

B.TECH.-II (CHEMICAL) 3rd SEMESTER SCHEME FOR TEACHING AND EXAMINATION

CS: Core Subject

EIS: Elective Interdisciplinary Subject

ES: Elective Subject (from Department)

IS: Interdisciplinary Subject

Sr. No.	Course	Code	Credits	Teaching Scheme			Examination Scheme						Total Marks
				Hours per Week			Theory				Practicals		
				L	Tu	Pr	Hr	Sessional	Tu	End Sem	Sessional	End Sem	
1	Engineering Chemistry-II (IS-1)	CY 201	5	3	1	2	2	50	25	50	20	30	175
2	Engineering Mathematics-III (IS-2)	MH 210	5	4	1	0	2	50	25	50	---	---	125
3	Solid Mechanics (IS-3)	AM 203	5	4	0	2	2	50	---	50	20	30	150
4	Chemical Engineering Materials (CS-1)	CH 201	4	3	1	0	2	50	25	50	---	---	125
5	Unit Processes (CS-2)	CH 203	3	3	0	0	2	50	---	50	---	---	100
	TOTAL		22	17	3	4		250	75	250	40	60	675
Total contact hours per week = 24				Total Credit = 22				Total marks = 675					

Corrected copy 05/10/2007

B.TECH.-II (CHEMICAL) 4th SEMESTER SCHEME FOR TEACHING AND EXAMINATION

Sr. No.	Course	Code	Credits	Teaching Scheme			Examination Scheme						Total Marks
				Hours per Week			Theory				Practicals		
				L	Tu	Pr	Hr	Sess ional	Tu	End Sem	Sess ional	End Sem	
1	Electrical Technology (IS-1)	EE 214	4	3	0	2	2	50	---	50	20	30	150
2	Engineering Chemistry-III (IS-2)	CY 202	5	3	1	2	2	50	25	50	20	30	175
3	Theory of Machines and Machine Design (IS-3)	ME 214	5	3	1	2	2	50	25	50	20	30	175
4	General Chemical Technology (CS-1)	CH 202	5	3	1	2	2	50	25	50	20	30	175
5	Process Calculations (CS-2)	CH 204	4	3	1	0	2	50	25	50	---	---	125
	TOTAL		23	15	4	8		250	100	250	80	120	800
Total contact hours per week = 27				Total Credit = 23				Total marks = 800					

CY 201: ENGINEERING CHEMISTRY - II

3 1 2 5

- **SEPARATION METHODS** (06 Hours)
Concepts of precipitation, fractional distillation, fractional crystallization, electrodeposition, electro-dialysis, reverse osmosis, distribution (partition coefficient), Chromatography – Basic concepts; paper chromatography and thin layer chromatography with suitable examples.
 - **CHEMICAL ANALYSIS OF WATER** (04 Hours)
Specifications of water; cooling water (Langelier Index and its treatment); tertiary waste water treatment; introduction to heavy water and rain water harvesting.
 - **ORGANIC CHEMISTRY** (11Hours)
Preparation, properties and uses of alcohols (ethanol, ethylene glycol, glycerol). Carbohydrates – structures, stereochemistry and reactions of monosaccharides (glucose and fructose), disaccharides (sucrose and maltose), polysaccharides (starch and cellulose). Peptides and proteins - general methods of protein structure determination with suitable examples; introduction to enzymes. Basic concepts of drug design; some drug types (antimalarials, antibiotics, antiseptic), structure and synthesis; antimalarials (4 and 8 anthraquinolines), antiseptics, antibiotics (chloramphenicol, penicillin). Newer concepts of dyes development/high-tech dyes (Liquid crystalline, fluorescent, biomedicinal dyes), natural and photochromic dyes.
 - **INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS** (06 Hours)
Instrumental methods of chemical analysis (Basic concepts and relevant applications); Spectroscopic methods – IR, UV- Visible, and fluorescence spectroscopy. TGA, DTA, DC polarography. Significant figures and expression of data.
 - **POLYMERS** (06 Hours)
Engineering polymers, plastics, composites and their characterization. Novel functional polymers-processing and applications.
 - **NEW APPROACH IN CHEMISTRY** (06 Hours)
Green chemical technology with few examples. Photochemical reactions: basic concepts and relevant Examples. Some aspects of supramolecular chemistry
 - **REACTIONS AND MECHANISMS** (06 Hours)
Organic reactions and mechanisms: types of organic reactions; general methods of getting mechanisms, mechanism of ionic, free radical and isopolar reactions
- (Total Contact Hours: 45)**

