

**National Education Policy 2020 Inserted PG Programme
on the basis of "Choice Based Credit System-C. B. C. S."**

Master of Science in INDUSTRIAL CHEMISTRY

(Session 2022-23 onwards)



*Prof. Ahsan Ali
(Debar)*

Examined and approved by:

Board of Studies- INDUSTRIAL CHEMISTRY

Maharaja Suhel Dev State University,

[Signature]

SEM	CODE	TITLE	TOPIC	CREDIT	TOTAL
SEMESTER 1					
Major compulsory	B190701T	Analytical Chemistry		4	(5 x 4)=20
Major compulsory	B190702T	Inorganic Chemistry		4	
Major compulsory	B190703T	Organic Chemistry		4	
Major compulsory	B190704T	Physical Chemistry		4	
Major compulsory (P)	B190705P	Practical		4	4
					20
SEMESTER 2					
Major compulsory	B190801T	Analytical Chemistry		4	(4 x 2)=8
Major compulsory	B190802T	Physical Chemistry		4	
Major opt	B190803T	Organic Chemistry	Choose any TWO	4	(4 x 2)=8
Major opt	B190804T	Inorganic Chemistry		4	
Major opt	B190805T	Mathematics		4	
Major opt	B190806T	Computers		4	
Major compulsory (P)	B190807P	Practical		4	4
					20
SEMESTER 3					
Major compulsory	B190901T	Spectroscopic Methods		4	(4 x 2)=8
Major compulsory	B190902T	Industrial Processes-		4	
Major opt	B190903T	Chemicals in Industries	Choose any TWO	4	(4 x 2)=8
Major opt	B190904T	Operation and process in industries		4	
Major opt	B190905T	Water management		4	
Major opt	B190906T	Waste management		4	
Major compulsory (P)	B190907P	Practical		4	4
					20
SEMESTER 4					
Major opt	B191001T	Pharmaceutical	Choose any FOUR	4	(4 x 4)=16
Major opt	B191002T	polymers		4	
Major opt	B191003T	Radiation chemistry		4	
Major opt	B191004T	corrosion		4	
Major opt	B191005T	Synthetic organic chem		4	
Major opt	B191006T	petrochemicals		4	
Major opt	B191007T	Enzyme /microbiological engineering		4	
Major opt	B191008T	nanomaterials		4	
Major Compulsory (P)	B191009P	Practical		4	4
					20

Amish

Jai

SEMESTER 1

(1) ANALYTICAL CHEMISTRY (paper code – B190701T) Credit-4

Chromatographic methods (Paper, TLC, Column, and gas chromatography). Electrophoretic methods of analysis; free electrophoresis, zone electrophoresis; paper electrophoresis, gel electrophoresis, capillary electrophoresis, isoelectric focusing. Electroanalytical methods of analysis; potentiometry, voltammetry and electrogravimetry. Kinetic methods of analysis.

Turbidimetry/Nephelometry:

Principle and instrumentation for nephelometry and turbidimetry, effect of concentration, particle size and wavelength on intensity of scattered light, applications to analysis, turbidimetric titrations, determination of molecular weight of a polymer.

Solvent Extraction:

Distribution law, batch and continuous extractions, synergistic extraction, ion-association complexes, soxhlet extraction, Extraction of drug from the biological matrix -Solid Phase Extraction.



(2) INORGANIC CHEM (paper code – B190702T) Credit-4

Symmetry and Group Theory in Chemistry

representation of groups by matrices. Character tables and their use in spectroscopy.

Stereochemistry and Bonding: VSEPR Theory, Walsh diagrams, bent rule and energetics of hybridization, some simple reactions of covalently bonded molecules. Limitation of crystal field theory, molecular orbital theory, Octahedral, tetrahedral and square planar complexes,

Metal-Ligand Equilibria: , factors affecting the stability of metal complexes with reference to the nature of metal ion and ligand, chelate effect and its thermodynamic origin,

Books Recommended:

1. F.A. Cotton and G. Wilkinson Advanced Inorganic Chemistry, 6th Edn.(1999), John Wiley & Sons, New York.
2. James E. Huheey, Inorganic Chemistry, 4th Edn. (1993), Addison-Wesley Pub. Co., New York.
3. Comprehensive Coordination Chemistry eds., G Wilkinson, R. D. Gillars and J. A. McCleverty, Pergamon.



