publishers, 1998.
2. Srinivasan, M.R., "Physics for Engineers", New Age International (P) Ltd., 1998.
3. Kin Sleer. L. E and Frey, A.R., "Fundamentals of Acoustics", Weilye Eastern Ltd., 1996.
4. Woodcock, J.P., "Ultrasonics", Adam Hilger Ltd., 1979.
5. Mcgonnagle, W.U., "Non-destructive Testing Methods", McGraw Hill Book Co., 1961

References:

1. Masilamani, V and Azzeer, A. M., "Laser the light extraordinary", Anuradha Agencies, 1999.
2. Halliday, Resnick and Krane, "Physics Vol.II, John Wiley and Sons (P) Ltd., 1994.

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DEPARTMENT OF CHEMICAL ENGINEERING

BCH13005 **CHEMISTRY - I** **3 0 0 3**

OBJECTIVE:

- To get an insight into energy sources and to understand the basics relevant to polymer materials and to control pollution

UNIT – I WATER 9Hrs

Sources and impurities – hardness of water – expression and estimation by EDTA – treatment of Water for boilers – Lime soda, Zealot and De-ionization Process – Internal treatment of boiler Water – Domestic Water Treatment – Coagulation, filtration and disinfecting – Reverse Osmosis.

UNIT – II ENERGY SOURCES 9Hrs

Classification of fuels – Gross and net Calorific Values – Proximate Analysis of Coal – Manufacture of coke – Refining of Petroleum – Cracking – Thermal and Catalytic – Petrol Knocking, Octane number – Unleaded Petrol – Diesel Knocking, Cetane number – Water Gas, Producer Gas and Bio-gas.

UNIT – III CORROSION AND ITS CONTROL 9Hrs

Corrosion – Chemical and Electrochemical – Factors affecting Electrochemical corrosion – Surface Anode, impressed current Cathodic protection – Surface Treatments and protective Coatings – Oil paint – Specail paints – Heat Resistant, fire retardant and luminous.

UNIT – IV POLYMERIC MATERIALS 9Hrs

Polymers – Addition and condensation – Thermoplastics and Thermosetting plastics – Preparation and uses of Polythene, PVC, Teflon, Terylene and Bakelite – Compounding of Plastics – natural Rubber – Vulcanization of Rubber – Synthetic Rubbers – Butyl, Nutrile and Styrene – Butadiene Rubber – Adhesives – Epoxides, urethanes and silicones.

UNIT – V POLLUTION AND ITS CONTROL 9Hrs

Causes of air and Water pollution – primary and secondary pollutants – Assessment of Water pollution – Definition and significance of BOD, DO and COD – Primary and Secondary treatment of Sewage – Environmental impact on Acid Rain, Green House Effect and Global Warming, Ozone Depletion – Smog – Pollution control by Cottrell Precipitator, Bio-filter and absorption towers.

Total no. of Hrs: 45

Text books:

1. M.R. Balasubramanian, S. Krishnamurthy and V.Murugesan, "Engineering Chemistry", Allied Publishers Ltd., 1993.
2. M.Karunanidhi, N. Ayyaswami, T. Ramachandran and H. Venkatraman, "Applied Chemistry", Anuradha Agencies.

References:

1. P.C.Jain and Monik Jain, Engineering Chemistry, Dhanpath Raj and sons, Delhi 1993.
2. C.Daniel Yesudasan, "Engineering Chemistry", Hi-tech Publications, 1999.

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DEPARTMENT OF CHEMICAL ENGINEERING

BME13044 **ENGINEERING GRAPHICS** **1 0 3 4**

OBJECTIVES:

- To develop graphic skills for communications of concepts, ideas and design of Engineering products and expose to pictorial view of simple machines with basic commands.

UNIT – I PROJECTION OF POINTS, LINES AND PLANE SURFACES 9Hrs

Size layout and folding of drawing sheets – lettering and dimensioning – Orthographic projection of points – Projection of straight lines – Projection of planes

UNIT – II PROJECTION OF SOLIDS 9Hrs

Projections of simple solids like prism, pyramid, cylinder, cone and sphere – selection of solids like prism, pyramid, cylinder, cone and sphere in simple positions.