PRACTICALS:

1. Separation of SO_4^{2-} from NO_3^- by BaSO_4 precipitation.
2. Determination of total dissolved solids in a given water sample by Conductometric method.
3. Separation of Cu^{2+} from Ni^{2+} by Electrodeposition.
4. Spectrophotometric analysis of any two important impurities of water like Ca^{2+} , Mg^{2+} , Fe^{2+} , NO_3^- , NO_2^- , PO_4^{3-} , CO_3^{2-} , Cl^- , SO_4^{2-}
5. Organic spotting of Salicylic acid, Naphthalene, Aniline, Glycerol etc.
6. Electrogravimetric analysis of Cu in Non-ferrous alloys like brass.
7. Estimation of HCl and HAc using Conductometric acid – base titration.
8. Coulometric titration of As_2O_3 by Internal generation of I_2 .
9. Separation of Amino acids by Paper Chromatography.
10. To determine the specific rotation of given substance using different concentration of sucrose.

BOOKS RECOMMENDED:

1. Chawla S., "Text Book of Engineering Chemistry", Dhanpat Rai & Co. Pvt. Ltd., Delhi, 2003.
2. Sharma B. K., "Engineering Chemistry", Krishna Prakashan Media (P) Ltd, Meerut., 2001
3. Ewing G. W., "Instrumental Methods of Chemical Analysis", Tata-McGraw Hill., New Delhi, 2001.
4. Khopkar S. M., "Basis Concept of Analytical Chemistry", New Age International Publishers, 1998.
5. Vogel A. I., "A Text Book of Quantitative Chemical Analysis", ELBS UK, 5th Edition, 1996.
6. Billmeyer F. W., "A Text Book of Polymer Science", Wiley Interscience, New York, 3rd ed., 1984.

- **CALCULUS, MULTIPLE INTEGRALS** (08 Hours)
Reorientation of concepts of integrals, Double and Triple integrals, evaluation techniques, change of order of Integration, change of variable, Application of double and triple integrals for evaluation of area, volume and mass.
- **BASIC CONCEPTS OF VECTOR CALCULUS** (08 Hours)
Line Integrals, scalar and vector point function, differential operator, gradient, directional derivative, physical meaning of gradient, divergence, curl and Laplacian with their properties, Surface Integral, Volume integral, Green's, Gauss and Stoke's theorem & application.
- **FOURIER SERIES** (06 Hours)
Definition, Fourier series with arbitrary period, in particular periodic function with period 2π . Fourier series of even and odd function, Half range Fourier series.
- **PARTIAL DIFFERENTIAL EQUATION** (06 Hours)
Second order pde of mathematical physics (Heat, wave and Laplace equation, one dimensional with standard boundary conditions, solution by separation of variable method using Fourier series.
- **FOURIER INTEGRAL & TRANSFORM** (06 Hours)
Fourier Integral theorem, Fourier sine and cosine integral complex form of integral, Inversion formula for Fourier transforms, Fourier transforms of the derivative of a function, Application of Fourier transforms to boundary value problems.
- **COMPLEX VARIABLES** (08 Hours)
Basic mathematical concept, Analytic function, C – R equations, Harmonic functions, its applications, Linear transformation of complex domain, some special transformation, bilinear transformations, conformal mapping and its application, complex integration including contour integration.
- **ELEMENTS OF STATISTICS & PROBABILITY** (08 Hours)
Correlation between two variable, application of correlation, evaluation of coefficients of correlation, Rank correlation, Regression, frequency distribution, Binomial, Poisson's distribution and Normal distribution, application to industrial problem, Test of significance, Chi-square (χ^2) test, student's t Test, application of the t-test, F-distribution.