(3) ORGANIC CHEMISTRY (paper code – B190703T) Credit-4

Nature of bonding in Organic Molecules: Resonance, hyper-conjugation, Aromaticity in benzenoid and non-benzenoid compounds, Huckel's rule, energy level of pi-molecular orbitals

Stereochemistry: Conformational analysis of cyclohexane, effect of conformation on reactivity, elements of symmetry, stereospecific and stereoselective synthesis, chiral carbon, biphenyls, allenes and spiranes. structure, stability and reactivity of benzyne, carbenes and nitrenes, resonance and field effect, steric effect,

Aliphatic nucleophilic substitution: The S_N^2 , S_N^1 , mixed S_N^1 and S_N^2 , the neighboring group mechanism, neighboring group participation by Pi and Sigma bonds, Reactivity, effects of substrate structure, attacking nucleophile, leaving group and reaction medium, ambident nucleophile, regioselectivity.

Aliphatic Electrophilic Substitution: Bimolecular mechanisms S_E2 and S_Ei . The S_{E1} mechanism, electrophilic substitution accompanied by double bond shifts. Effect of substrates, leaving group and the solvent polarity on the reactivity.

Aromatic electrophilic substitution: The arenium ion mechanism, orientation and reactivity, energy profile diagrams, The Ortho/Para ratio, ipso attack

Aromatic nucleophilic substitution: The ArS_N^1 , Benzyne and ArS_N^2 mechanism, Reactivity effect of substrate structure, leaving group and attacking nucleophile

Books Recommended:

1. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, John Wiley.
2. Advanced Organic Chemistry, F.A. Carey and R.J. Saundberg, Plenum.
3. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
4. Structure and Mechanism in Organic Chemistry, C.K. Ingold, Cornell University press.
5. Organic Chemistry, RT. Morrison and R.N. Boyd. Prentice Hall.

(4) PHYSICAL CHEMISTRY (paper code – B190704T) Credit-4

Microwave Spectroscopy: Effect of isotopic substitution on the transition frequencies intensities, Born Oppenheimer approximation, rotational, vibrational and electronic energy levels.

Vibrational Spectroscopy: Infrared Spectroscopy, force constant and bond strength; vibrations of polyatomic molecules, Selection rules, normal modes of vibration, factors affecting, the band positions and intensities. theories of Raman effect, Pure rotational, vibrational and vibrational-rotational Raman spectra

Quantum Chemistry: Postulates of Quantum Mechanics, Hamiltonian for different systems, Angular momentum, The Schrodinger equation, particle in a box, the harmonic oscillator, the rigid rotar, the hydrogen atom. The Variation theorem, linear variation principle,

Chemical Dynamics: Methods of determining rate law, collision theory of reaction rates steric factors Activated complex theory, Arrhenius equation and the activated complex theory, photochemical (hydrogen bromine reactions) and oscillatory reactions. homogeneous catalysis, kinetics of enzyme reaction General features of fast reaction study of fast reaction by relaxation method, flash photolysis and the nuclear magnetic resonance method.

Books Recommended:

1. Modern Spectroscopy, J.M. Hollas, John Wiley.
2. Physical methods in Chemistry, R.S. Drago, Saunders College.
3. Introduction to Molecular Spectroscopy G.M. Barrow, Mc Graw Hill.
4. Physical Chemistry P.W. Atkins, ELBS.
5. Introduction to Quantum Chemistry, A.K. Chandra, Tata Mc Graw Hill.
6. Quantum Chemistry, Ira N. Levine. Prentice Hall.
7. Coulson's Valence, R.McWeeny, ELBS.
8. Chemical Kinetics, K.J. Laidler, Mcgraw-Hill.

PRACTICAL (paper code – B190705P) Credit-4

Inorganic Chemistry

- 1- Qualitative analysis of mixture containing trace elements Tl, Mo, W, Zr, Ti, Th, V, U (Two metal ions in cationic/anionic forms) and insoluble oxides, sulphates and halides. The mixture should not contain more than five cations and should be analyzed by semi micro technique.
- 2- Thin layer chromatography separation of a mixture of the following and measurements of R_f values.
(a) Pb^{+2} , Ag^+ , Hg^{+2} (b) Co^{+2} , Ni^{+2} , Cu^{+2} (c) Ba^{+2} , Ca^{+2} , Sr^{+2}

Organic Chemistry

1. Separation, purification, and identification of ternary mixture. Preparation of derivatives, if possible.
2. Quantitative Analysis (Any one):
 - a. Determination of the percentage or number of hydroxyl groups in an organic compound by acetylation method.
 - b. Estimation of amine/phenols using bromate bromide solution or acetylation method.Determination of iodine and saponification values of an oil sample.