UNIT – III DEVELOPMENT OF SURFACES AND ISOMETRIC PROJECTION 9Hrs

Development of surfaces of solids – Prism, pyramids, cylinder, cone, sphere and cut solids

UNIT – IV ORTHOGRAPHIC PROJECTION 9Hrs

Isometric projections of solids (for simple objects)

UNIT – V COMPUTER AIDED DRAFTING 9Hrs

Conversion of pictorial view to orthographic view of simple machine members – Basic Auto-CAD commands.

Total no. of Hrs: 45

TEXT BOOKS:

1. Venugopal, K. “Engineering Drawing and Graphics”, New Age International, Reprint, 2002.

REFERENCES:

1. N.D.Bhatt, “Elementary Engineering Drawing”, (first angle projection), Charotar Publishing Co., anand, 2003.
2. K.R. Gopalkrishnan, “Engineering Drawing”, Suba Publications, Bangalore, 2002.

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DEPARTMENT OF CHEMICAL ENGINEERING

SEMESTER II

BMA 13025 MATHEMATICS II FOR CIVIL AND CHEMICAL ENGINEERS 3 1 0 4

OBJECTIVE:

- The aim of this course is to introduce the concepts of Partial differential equations and, Transform methods for chemical students.

UNIT I PARTIAL DIFFERENTIAL EQUATIONS 12Hrs

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

UNIT II 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 III LAPLACE TRANSFORMS I 12Hrs

Transforms of simple functions – Properties of Transforms – Inverse Transforms – Transforms of Derivatives and Integrals.

UNIT IV LAPLACE TRANSFORMS II 12Hrs

Periodic functions – Initial and final value theorems – Convolution theorem – Applications of Laplace transforms for solving linear ordinary differential equations up to second order with constant coefficients.

UNIT V FOURIER TRANSFORM 12Hrs

Statement of Fourier integral theorem – Fourier transform pairs – Fourier Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's theorem.

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).

REFERENCES

1. Singaravelu, *Transforms and Partial Differential Equations*, Meenakshi Agency, (2009).
2. Kreyszig E., *Advanced Engineering Mathematics (9 th ed.)*, John Wiley & Sons, (2011).
3. Grewal B.S., *Higher Engineering Mathematics*, Khanna Publishers, (2012).

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DEPARTMENT OF CHEMICAL ENGINEERING

BEE13031 BASIC ELECTRICAL AND ELECTRONICS 3 0 0 3

OBJECTIVE:

- To gain knowledge on circuit systems and digital measuring instruments required for instrumental analysis for chemical students

UNIT I DC CIRCUITS 9Hrs

Definition of electrical quantities – electric circuits – Kirchoff's laws- voltage division and current division – star- delta transformation- solution to simple circuits.

MAGNETIC CIRCUITS – Definition of Magnetic quantities – leakage flux and fringing effect – Magnetic circuit analysis – core losses – self inductance and mutual inductance – coefficient of coupling – Faraday's laws of induction – induced EMF

UNIT II AC FUNDAMENALS 9Hrs

Generation of alternating EMF – RMS and average value of periodic wave forms –Form factor and peek factor – Phase and Phase difference.

AC CIRCUITS: Representation of AC quantities in rectangular and polar form Analysis of RL, RC and RLC series AC circuits – Power and power factor. Three phase circuits – Line and phase values (analysis of balanced system only)

UNIT III ELECTRONICS 9Hrs

PN junction diode –Construction and Characteristics – Rectifier circuits –Zener diode- Voltage regulation – Bipolar junction trandidtors – Construction and Characteristics – common base and common emitter circuits – Transistor as an amplifier – Transistor as a switch.

UNIT IV DIGITAL SYSTEMS 9Hrs

Number system: Binary system, Decimal to binary, Octal system, Hexadecimal system, Binary – addition, subtraction, multiplication and division.

Logic gates; OR, AND, Exclusive – OR, NOR, NOT, NAND gates. Logic networks, Gate standardization, simple combinational logic circuits.

UNIT V MEASURING INSTRUMENTS: 9Hrs

Classification of measuring instruments Basic principles of indicating instruments- constructional details and working pf PMMC , MI and Dynamometer tupe instruments as voltmeter/ammeter/wattmeter – Construction and working of single phase energy meter-Cathode ray oscilloscope.