(Total Contact Hours: 50)

BOOKS RECOMMENDED :

1. Kreyszing E., "Advanced Engineering Mathematics", John Wiley & Sons, Singapore, Int. Student Ed. 1995.
2. Wiley C. R., "Advanced Engineering Mathematics", McGraw Hill Inc., New York Ed. 1993.
3. O'Neel Peter., "Advanced Engg. Mathematics", Thompson, Singapore, Ind. Ed. 2002.
4. Greenbar Michael D., "Advanced Engg. Mathematics", Pearson, Singapore, Ind. Ed. 2007.
5. Ramana D. V., "Higher Engg. Mathematics", The McGraw-Hill Inc., New Delhi, 2007.

- **STRESSES AND STRAINS** (Hours-06)
Concept of stresses and strains – Types of stresses – Hook's Law – Lateral strain – Poisson's ratio – Elongation due to own weight – Tapering sections – Varying cross sections – Composite sections – Relation between Modulus of Elasticity, Modulus of Rigidity and Bulk Modulus – Thermal Stresses – Eccentric load – Limit of eccentricity – Core /Kernel of the section.
- **SHEAR FORCE DIAGRAM AND BENDING MOMENT DIAGRAM** (Hours-06)
Types of beams – Types of supports – Types of loads – shear force – Bending moment – Sign conventions – Overhanging beams – Point of contraflexure – Varying loads – Relation between SF and BM.
- **STRESSES IN BEAMS** (Hours-06)
Theory of simple bending – Moment of Resistance – Beam of Uniform strength – Flitched beams – Shear stress concept – Derivation of shear stress – Shear stress variation in rectangular, circular, T-section and I – section
- **SPRINGS** (Hours-04)
Types of springs – Close coiled helical spring subjected to axial load and twist – Leaf springs – Semi elliptical and Quarter elliptical leaf springs
- **PRINCIPAL STRESSES** (Hours-02)
Principal plane – Principal stress – Tangential and normal stress – Derivation of Major and Minor principal stresses for different cases – Mohr's circle graphical method
- **THEORIES OF FAILURE** (Hours-02)
- **THIN CYLINDERS** (Hours-04)
Stresses in cylinders – Thin cylinders and thin spheres – Volumetric strain – Wire wound thin cylinders.
- **WELDED JOINTS** (Hours -02)
- **TORSION** (Hours-06)
Basic theory of Torsion – Solid shaft – Hollow shaft – Power transmitted by shaft – Composite shafts
- **COLUMN AND STRUTS** (Hours-06)
Euler's theory for columns – Different end conditions – Rankine's formula – Limitations of Euler's theory
- **STRAIN ENERGY** (Hours-04)
Strain energy – Resilience – Strain energy due to Tension and compression - Strain energy due to freely falling load

PRACTICALS

1. Tension Test on MS and CI specimens
2. Torsion Test on MS Specimen
3. Charpy Impact Test
4. Transverse Test on Wooden beam
5. Spring Test
6. Compression test on CI Columns
7. Shear Strength Test
8. Hardness Test

BOOKS RECOMMENDED:

1. Timoshenko S & Young D H "Elements of Strength of Materials", Tata Mc Graw Hill, New Delhi, 2006.
2. Ryder G H, "Strength of Material", English Language Book Society, New Delhi, 2006
3. Bhavikatti S S "Strength of Materials", Vikas Publication House, New Delhi, 2007
4. Egar P. Popov & Toader A . Balan "Engineering Mechanics of Solids" 2nd Edition, Prentice Hall of India Pvt Ltd, New Delhi, 2002
5. Beer F. P. & Johnston S J, "Strength of Materials" Tata Mc Graw Hill Publication, New Delhi, 2004

CH 201: CHEMICAL ENGINEERING MATERIALS**3 1 0 4**

- **CONCEPTS FROM PHYSICAL METALLURGY** (08 Hours)

Structure of atoms and molecules, Bonding in solids, Crystal structure, Methods of determination of structures, Imperfection in crystals, Solid phases and phase diagrams, solid solutions, Fick's law.