Physical Chemistry (Any two):

- a. Study the adsorption of acetic acid on charcoal and draw the Freundlich isotherm.
 - b. Show that the order of reaction between acetone and Iodine is zero with respect to Iodine.
 - c. Determination of congruent composition and temperature of a binary mixture e.g. diphenylamine-benzophenone system.
 - d. Determination of the velocity constant of hydrolysis of an ester / ionic reaction in micellar media.
 - e. Determination of the velocity constant of decomposition of Benzene diazonium chloride.
 - f. Determination of molecular weight of nonvolatile and nonelectrolyte/ electrolyte by cryoscopic method and to determine the activity coefficient of an electrolyte.
- Determination of DO, COD and BOD of water sample.

SEMESTER 2

(1) ANALYTICAL CHEMISTRY (paper code – B190801T) Credit-4

Atomic Absorption Spectroscopy: instrumentation, detection limits, sensitivity, interferences, comparison of AAS with flame photometry, applications.

Flame photometry: principle and instrumentation of flame photometry, experimental techniques – standard addition method and internal standard method, interferences in flame photometry and applications

Fluorescence and Phosphorescence: filter fluorometer and double beam monochromator instruments, working, analysis, ultra trace analysis

Mössbauer Spectroscopy: Mössbauer nuclides, parameters required for evaluation, instrumentation, applications.

Thermal analysis: thermal analysis, Differential Thermal Analysis (DTA), Thermogravimetry (TG) and Differential Thermogravimetry (DTG), static and dynamic thermogravimetry; Instrumentation and applications,

Mass Spectrometry: mass spectrometer, mass spectrum, metastable ion, nitrogen rule, molecular weight determination, molecular formula from isotopic ratio data, isotopic profile of halogen compounds, factors effecting reaction pathways, fragmentation patterns, McLafferty rearrangement,

Electron Spin Resonance Spectroscopy: Hyperfine coupling, spin polarization for atoms and transition metal ions, spin-orbit coupling and significance, application to transition metal complexes (having one unpaired electron) including biological systems and to inorganic free radicals.)

Nuclear Magnetic Resonance: General introduction and definition, chemical shift, spin-spin interaction, shielding mechanism, chemical shift values and correlation for protons bonded to carbon (aliphatic, olefinic, aldehydic and aromatic) and other nuclei (alcohols, phenols, enols, carboxylic acids, amines, amides & mercapto), chemical exchange, effect of deuteration, complex spin-spin interaction between two, three four and five nuclei (first order spectra), Simplification of complex spectranuclear magnetic double resonance, contact shift reagents, solvent effects. The contact and pseudo contact shifts, factors affecting nuclear relaxation, some applications including biochemical systems, an overview of NMR of metal nuclides

Carbon-13 NMR Spectroscopy: General considerations, chemical shift (aliphatic, olefinic, alkyne, aromatic, heteroaromatic and carbonyl carbon), coupling constants.

BOOKS RECOMMENDED:

1. Introduction to spectroscopy by D.L. Pavia et. al. Saunders Golden Sunburst Series 1996.
2. "Spectrometric identification of organic compounds", R.M. Silverstein, G.S. Bassler & T.C. Morrill, John Wiley & Sons, New York.
3. "An Introduction to spectroscopy methods for identification of organic compounds." F. Scheinman, Vol. I & II, Pergamon Press.
4. "Spectroscopy of organic compound", P.S. Kalsi, Wiley Eastern, New Delhi.
5. "Organic Mass Spectrometry", K.G. Das & E.P. James, Oxford & IBH Publishing Co.
6. "Instrumental methods of analysis", M.H. Willard, L.L. Merritt, J.A. Dean and F.A. Settle, 7th Ed. (1988).

(2) PHYSICAL CHEMISTRY (paper code – B190802T) Credit-4

Classical Thermodynamics

Free energy, chemical potential and entropies. Partial molar properties; Partial molar free energy, partial molar volume and partial molar heat content and their significances. Determination of these quantities. Concept of fugacity and determination of fugacity. Application of phase rule to three component systems.