Tranducers: Classification – LVDT –Strain guage – Hall effect transducers – piezo – electric and photo – electric transducers.

Total no. of Hrs: 45

TEXT BOOKS:

1. "*Hughes Electrical technology*", revised by 1MC kenzie smith, low price edition, Pearson Education, Seventh edition (2001).

REFERENCES

1. R.Muthusubramanium, S.Salivahanana, K.A.Muraleedharan, "*Basic Electric and Computer Engineering",* Tata Mcraw Hill Publishing company, (2000)
2. T. Thygarajan, K.P.Sendur Chelvi, T.R.Rangaswamy, "*Engineering Basic Electrical, Electronics and computer engineering",* New age international (p) Limited, (1997)
3. M.S.Naidu, S.Kamashaiah, " *Indroductionto Electrical Engineering'* , Tata McGraw Hill Publishing Company, (2000).

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DEPARTMENT OF CHEMICAL ENGINEERING

BCT13001 MECHANICAL ENGINEERING 3 0 0 3

OBJECTIVE:

- To get insight into thermodynamic concepts and to study about properties of various engine systems

UNIT I LAWS OF THERMODYNAMICS 9Hrs

Basic concepts and hints; Zeroth law; First Law of Thermodynamics - Statement and application; Steady flow energy equation; Second law of Thermodynamics - Statement; Limitations Heat Engine; Heat Pump, Available energy, Kelvin - Plank statement and Clausius statement; Equivalence entropy; Reversibility: Entropy charts; Third law of Thermodynamics - Statement.

UNIT II HEATING AND EXPANSION OF GASES AND AIR STANDARD EFFICIENCY 9Hrs

Expressions for; work done; Internal energy, Hyperbolic and polytropic processes; Free expansion and Throttling. Carnot cycle; Stirlings Cycle: Joule Cycle; Otto Cycle; Diesel Cycle; Dual combustion Cycle.

UNIT III I.C. ENGINES, STEAM AND ITS PROPERTIES 9Hrs

Engine nomenclature and classifications; SI Engine: CI Engine; Four Stroke cycle' Two stroke cycle; Performance of I.C. Engine; Brake thermal efficiency; Indicated Thermal Efficiency, Specific fuel consumption.

Properties of steam; Dryness fraction; latent heat; Total heat of wet steam; Superheated steam. Use of steam tables; volume of wet steam; Volume of superheated steam; External work of evaporation; Internal energy; Entropy of vapour, Expansion of vapour, Rankine cycle; Modified Rankine cycle.

UNIT IV STEAM ENGINES AND TURBINES AND SIMPLE MECHANIS 9Hrs

Hypothetical indicator diagram of steam engine; Working of a simple steam engine; steam turbines - Impulse and Reaction types - Principles of operation.

Kinematic Link, Kinematic Pair Kinematic Chain; Slider Crank mechanism and inversions; Double slider crank mechanism and inversions.

UNIT V FLY WHEEL, DRIVES AND BALANCING 9Hrs

Turning moment Diagram; Fluctuation of Energy; Design of fly wheel.Belt and rope drives; Velocity ratio; slip; Ratio of tensions; Length of belt; Maximum HP; simple compound and Epicyclic gear trains.Balancing of rotating masses in same plane; Balancing of masses rotating in different planes.

Total no. of Hrs: 45

TEXT BOOKS:

1. Smith, "Chemical Thermodynamics ", Reinhold Publishing Co., 1977.
2. Bhaskaran, K.A., and Venkatesh, A., "Engineering Thermodynamics ", Tata McGraw Hill, 1973.

REFERENCES:

1. Pandya A. and Shah, "Theory of Machines ", Charatakar Publishers, 1975.
2. Nag, P.E., " Engineering Thermodynamics ", II Edition, Tata McGraw Hill Publishing Co., Ltd., 1995.