- **MECHANICAL PROPERTIES** (08 Hours)

Structure of high polymers phase transformation, deformation of metals, creep, fracture, fatigue, radiation damage equilibrium diagrams, iron-carbon diagrams.

- **ENGINEERING PROPERTIES** (04 Hours)

Methods of fabrication of materials like timber, plastics, rubber, fibers and other polymeric materials.

- **FERROUS METALS** (06 Hours)

Pig iron, Cast iron, Wrought iron, Steel, Alloy steels, Effects of alloying elements.

- **NON-FERROUS METALS AND ALLOYS** (04 Hours)

Aluminum, Copper, Lead, Tin, Bearing metals, Zinc, Nickel.

- **INORGANIC, ORGANIC AND OTHER MATERIALS** (07 Hours)

Crystalline and non-crystalline ceramic systems, Glass and porcelain enamels, Cement refractories, Ceramics.

- **CORROSION AND ITS PREVENTION** (08 Hours)

Protective coatings, chemical principles involved. Factors determining the choice of materials of construction in chemical industries.

(Total Contact Hours:**45)****BOOKS RECOMMENDED:**

1. ZasterZebski D., "Nature and Properties of Engineering Materials", John Wiley & Sons, 2nd Edition, 1976.
2. Rumford F., "Chemical Engineering Materials", Constable and Company Limited, 2nd Edition, 1987.
3. Vlack V., 'Elements of Material Science & Engineering Structures, Properties and Performance', Wesley Publishing Company, 2nd Edition, 1964.
4. Chaudhry H., 'Chemical Engineering Materials' Indian Book Distributing Company, 2nd Edition, Delhi, 1982.
5. Lee and Evans, 'Selecting Engineering Materials for Chemical and Process Plants', Business Works, 1978.

CH 203: UNIT PROCESSES**3 0 0 3**

- **INTRODUCTION** **(4 Hours)**
Definition and importance of Unit processes in Chemical Engg., Outlines of unit processes, and operations, Chemical process kinetics and Factors affecting it, Symbols used in Chem. Engg. Process flow diagram.
 - **NITRATION** **(5 Hours)**
Definition & scope of nitration reactions, Nitrating agents, Aromatic Nitration (Schimid and Biazzi; nitrators) mixed acid for nitration, D.V.S. value and nitric reaction, Comparison of batch Vs. Cont. nitration, Mfg. of Nitrobenzene, Dinitrobenzene, O-and P-Chloronitrobenzene.
 - **AMINATION BY REDUCTION** **(6 Hours)**
Definition & scope of Amination reactions, various methods of reductions and factors affecting it, Batch and Cont. process for manufacture of Aniline from Nitrobenzene, Cont. process for Mfg. of Aniline from nitrobenzene using catalytic fluidized bed reactor, M/c. in such processes.
 - **HALOGENATION** **(6 Hours)**
Definition and scope of various halogenation reactions, Halogenating agents Industrial halogenation with types of equipment's and its materials M/c. MFG. of Chlorobenzene, Benzene hexa-chloride and vinyl chloride from Ethylene and Acetylene.
 - **SULFONATION AND SULFATION** **(3 Hours)**
Definition and scope of such reactions, sulfonating and sulfating agents and their applications, Chemical and physical factors affecting it. Industrial equipments and techniques for batch Vs. Cont. sulfonation, Mfg. of Benzene sulfonates, Sulfation of Dimethyl Ether and Lauryl Alcohol.
 - **AMINATION BY AMMONOLYSIS** **(3 Hours)**
Definition & types of reactions, Aminating agents, Physical and Chemical factors affecting it. Catalyst used in Ammonolysis, Mfg. of Aniline from chlorobenzene and Nitroaniline from Dichloro Nitro Aniline.
 - **OXIDATION** **(5 Hours)**
Definition and Types, Oxidizing agents, Liquid phase oxidation with oxidizing agents and oxygen. Oxidation of toluene with MnO_2 . Mfg. of Acetaldehyde from Acetic acid and mfg. of Acetic acid from Ethanol. Vapor phase oxidation of Methanol, Benzene and Naphthalene, Apparatus and its M/s. for oxidation reactions.
 - **HYDROGENATION** **(5 Hours)**
Definition and its scope, properties of hydrogen and sources of hydrogen, gas catalytic hydrogenation and hydrogenolysis, factors affecting it, Apparatus and M/c., Industrial hydrogenation of fat & oil, Mfg. of Methanol from CO_2 & H_2 .
 - **HYDROLYSIS** **(3 Hours)**
Definition and types of hydrolysis, Hydrolyzing agents, equipment's of hydrolysis, Industrial Hydrolysis of fat, hydrolysis of carbohydrates, starch to dextrose, Mfg. of ethanol from ethylene (shell process) Mfg. of phenol from benzene sulfonic.
 - **POLYMERIZATION** **(5 Hours)**
Introduction & chemistry of polymerization reactions, classifications of polymers methods of polymerization.
- (Total contact time : 45 Hours)**