Statistical Thermodynamics

Concept of distribution, thermodynamic probability and most probable distribution. Ensemble averaging, postulates of ensemble averaging. Canonical, grand canonical and microcanonical ensembles, corresponding distribution laws (using Langrange's method of undetermined multiplier). Partition functions – translational, rotational, vibrational and electronic partition functions, calculation of thermodynamic properties in terms of partition functions. Application of partition functions.

Electrochemistry

Nonideal Systems: Excess functions for nonideal solutions. Activity, activity coefficient, Debye-Huckel Theory for activity coefficient of electrolyte solutions, Determination of activity and activity coefficients, ionic strength. Debye-Huckel-Bjerrum model. Overpotential, exchange current density, derivation of Butler-Volmer equation, Tafel plot, Electrocatalysis, Hydrogen electrode, Polarography theory, interpretation of a polarographic curve, instrumentation, limiting current, residual and charging current, diffusion current. Supporting electrolytes,

Surface chemistry:

a. Adsorption: Gibbs adsorption isotherm estimation of surface area (BET equation), surface films on liquids (Electro kinetic phenomenon), catalytic activity at surfaces.

Micelles: Surface active agents, classification of surface active agents, micellization hydrophobic interactions, Critical micellar concentration (CMC), Factors affecting CMC of surfactants counter ion binding to Micelles, solubilization, micro emulsion reverse micelles

Normal, reverse and mixed micelles, micellization in non-aqueous media, effect of solvent, micellar solubilization, Micellar growth- various micellar morphologies surfactant packing parameter, factors affecting micellar growth (nature and concentration of surfactant, temperature, additives, etc.), implication of micellar growth.

Crystals defects and non stoichiometry: perfect and imperfect crystals, thermodynamics of Schottky and Frenkel defects, colour centres. extended defects; stacking faults, grain boundaries and dislocations.

Conductivity in solids: structure and conduction mechanism in ionic conductors and superionic conductors, band theory of metals, band structure of semiconductors, n- type and p-type semiconductivity.

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1. Modern Spectroscopy, J.M. Hollas, John Wiley.
2. Physical methods in Chemistry, RS. Drago, Saunders College.
3. Introduction to Molecular Spectroscopy G.M. Barrow, Mc Graw Hill.
4. Physical Chemistry P.W. Atkins, ELBS.
5. Introduction to Quantum Chemistry, A.K. Chandra, Tata Mc Graw Hill.
6. Quantum Chemistry, Ira N. Levine. Prentice Hall.
7. Coulson's Valence, R.McWeeny, ELBS.

8. Chemical Kinetics, K.J. Laidler, Mcgraw-Hill.

(3) INORGANIC CHEMISTRY (paper code – B190803T) Credit-4

Reaction mechanism of Transition Metal Complexes: Energy profile of a reaction, reaction reactivity of metal complexes, inert and labile complexes, acid hydrolysis, factors affecting acid hydrolysis, base hydrolysis, Substitution reaction in square planar complexes, outer sphere type reactions, cross- reactions and Marcus-Hush theory, inner sphere type reaction

Application of valence bond and crystal field theories: kinetics of octahedral substitution, Redox reactions, electron transfer reactions, mechanism of one electron transfer reactions,

Electronic spectra and Magnetic Properties of Transition Metal Complexes: Orgel energy level and Tanabe-Sugano diagrams for transition metal complexes (d^1 - d^9 states); Charge transfer spectra; electronic spectra of octahedral and tetrahedral Co(II) and Ni(II) complexes and calculation of ligand-field parameters.

Metal π -Complexes and Clusters: structure and bonding, vibrational spectra of Metal carbonyls for bonding and structural elucidation, important reactions of Metal carbonyls, preparation, bonding, Structure and important reactions of transition metal nitrosyl, dinitrogen and dioxygen complexes, tertiary phosphine as ligand, Higher boranes, carboranes, metallocarboranes,

Books Recommended:

1. F.A. Cotton and G. Wilkinson Advanced Inorganic Chemistry, 6th Edn.(1999), John Wiley & Sons, New York.
2. James E. Huheey, Inorganic Chemistry, 4th Edn. (1993), Addison-Wesley Pub. Co., New York.
3. Comprehensive Coordination Chemistry eds., G Wilkinson, R. D. Gillars and J. A. McCleverty, Pergamon.
4. Magneto Chemistry, R. L. Carlin, Springer Verlag.
5. F.A. Cotton and G. Wilkinson Advanced Inorganic Chemistry, 6th Edn.(1999), John Wiley & Sons, New York.