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DEPARTMENT OF CHEMICAL ENGINEERING

BCE 13030 **MECHANICS OF SOLIDS** **3 0 0 3**

OBJECTIVE:

- A knowledge of statics and dynamics will be helpful to students to understand the stability of the structures suited for given chemical plant operation

UNIT I STRESS, STRAIN AND DEFORMATION OF SOLIDS **9Hrs**

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

UNIT II TRANSVERSE LOADING ON BEAMS **9Hrs**

Beams – support conditions – tupes of beams –transverse loading on beams –shear force and bending moment in beams – analysis of cantilevers, simply –supported beams and over hanging beams-relationships between loading, S.F and B.M in beams and their applications – S.F & B.M. diagrams.
DEFLECTION OF BEAMS: Double integration method – Macaulay's method –Area – mement theorems for computation of slopes and deflections in beams –conjugate beam method.

UNIT III STRESSES IN BEAMS **9Hrs**

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

UNIT 4 TORSION **9Hrs**

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

UNIT 5 COLUMNS **9Hrs**

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

Total no. of Hrs: 45

TEXT BOOK:

1. Junarkar, S.B., " *Mechanics of Structures*", Vol.1 21 st Edition, Character Publishing Housing, nand, India. (1995)

REFERNCE:

1. William A. Nash,*" Theory and problems of strength of materials"* Schaum's Outline Serious, McGraw Hill International Editions, 3 rd edition,1994.

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DEPARTMENT OF CHEMICAL ENGINEERING

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

OBJECTIVE

To understand the phase changes which will be help to understand the thermodynamic, heat transfer and mass transfer applications, also to know about the specialty materials

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

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

UNIT III PHARMACEUTICAL 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 – Electro kinetic phenomena - Donnan Membrane equilibrium -Emulsions - Gels - colloidal electrolytes.

UNIT V PHOTOCHEMISTRY 9Hrs

Laws of Photochemistry, Quantum efficiency, Photo chemical 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.Nagin Chand and Company, Delhi (1994).
2. Kund and Jain, " Physical Chemistry ", S. Chand and Company, Delhi (1996).
3. Gordon M.Barrow, " Physical Chemistry ", Sixth Edition, Tata McGraw Hill (1998).
4. Agarwal, O.P.," Synthetic Organic Chemistry ", Vth Edition, 1980-81, Goel Publishing house, Meerut.
5. Ashutoshkar, " Medicinal Organic Chemistry ",NewAge International Private Ltd., 1993, Chennai.

REFERENCES:

1. Bahl, B.S. and Arun Bahl, " Advanced Organic Chemistry ", IIIrd Edition(1994),Sultan Chand and sons, New Delhi.
2. Mrs. Lakshmi, S., " Pharmaceutical Chemistry ", First Edition (1995),Sultan Chand and Sons, New Delhi.
3. Morrison, R.T. and Boyd, R.N., " Organic Chemistry ", VI Edition,Prentice Hall Inc.(1996), USA.
4. Tiwari, K.S., Vishnoi, N.K. and Vishnoi, S.N., " A Text book of Organic Chemistry ",Second Edition, Vikas Publishing House (1998), New Delhi.

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DEPARTMENT OF CHEMICAL ENGINEERING

SEMESTER III

BCT 13003 COMPUTER APPLICATIONS 2 1 1 3

OBJECTIVE

- To give an introduction about the various programming languages and their applications in chemical engineering

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. Jerry, O., Breneman, G.L., *"Spreadsheet Chemistry "*, Prentice Hall, Englewood Cliffs, 1991.

REFERENCES

1. Hanna, O.T., Scandell, O.C., *"Computational Methods in Chemical Engineering "*,Prentice Hall, 1995.
2. Taxali, R.K., T.K., *"dBase IV made simple "*, Tata McGraw Hill 1991.
3. Myers, A.L., Seider W.D., *"Introduction to Chemical Engineering and Computer Calculations "*.

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DEPARTMENT OF CHEMICAL ENGINEERING

BEE 13034 ELECTRICAL TECHNOLOGY 3 0 0 3

OBJECTIVE

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

UNIT I DC CIRCUITS 9Hrs

Introduction - circuit parameters - Kirchhoff's laws - circuit reduction techniques - The venin'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 -

Constructiona 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 V ELECTRICAL 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 McGraw Hill, 2001.