BOOKS RECOMMENDED:

1. Groggins P. H., "Unit Processing of Organic Synthesis", 5th edition, Tata-McGraw Hill, New Delhi, 2001.
2. Gopal Rao. M. & Sittig M., "Dryden's Outlines of Chemical Tech.", 2nd Ed., East-West Pub., New Delhi, 1997.
3. Austin G. T., "Shreve's Chemical Process Industries", 5th Ed. McGraw-Hill Pub., 1994.
4. Felder R.M., Rousseau R.W., "Elementary Principles of Chemical Processes", 3rd ed., John Wiley, New York, 2000.
5. Kent J.A., "Riggel's Handbook of Industrial Chemistry", Van Nostrand Reinhold, 1974.

EE 214: ELECTRICAL TECHNOLOGY**3 0 2 4**

- **D.C. MACHINES** (08 Hours)
Construction, windings, EMF, torque and power equations, circuit model, Generating and Motoring modes, introduction to armature reaction, Types of generators and motors and their characteristics, Efficiency and Losses, Speed control of D C motors
- **TRANSFORMERS** (07 Hours)
Review of equivalent circuit, no load and short circuit tests, per unit system, voltage regulation, Efficiency, Auto-transformer, three phase transformers, star and delta connection.
- **INDUCTION MACHINE** (06 Hours)
Review of equivalent circuit, torque speed characteristics, No load and blocked rotor tests, load test, efficiency and losses , starting, Braking & speed control.
- **SYNCHRONOUS-MACHINE** (07Hours)
Construction and basic principals, EMF equation, Synchronous speed, armature reaction, synchronous reactance, voltage regulation, vector diagram for generating and motoring modes, synchronous motor starting, Synchronous condensers.
- **SPECIAL MACHINE** (06 Hours)
Theory, performance and applications of Servo motors, Stepper motors.
- **ELECTRICAL MEASUREMENT AND INSTRUMENTS** (04 Hours)
Principles of measurement of voltage, current, Power, Energy, Electrical parameters and measuring instruments.
- **PRINCIPLES OF ELECTRICAL POWER SYSTEMS** (03 Hours)
Generation of Electrical power, transmission of Electrical power, distribution of Electrical power .
- **ECONOMIC ASPECTS OF POWER SYSTEM** (04 Hours)
Cost of Generation and Supply (Tariff), Power factor and its effect on system economy, power factor improvement.