(4) ORGANIC CHEMISTRY (paper code – B190804T) Credit-4

Free Radical Reactions: Types of free radical reactions, free radical, mechanism at an aromatic substrate, neighbouring group assistance. Reactivity for aliphatic and aromatic substrates at a bridgehead. The effect of solvents on reactivity. Sandmeyer reaction. Free radical rearrangement. Hunsdiecker reaction.

Addition to Carbon-Carbon Multiple Bonds: Mechanistic and stereochemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals, regio- and chemoselectivity, orientation and reactivity. Hydrogenation of double and triple bonds, hydrogenation of aromatic rings. Hydroboration. Michael reaction. Sharpless asymmetric epoxidation.

Addition to Carbon-Hetero Multiple Bonds: Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds acids, esters and nitriles. Addition of Grignard reagents, organozinc and organolithium reagents to carbonyl and unsaturated carbonyl compounds. Wittig reaction Mechanism of condensation reactions involving enolates - Aldol, Knoevenagel, Claisen, Mannich, Benzoin, Perkin and Stobbe reactions.

Pericyclic reactions: Molecular orbital symmetry, frontier orbitals of ethylene, 1, 3- butadiene, 1,3,5-hexatriene and allyl system, Classification of pericyclic reactions, Woodward-Hoffmann correlation diagrams. FMO approach, Electrocyclic reactions- conrotatory and disrotatory motions, $4n$, $4n+2$ and allyl systems, Cycloadditions-antarafacial and Suprafacial additions, $4n$ and- $4n+2$ system, Sigmatropic rearrangements-suprafacial and antarafacial shift of H, sigmatropic shifts involving carbon moieties, 3, 3 and 5, 5 sigmatropic rearrangements, Claisen- Cope and Azacope rearrangement, Fluxional tautomerism, Ene reaction

Books Recommended:

1. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, John Wiley.
2. Advanced Organic Chemistry, F.A. Carey and R.J. Saundberg, Plenum.
3. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
4. Structure and Mechanism in Organic Chemistry, C.K. Ingold, Cornell University press.
5. Organic Chemistry, R.T. Morrison and R.N. Boyd. Prentice Hall.
6. Modern Organic Reactions H.O. House, Benjamin
7. Principles of Organic Synthesis, R.O.C. Normon and J.M. Coxon, Blackie Academic and professional.
8. Pericyclic Reactions. S.M. Mukherji, Macmillan India.
9. Reaction Mechanism in Organic Chemistry : S.M. Mukherji and S.P. Singh, Macmillan.

(5)MATHEMATICS (paper code – B190805T) Credit-4

Solutions in series, differential equations, Powerseries method of solving second order differential equation, Generating functions of $J_n(x)$, Orthogonal property

Integral Transform: Laplace transform and its properties, Inverse Laplace Transform. Use of partial fractions. Fourier transform and its properties. Inverse Fourier Transform.. Laplace equation. Heat equation and Wave equation.

Probability and Statistics: Probability:

. Binomial, Poisson, normal and exponential distributions, mean variance moment Generating function,

Errors and their estimation

Matrices: Eigen value and eigen vectors, matrix decomposition, inverse of matrix, norm of matrix.

Numerical integration and differentiation.



(6)COMPUTERS (paper code – B190806T) Credit-4

Computer Programming: Elements of C language, functions and subroutines, Graphics commands, commands for accessing hardware (data acquisition).

Introduction to Programming in Visual Basic: Introduction, different controls and their properties, application.

Application Package for Report Generation and Presentation:

MS-Office: Introduction to MS-Office and its application in report generation.

MS-Excel: Spreadsheets, report generation, cell manipulation, data base management; Graphical representation of tabulated data-pie charts, bar & line graphs, surfaces and 3D graphs.

Internet: Basic concepts, importance in chemical industry, design and maintenance of a small web site.