REFERENCES:

1. J.A.Edminister, *" Theory and Problems on Electrical Circuits"* McGraw Hill, 1994.
2. I.J.Nagrath & D.P.Kothari, *"Electrical Machines"* , TMH publications

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DEPARTMENT OF CHEMICAL ENGINEERING

BCT 13004 INTRODUCTION TO CHEMICAL PROCESS INDUSTRIES 3 0 0 3

OBJECTIVE

- To make the students understand the basic requirements of chemical 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 – important metals 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

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DEPARTMENT OF CHEMICAL ENGINEERING

BCT 13005 CHEMICAL TECHNOLOGY – I 3 0 0 3

OBJECTIVES

- To introduce history, importance and components of chemical engineering.
- T o introduce concepts of unit operations and unit processes, and current scenario of chemical & allied process industries.

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 and 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 and Revised 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.

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DEPARTMENT OF CHEMICAL ENGINEERING

BCT13006 **PROCESS 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: INTRODUCTION TO UNIT PROCESS OF NITATION, AMINATION BY REDUCTION AND HALOGENATION **9Hrs**
Thermodynamic and kinetic concepts, nitration, amination by reduction ,halogenation

UNIT II: UNIT PROCESS ON SULFONATION, AMINATION BY AMMONOLYSIS AND OXIDATION **9Hrs**
Sulfonation, amination by ammonolysis, oxidation

UNIT III: UNIT PROCESS ON HYDROGENATION AND HYDROFORMYLATION
Hydrogenation, hydrocarbon synthesis , hydroformylation **9Hrs**

UNIT IV: UNIT PROCESS ON ESTERIFICATION, HYDROLYSIS AND ALKYLATION **9Hrs**
Esterification, hydrolysis , alkylation

UNIT IV: **PRINCIPLES OF POLYMER CHEMISTRY** **9Hrs**
Polymer chemistry, polymerisation

Total No. of Hrs: 45

TEXT BOOK:

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

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DEPARTMENT OF CHEMICAL ENGINEERING

SEMESTER IV

BCT 13008 CHEMICAL PROCESS CALCULATIONS 3 0 0 3

OBJECTIVE

- To introduce students the use of data sources for physical and chemical properties.
- To help them to do the calculation which is needed for the design or analysis of Chemical processing operations.

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 II;MATERIAL 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 III:HUMIDITY 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 IV :FUELS 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 V : THERMO 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 Hrs: 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.

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DEPARTMENT OF CHEMICAL ENGINEERING

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 FUNDAMENTAL CONCEPTS IN THERMODYNAMICS 9Hrs

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

UNIT - II FIRST LAW OF THERMODYNAMICS 9Hrs

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

UNIT - III SECOND LAW OF THERMODYNAMICS 9Hrs

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

UNIT - IV REFRIGERATION AND LIQUEFACTION 9Hrs

Heat engines – refrigeration – cycles.

UNIT – V THERMODYNAMIC PROPERTIES OF FLUIDS 9Hrs

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

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

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DEPARTMENT OF CHEMICAL ENGINEERING

BCT 13011 **FLUID MECHANICS** **3 0 0 3**

OBJECTIVE

- To understand basic concept of fluid flow and its application to chemical process industries including pipe flow, fluid machinery and agitation and mixing.

UNIT I INTRODUCTION **9Hrs**

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

UNIT II FLUID STATICS **9Hrs**

Application to manometry – Floatation – gravity settling – centrifugal separation – acceleration.

UNIT III FLOW OF FLUIDS **9Hrs**

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

UNIT IV COMPRESSIBLE FLUID FLOW **9Hrs**

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

UNIT V INDUSTRIAL PIPING **9Hrs**

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

Total No of Hrs: 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.

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DEPARTMENT OF CHEMICAL ENGINEERING

BCT 13010 CHEMICAL TECHNOLOGY-II 3 0 0 3

OBJECTIVE

- To make the students understand the various unit operations and unit processes practiced in chemical 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 II SUGAR, STARCH INDUSTRIESAND 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 Hrs: 45

Text Books

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

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.

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DEPARTMENT OF CHEMICAL ENGINEERING

BCT 13007 **MECHANICAL OPERATIONS** **3 0 0 3**

OBJECTIVE

- To make the students familiar with basic principles of practical size measurement and distribution.
- To acquire basic knowledge in practical technology and phenomena revalant to specific surface of particles.