(Total Contact Hours: 45)**PRACTICALS:**

1. Speed control of D.C. shunt motor.
2. Speed –Torque Characteristics of D.C. Shunt motor.
3. D.C. Series motor N.T. characteristics.
4. D.C. Generator Characteristics.
5. Efficiency and regulation of 1 phase Transformer from O.C. and S.C. test .
6. Load test on Induction motor.
7. Circle –diagram.
8. Regulation of an alternator by synchronous impedance method.
9. V and inverted V curve .
10. Calibration of single phase energy meter.

BOOKS RECOMMENDED:

1. Mehta, V.K., "Principles of Power System" S. Chand & Co., New Delhi, 2005
2. Husain A., "Fundamentals of Electrical Engineering", Dhanpat Rai & Co., Delhi, 2001
3. Bimbhra P.S., "Electrical machinery", Khanna Pub., Delhi, 1998
4. Mukherjee P.K., Chakravorti S., "Electrical Machines" Dhanpat Rai & Co., Delhi, 2001
5. Thereja B.L., & Thereja A.K., "A Text Book of Electrical Technology", S. Chand & Co., New Delhi, 2005

CY 202: ENGINEERING CHEMISTRY - III

3 1 2 5

-
- **SEPARATION TECHNIQUES AND STRUCTURAL CHARACTERIZATION** (10 Hours)
Introductory discussion of mass, GC, HPLC, GC-MS, PMR, XRD, SEM, TEM.
 - **CHEMICAL KINETICS** (04 Hours)
Chemical equilibrium, determination of rate and order of reaction, ultra fast processes, kinetics of enzyme catalysis
 - **THERMODYNAMICS** (04 Hours)
Laws of thermodynamics, Clapeyron clausius equation, carnot cycle
 - **SURFACE CHEMISTRY** (05 Hours)
Roughness and friction lubricants, absorption adsorption isotherms, catalysis, surface characterization, organic assemblies; synthesis, structure, property and application of nanoparticles
 - **A.FUELS** (10 Hours)
Classification, characteristics, combustion, calorific value and its determination by Bomb and Bouy's calorimeters, theoretical calculations by Dulong formula, analysis of coal and fuel gases, fuel cells, H₂ as fuel and biofuels
B.NUCLEAR CHEMISTRY
Nuclear fission and fusion, nuclear energy, nuclear reactors, disposal of nuclear waste, radiation measurement and contentment
 - **COORDINATION COMPOUNDS AND ORGANOMETALLICS** (06 Hours)
Structure and bonding, its application in catalysis; biological role of iron, magnesium and manganese (hemoglobin and chlorophyll)
 - **CORROSION AND ITS CONTROL** (06 Hours)
Pourbiax diagram, boiler corrosion, intergranular corrosion and bio-corrosion. Selection of material like SS, Ti/Zr alloy and design for corrosion control, corrosion inhibitors, cathodic and anodic protection
- (Total Contact Hours: 45)**
-

PRACTICALS:

1. Rate determination of chemical reactions.
2. Conductometric rate determination of esterification reaction.
3. Potentiometric estimation of Cu⁺² by titration with EDTA.
4. Photometric estimation of Ti.
5. Estimation of Cu⁺² by iodimetric titration.
6. Viscosity measurement.
7. Study of Corrosion of Steel at different concentration of Sulfuric Acid **OR**
Study of effect of inhibitors on corrosion of steel in sulphuric acid.
8. Demo: 1. Effects of removal of DO on corrosion.
9. Demo: 2. Anodic protection of steel in sulphuric acid.

BOOKS RECOMMENDED:

1. Atkins P. & de Paula J., "Physical chemistry", Oxford University Press, UK, 2002.
2. Chawla S., "Text Book of Engineering Chemistry", Dhanpat Rai & Co., Delhi, 2003.
3. Dara S. S., "A Text Book of Engineering Chemistry", S Chand & Sons., New Delhi, 2004.
4. Fontana M. G., "Corrosion Engineering", Tata-McGraw Hill, New Delhi, 1988.
5. Skoog, West & Holler, "Analytical Chemistry: An Introduction", 6th edition, Saunders College Publishing, 1994.