PRACTICALS (paper code – B190807P) Credit-4

Inorganic Chemistry

1-Quantitative and separation and determination of the following pairs of metals ions using gravimetric and volumetric methods respectively (any one)

- (a). Ni^{2+} and Cu^{2+}
- (b). Cu^{2+} and Zn^{2+}
- (c). Ba^{2+} and Cu^{2+}
- (d). Mg^{2+} Ca^{2+}

2-Preparation of selective inorganic compounds (any one)

- (a). $\text{VO}(\text{acac})_2$,
- (b). $\text{Na}[\text{Cr}(\text{NH}_3)_2(\text{SCN})_4]$
- (c). $\text{K}_3[\text{Fe}(\text{C}_2\text{O}_4)_3]$
- (d). $[\text{Co}(\text{Py})_2\text{Cl}_2]$
- (e). $[\text{Cu}(\text{NH}_3)_4]\text{SO}_4 \cdot \text{H}_2\text{O}$

Organic Chemistry

1-Organic Synthesis (any one):

- a. Eosin from phthalic anhydride.
- b. Benzene azo- β -naphthol(Dye)
- c. Bakelite (Polymer).
- d. Acetyl salicylic acid (Aspirin).
- e. Synthesis of p-hydroxyacetanilide (Paracetamol).

2- Separation and estimation of R_f value of amino acids by paper chromatography.

Physical Chemistry (Any two):

- a. Determination of glass transition temperature of a given salt (e.g., CaCl_2) conductometrically.
 - b. Determination of the degree of dissociation of weak electrolyte and to study the deviation from ideal behaviour that occurs with a strong electrolyte.
 - c. Determination of the velocity constant, order of the reaction and energy of activation for saponification of ethyl acetate by sodium hydroxide conductometrically.
 - d. Determination of solubility and solubility product of sparingly soluble salts (e.g PbSO_4 , BaSO_4) conductometrically.
 - e. Determination of the strength of strong and weak acids in a given mixture conductometrically.
 - f. Potentiometric titration of strong acid and strong base.
- Kinetics of oxidation of lactose/maltose by potassium ferricyanide in presence of sodium hydroxide.

SEMESTER 3

(1) SPECTROSCOPIC METHODS (compulsory) (paper code – B190901T) Credit-4

Principles of UV Spectroscopy, Application of Woodward-Fieser rule in interpretation of Organic compounds, Basic principles of IR Spectroscopy, Identification of Functional groups of various classes of organic compounds, Application of Chemical Shifts, Splitting of signals, Spin coupling and Over Houser effect in interpretation of NMR spectra, Significance of decoupling phenomenon and Isotopic exchange reaction in NMR. Basic principles Mass Spectrometry, Application of fragmentation rule in characterization of organic compounds. Problems on structure elucidation of organic compounds based on spectral data.

Infrared (IR) Spectroscopy: Introduction, principles of IR spectroscopy, sample handling, various modes of vibrations, presentation of spectra, functional group and finger print region, combination and overtones, Fermi resonance, bond properties and absorption trends, factors influencing vibration frequencies, interpretation of IR spectra, introduction of FT-IR spectroscopy

Nuclear Magnetic Resonance (NMR) Spectroscopy: Principles of NMR spectroscopy, nuclear spin states, nuclear magnetic moments, absorption of energy, chemical shift and its measurements, shielding and deshielding of protons, anisotropy, chemical shift and chemical equivalence, integrals, spin-spin splitting, N+1 rule, mechanism of coupling and coupling constants, presentation of spectra, magnetic equivalence, allylic coupling, exchangeable protons, Interpretation of NMR spectra of simple organic compounds, effect of enantiotopic, diastereotopic protons, Karplus curves- Variation of coupling constant with dihedral angles. Techniques of simplifying NMR spectra, double resonance, shift reagents and deuteration, elementary idea of C^{13} NMR, Introduction to FT-NMR spectroscopy.

ESR Basic concepts: hyperfine splitting, ESR of hydrogen atom, free radicals, ESR of solids, ESR of simple free radical in solutions, spin densities, spin polarization anisotropy of Zeeman and hyperfine interactions.

(2) INDUSTRIAL PROCESSES(compulsory) (paper code – B190902T) Credit-4

Distillation: Boiling and distillation, vapor-liquid equilibria, azeotropic mixtures, flash distillation, steam distillation, vacuum distillation and fractional distillation.

Extractions: Extraction with reflux, Extraction with agitation, equipment, it's use and performance, continuous contact equipment, agitator extractors and packed spray extractors.

Filtration: Classification of filters, Sand filters, filter press, plates & frame press.

Flow of Heat: Introduction, Conduction, Convection and Radiation.

Heat Exchange Equipments: Introduction, Double Pipe, Shell & tube, Fixed tube and U tube heat exchangers.

Classification of crystallizers and Agitated tank.

Drying: General Principles, Rate of drying, Drying equipments, Tray dryers, Rotary dryers, Single Drum dryer & Spray dryers.