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

General characteristics of solids, their behaviour 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.

UNITV 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.

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DEPARTMENT OF CHEMICAL ENGINEERING

SEMESTER V

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 APPLICATION OF THERMODYNAMICS TO GAS EQUATIONS 9Hrs

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

UNIT II FUGACITY CORRELATIONS 9Hrs

Residual properties – fugacity – fugacity coefficient - correlation

UNIT III SOLUTION THERMODYNAMIC THERORY 9Hrs

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

UNIT IV V.L.E FROM EQUATION OF STATES 9Hrs

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

UNIT V CHEMICAL REACTION EQUILIBRIA 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.

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DEPARTMENT OF CHEMICAL ENGINEERING

BCT 13013 CHEMICAL REACTION ENGINEERING-I 3 0 0 3

OBJECTIVES:

- To apply knowledge from calculus, differential equations, thermodynamics, general chemistry, and material and energy balances to solve reactor design problems.
- To examine reaction rate data to determine rate laws, and to use them to design chemical reactors.
- To simulate several types of reactors in order to choose 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. Levenspiel.O, *" Chemical Reaction Engineering "*, John Wiley, Second Edition, 1972.

REFERENCES

1. Smith.J.M., *" Chemical Engineering Kinetics "*, McGraw-Hill Third Edition, 1981.

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DEPARTMENT OF CHEMICAL ENGINEERING

BCT 13014 **MASS TRANSFER-I** **3 0 0 3**

OBJECTIVES

- The purpose of this course is to introduce the undergraduate students with the most important separation equipments in the process industry.
- To provide proper understanding of unit operations.

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 Hrs: 45

Text Books

1. McCabe, W.L., Smith, J.C., and Harriot, P., *" Unit Operations in Chemical Engineering "*, McGraw-Hill Edn, 1993.
2. Coulson, J.M., Richardson, J.F., *" Chemical Engineering* " Vol. I, Pergamon Press, 1977.
3. Foust, A.S.Wenzel, L.A., Clump, C.W., Naus, L., and Anderson, L.B., *" Principles of Unit Operations* ",Second Edition, Wiley, 1980.

References

1. Treybal, R.E., *" Mass Transfer Operations "*, McGraw-Hill Kogakusha, 1980.
2. Roman Zarzytci, Andrzai Chacuk, *" Absorption: Fundamentals and Application "*, Pergamon Press, 1993.
3. 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.

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DEPARTMENT OF CHEMICAL ENGINEERING

BCT 13015 **HEAT TRANSFER** **3 0 0 3**

OBJECTIVE:

- To understand the fundamentals of heat transfer mechanisms in fluids and solids and their applications in various heat transfer equipment in process industries.

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. Binay K.Dutta *"Heat Transfer Principles and Applications*", Prentice Hall of India, 2001.
3. Kern, D.Q., *" Process Heat Transfer "*, McGraw-Hill - Revised adition - 1999.

REFERENCES

1. Coulson, J.M., Richardson, J.F., " *Chemical Engineering* ", Vol.I., Pergamon and ECBS, 1970.

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DEPARTMENT OF CHEMICAL ENGINEERING

BCT13017 PROCESS CONTROL AND DYNAMICS 3 0 0 3

OBJECTIVE:

- To gain the knowledge of process instruments.
- To understand dynamic modeling of a physical process using first principles.
- To design various control schemes and to apply the control system in various processes.

UNIT I RESPONSE OF FIRST ORDER SYSTEM 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 THE CONTROL SYSTEM 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 CLOSED LOOP TRANFER FUNCTIONS 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 CONTROL SYSTEM DESIGN BY FREQUENCY RESPON 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 ADVANCED CONTRO SYSTEM 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

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DEPARTMENT OF CHEMICAL ENGINEERING

SEMESTER-VI

BCT 13018 CHEMICAL REACTION ENGINEERING - II 3 0 0 3

OBJECTIVE

- To apply knowledge of material and enery balance of chemical reaction engg I for solving problems of heterogeneous reaction and designing reactors.

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.

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DEPARTMENT OF CHEMICAL ENGINEERING

BCT 13019 **MASS TRANSFER-II** **3 0 0 3**

OBJECTIVE

- The subject provides knowledge to design anequipment used in separation process, which in turn has direct impact on the cost of final product.