THEORY OF MACHINES:

- **INTRODUCTION TO MACHINES AND MECHANISMS** (07 Hours)
Introduction, Mechanism and machine, Rigid and Resistant body, Link, Kinematic pair, Types of motion, Degrees of Freedom (Mobility), Classification of Kinematic pairs, Kinematic Chain, Linkage, Kinematic Inversion, Inversions of Slider-Crank Chain, Double Slider-Crank Chain.
- **CAMS** (06 Hours)
Introduction, Types of Cams, Types of Followers, Cam Terminology, Displacement Diagrams, Motions of the Follower, Drawing of Cam Profile.
- **GEARS** (05Hours)
Different Types of Motion Transmitting Elements, Advantages and Disadvantages, Types of Gears and Gear trains, Gear Terminology and classification.
- **FRICTION** (05 Hours)
Introduction to Friction, Significance of Friction, its Merits and Demerits, Application of Friction to Screw Jack, Bearings, Breaks, Clutches etc.

MACHINE DESIGN:

- **DESIGN PROCESS, MATERIAL SELECTION, FACTOR OF SAFETY, FAILURES & THEIR CAUSES** (07 Hours)
Introduction, Types of Load, Design Process, Material Selection, Factor of Safety, Failure and Their Causes, Introduction to Corrosion (Design Aspect).
- **DESIGN OF JOINTS** (07 Hours)
Introduction, Different types of Joints and Their Applications, Design of Bolts and Rivets joints, Design of Screw Joint, Design of Welded Joints (Efficiency & Strength).
- **DESIGN OF POWER TRANSMISSION ELEMENTS** (08 Hours)
Introduction, Stresses Induced in the Shaft Under Different Conditions, Selection of Keys, Selection of Bearings, Power Rating of Spur/Helical Gears, Power Transmitting Capacity of Flat & V Belt.

(Total Contact Hours: 45)**PRACTICALS:**

Design and Drawing of various machine elements using conventional methods and few drawing sheets will be prepared using CAD software.

BOOKS RECOMMENDED:

1. Rattan, S.S.: Theory of Machines, Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 1984.
2. Rao, J.S., and Duggipati, R.V.: Mechanism and Machine Theory, Wiley Eastern Ltd., 1992.
3. Green, W.G.: Theory of Machines, 2nd Ed., Balckie, London, 1992.
4. Bhandari, V.B.: Design of Machine Elements, Tata McGraw-Hill Publishing Co. Ltd., 1984.
5. Shigley, J.: Mechanical Engineering Design, McGraw Hill Book Co., 1989.

CH 202: GENERAL CHEMICAL TECHNOLOGY

3 1 2 5

- **CHLOR-ALKALI INDUSTRY** (4 Hours)
Manufacture of soda ash, Caustic Soda, Chlorine, hydrogen and Hydrochloric acid.
- **CEMENT & GLASS MANUFACTURE** (4 Hours)
Portland cements, other cements, Methods and manufacture of special Glasses
- **SULFURIC ACID MANUFACTURE** (2 Hours)
- **PULP & PAPER INDUSTRY** (3 Hours)
Cellulose derivatives, pulp, paper & board.
- **SUGAR & STARCH INDUSTRY** (3 Hours)
Sugar, starches and related products
- **OIL, FATS, SOAPS AND DETERGENTS** (3 Hours)
Vegetable Oils, animal fats, their nature, analysis & extracted methods, Hydrogenations oil, Fatty acids and alcohol, waxes, soap, synthetic detergent.
- **POLYMER INDUSTRY:** (4 Hours)
Manufacture of Phenol and Urea Formaldehyde resin, PVC, Polyethylene, Synthetic rubber etc.
- **SYNTHETIC FIBER INDUSTRY:** (4 Hours)
Nylon, Polyester, Acrylics, and Rayons.
- **FINE CHEMICALS AND DRUGS** (5 Hours)
Classifications of pharmaceuticals, manufacture of important drugs and pharmaceuticals, salicylic acid, Methyl salicylate, Aspirin, Anti-biotics, Vitamins.
- **INTRODUCTION TO N & P FERTILIZERS.** (3 Hours)
- **INTRODUCTION TO PETROLEUM REFINING & PETROCHEMICAL INDUSTRY** (10 Hours)