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) **9Hrs**

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

UNIT V ADSORPTION, ION EXCHANGE AND MISCELLANEOUS SEPARATION PROCESSES **9Hrs**

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*", Pergamo 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.

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DEPARTMENT OF CHEMICAL ENGINEERING

BCT 13020 TRANSPORT PHENOMENA 3 0 0 3

OBJECTIVE:

- The topic emphasises on development and application of various analysis .
- To give a clear picture of solving problems based on transport process in industries.

UNIT I PHILOSOPHY AND FUNDAMENTALS OF TRANSPORT PHENOMENA 9Hrs

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

UNIT II TRANSPORT BY MOLECULAR MOTION 9Hrs

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) 9Hrs

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 9Hrs

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 9Hrs

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 over flat 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:45

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.
4.

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DEPARTMENT OF CHEMICAL ENGINEERING

BCT 13021 SAFETY IN CHEMICAL PROCESS INDUSTRIES 3 0 0 3

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.

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DEPARTMENT OF CHEMICAL ENGINEERING

BCT 13031 ENVIRONMENTAL SCIENCE AND ENGINEERING 3 0 0 3

OBJECTIVE

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

UNIT I AIR POLLUTION 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 WATER POLLUTION 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 SOIL POLLUTION 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 NOISE POLLUTION 9Hrs

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

UNITV ABATEMENT TECHNOLOGY 9Hrs

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

Total No of Hrs: 45

TEXT BOOKS:

1. *Industrial chemistry* by Dr.B.K.Sharma 7th edition.

REFERENCE:

1.Introduction to Environmental Engineering and Science by Gilbert M.Masters, Prentice Hall, 2004.

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DEPARTMENT OF CHEMICAL ENGINEERING

SEMESTER VII

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 VESSELS AND ITS SUPPORTS 9Hrs

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

UNIT II HEAT EXCHANGERS AND EVAPORATORS 9Hrs

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

UNIT III ABSORBER AND DISTILLATION COLUMN 9Hrs

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

UNIT IV DRYERS AND COOLING TOWERS 9Hrs

Design of Dryers – Rotary – Spray dryers – cooling towers

UNIT V AGITATED VESSELS, FILTERS AND CYCLONES 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.

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DEPARTMENT OF CHEMICAL ENGINEERING

BCT 13L07 **PROJECT WORK** **0 0 6 9**

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.

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DEPARTMENT OF CHEMICAL ENGINEERING

ELECTIVES

BCT13E01 FOOD TECHNOLOGY 3 0 0 3

OBJECTIVE:

- To enable the students to learn to design processing equipments for Food Industries

UNIT I AN OVERVIEW 9Hrs

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

UNIT II FOOD CONSTITUENTS, QUALITY AND DERIVATIVE FACTORS 9Hrs

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 9Hrs

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 9Hrs

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

Total 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.

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DEPARTMENT OF CHEMICAL ENGINEERING

BCT13E02 **AIR POLLUTION AND CONTROL** **3 0 0 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 Regulatory Framework - 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 –Equelbonem consecoation 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.

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DEPARTMENT OF CHEMICAL ENGINEERING

BCT13E03 GREEN 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 ENVIRONMENTAL ISSUES AND ASSESMENT 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 PREVENSION OF POLLUTION 9Hrs

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

UNIT III GREEN CHEMISTRY PRINCIPLES 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 WASTE PRODUCTION, PROBLEMS AND PREVENSION 9Hrs

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

UNIT V MEASURING AND CONTROLLING ENVIRONMENTAL PERFORMANCE 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.

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DEPARTMENT OF CHEMICAL ENGINEERING

BCT13E04 ENVIRONMENTAL 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 AWARENESS 9Hrs

Environment – friendly chemical Process; Hazard and risk analysis; Environmental Audit.

UNIT II CHEMICAL ENGINEERING PROCESSES 9Hrs

UNIT Operations – application of - Abatement of water pollution; Current strategies to control air pollution; Disposal of solid wastes

UNIT III RECYCLING 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 transfer and Transformation in the environment, Biological and electrochemical
technology for effluent treatments

UNITV POLLUTION PREVENTION 9Hrs

Mass exchange network synthesis for pollution control and minimization Implications 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, Environmental Engineering, 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.

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DEPARTMENT OF CHEMICAL ENGINEERING

BCT13E05 **WASTE WATER TREATMENT** **3 0 03**

OBJECTIVE:

- To focus on the wastewater transport system and the theory and design technique 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 and metallic 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 flow in 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 TREATMENT **9Hrs**

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

UNIT V ADVANCED WASTE WATER TREATMENT **9Hrs**

Technologies used in advanced treatment – Classification of technologies. Removal 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.

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DEPARTMENT OF CHEMICAL ENGINEERING

BCT13E06 DRUGS AND PHARMACEUTICAL TECHNOLOGY 3 0 0 3

OBJECTIVE:

- To give the students an understanding of the polytechnical nature of engineering and drug discovery in the pharmaceutical industry involving chemical engineering.

UNIT I INTRODUCTION 9Hrs

Development of drugs and pharamaceutical industry; organic therapeutic agents 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; advancement in 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.

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DEPARTMENT OF CHEMICAL ENGINEERING

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 the production 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 sulphat their characteristics and specifications.

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

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

UNIT V MISCELLANEOUS FERTILISERS **9Hrs**

Mixed fertilizers and granulated mixtures; biofertilisers, nutrients, secondary nutrients 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.

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DEPARTMENT OF CHEMICAL ENGINEERING

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

OBJECTIVE:

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

UNIT I INTRODUCTION **9Hrs**
Refinery products – Refinery Feeds – crude distillation – Coking and thermal process.

UNIT II CATALYTIC CRACKING **9Hrs**
Catalytic Cracking - Catalytical hydro cracking – Hydro processing and Reused processing 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

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BCT13E09 **PULP 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, Goran Gellerstcdt Gunnar Hennksson De Gneyter 2009.

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DEPARTMENT OF CHEMICAL ENGINEERING

BCT13E10 POLYMER TECHNOLOGY 3 00 3

OBJECTIVE:

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

UNIT I INTRODUCTION 6Hrs

History of Macromolecules – structure of natural products like cellulose, rubber, proteins – concepts of macro molecules – Staudinger's theory of macromolecules – 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 to polymer synthesis – functional group reactivity – polycondensation – kinetics of polycondensation- 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 of polymerization 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.

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DEPARTMENT OF CHEMICAL ENGINEERING

BCT13E11 FUNDAMENTALS 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 9Hrs

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 9Hrs

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 9Hrs

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.

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DEPARTMENT OF CHEMICAL ENGINEERING

BCT13E12 FRONTIERS OF CHEMICAL ENGINEERING 3 0 0 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

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DEPARTMENT OF CHEMICAL ENGINEERING

BCT13E13 PROFESSIONAL ETHICS IN ENGINEERING 3 0 0 3

OBJECTIVE:

- To enable the students to create an awareness on Engineering Ethics and Human 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

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DEPARTMENT OF CHEMICAL ENGINEERING

BCT13E14 INDUSTRIAL INSTRUMENTATION 3 0 0 3

OBJECTIVE:

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

UNIT I MEASUREMENT 5Hrs

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

UNIT II MEASUREMNT OF PARAMETERS 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 Moisture system, Humidity Measurement, Moisture measurement system, Rheological system, Viscosity measurement, Radiation system, Nuclear radiation instrumentation.

UNIT III ANALYTICAL INSTRUMENTATION 12Hrs

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

UNIT IV FUNDAMENTALS OF CONTROL SYSTEMS 9Hrs

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

UNIT V SENSOR AND TRANSMITTERS 7Hrs

Sensors, Transmitters and control valves - Pressure, Flow, Level, Temperature and Composition sensors, Transmitters, Pneumatic and electronic control valves, 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.

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DEPARTMENT OF CHEMICAL ENGINEERING

BMG13002 TOTAL QUALITY MANAGEMENT 3 0 0 3

OBJECTIVE

- TQM provides idea about quality aspects of a raw material, process and final product, inclusive of marketing and sales.

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*, Pearson Education Asia, 1999. (Indian reprint 2002).

REFERENCES

1. James R.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 Management,* 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.