(Total Contact Hours: 45)

PRACTICALS

1. Preparation of Boric acid by acidified solution of Borax ($\text{Na}_2\text{B}_4\text{O}_7$).
2. Preparation of CaCl_2 from HCl and lime (CaCO_3).
3. Preparation of detergent.
4. Preparation of nitro naphthalene from given chemicals.
5. Preparation of polystyrene from styrene monomer.
6. Preparation of Potash alum from Aluminium Sulphate and Potassium sulphate.
7. Preparation of soap from KOH and coconut oil
8. Determination of the kinematic viscosity of given oil sample using Engler viscometer & Red Wood Viscometer.
9. Determination of the aniline point of diesel using proper instruments.
10. Determination of the smoke point of kerosene and diesel.
11. Measurement of the softening point of grease sample.
12. Determination of the penetration index using penetrometer.
13. Determination of flash point and fire point of kerosene using Pensky Martin apparatus.
14. ASTM Distillation of gasoline.

BOOKS RECOMMENDED:

1. Austin G. T., "Shreve's Chemical Process Industries", 5th Ed. McGraw-Hill Pub., 1994.
2. Gopal Rao M. & Sittig M., "Dryden's Outlines of Chemical Tech.", 2nd Ed., East-West Pub., New Delhi, 1997
3. Rao B.K.B., "Modern Petroleum Refining Processes", 4th ed., Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, 2002.
4. Nelson, W.L., "Petroleum Refinery Engineering", 4th ed. (International student edition), McGraw-Hill Kogakusha, Ltd., Tokyo, 1958.
5. Mall I.D., "Petrochemicals Process Technology", Macmillan India Ltd, New Delhi, 2006.

-
- **INTRODUCTION** (4 Hours)
Dimension and Units, Fundamental and derived quantities, Mathematical techniques in chemical engineering.
 - **BASIC CHEMICAL CALCULATIONS** (6 Hours)
Gas laws and phase equilibria, Humidity, saturation and crystallization.
 - **COMBUSTION** (8 Hours)
Combustion and chemical processes.
 - **MATERIAL BALANCE** (9 Hours)
Material balances involving recycle, bypass and purge systems.
 - **THERMOPHYSICS** (8 Hours)
Heat capacity calculations. Enthalpy changes of reactions, dissolution and laws of thermochemistry. Effect of pressure and temperature on heat of reactions.
 - **MATERIAL AND ENERGY BALANCE** (10 Hours)
Combined material and energy balances for single stage processes. Material and energy balance calculations for industrial processes.

(Total Contact Hours: 45)

BOOKS RECOMMENDED:

1. Bhatt B.I. & Vora S.M., "Stoichiometry", 4th Ed., Tata-McGraw-Hill, New Delhi, 2004
2. Hougen O.A., Watson K.M. & Ragatz R.A., "Chemical Process Principals: Part-I", 2nd Ed., CBS Publishers and Distributors, New Delhi, 1995.
3. Himmelblau D.M., "Basics Principles and Calculations in Chemical Engineering" 6th Ed., Prentice-Hall India, 1996.
4. Whitwell J.C. & Jone R.K., "Conservation of Mass and Energy", McGraw-Hill, Singapore, 1973.
5. Process Calculation for Chemical Engineering, Second Revised Edition, Chemical Engineering Education Development Centre, I.I.T., Madras, 1981.