Evaporation: Types of evaporators, jacketed, horizontal and vertical tube evaporators.

Gas Absorption: Definition, examples, comparison of absorption and distillation, Packed columns and plate columns.

Industrial Instrumentation: Measurement of temperature, Thermo couples and pyrometers, High temperature thermometers, Optical pyrometers, Measurement of pressure and vacuum, Manometric and Bourdon gauges, Vacuum gauges, Ionization and pirani gauges. Flow measurement, Pitot tube, Rotameters, Liquid level indicators. Hook Type, Sight glass, Float type, Capacitance level indicator, Radiation level indicator.

Industrial Waste Management: Definition, Classification, sources and composition of solid, liquid and gaseous wastes, hazardous and non-hazardous wastes, special waste materials, Storage and transport of wastes, Management of wastes, minimization, reuse and recycling, waste utilization and, anaerobic digestion, combustion and incineration.

(3) CHEMICALS IN INDUSTRIES(optional) (paper code – B190903T) Credit-4

Reagents in Organic Synthesis

Synthesis and application of complex metal hydrides, Gilman's reagent, lithium dimethylcuprate, lithium diisopropylamide (LDA), dicyclohexylcarbodiimide, 1,3-dithiane (reactivity Umpolung), trimethylsilyl iodide, tri-n-butyltin hydride, Woodward and plevost hydroxylation, osmium tetroxide, DDQ, selenium dioxide, Phase transfer catalysts, crown ethers and Merrifield resin, Peterson's synthesis, Wilkinson's catalyst, Baker yeast.

A. Dairy Chemistry: Milk and milk products, composition and structure of milk, milk proteins, enzymes, vitamins, minerals, density and viscosity of milk, effect of heat on milk, milk processing, basic milk categories, butter, ghee and clarified butter.

B. Leather Chemistry: Introduction, constituents of animal skin, manufacture and preparation of hides, cleaning, soaking, liming and degreasing, finishing and sharing, tanning; leather, vegetable, chrome, tanning effluents; pollution and control.

A. Dyes and Pigments: Classification of Dyes, Methods of preparation of commercial dyes of different classes with suitable examples. Typical manufacturing processes of few dyes, Fluorescent brightening agents, Photosensitive dyes, dyes as food additives, natural dyes.

B. Oils, Soaps and Detergents: Refining of edible oils, Manufacturing of soaps, Detergents, Liquid Soaps. Manufacturing of fatty Acids and glycerol, greases from fatty acids, turpentine –red oil.

Food Chemistry: Classification, chemical composition and nutritional value of common food stuffs, properties of foods, food preservation and processing, food deterioration, methods of preservation and processing by heat, cold, chill storage, deep freezing, drying, concentration, fermentation, and radiation, Food quality; sensory evaluation, objective methods, non-nutritional constituents and food safety.

Permitted food additives and their role; Antioxidants, coloring agents, flavours, emulsifiers, curating agents, non-curative sweeteners, flour improvers, leavening agents, stabilizers, thickeners and preservatives.

Glass and Refractory materials: Raw materials, Soda glass, borosilicate glass, Lead Glass, Colored Glass, Refractory: Raw materials, clay pots, Zeolites.

(4)OPERATION AND PROCESSES IN INDUSTRIES (optional) (paper code – B190904T) Credit-4

Introduction to Chemical Reaction Engineering.: Rate of reaction, Elementary and Non-elementary reactions, Molecularity and Order of reaction, Mechanism of reaction, Temperature dependency from thermodynamics, Arrhenius and Collision theories.

Chemical Reactor Analysis.: Integral and differential methods for analyzing kinetic data, Interpretation of constant volume batch reactor data for zero, first, second and third order reactions, Half life period, Auto catalytic reaction, Interpretation of variable volume batch reactor data for zero, first and second order reactions, enzyme catalyzed reactions.

Introduction to Reactor Design.: Industrial reactors, Space time and Space velocity. Design of single ideal reactor - Batch, CSTR, PFR using graphical procedure. Multiple reactor system and optimum reactor size, Recycle reactors, Temperature and Pressure effects, Optimum temperature progression in a chemical reaction, Adiabatic and Non adiabatic reaction conditions and conversion.

Multiple Reaction System and Design: Multiple reactions: Independent, Parallel and Series reactions, Instantaneous and over all fractional yield, Choice of reactors for simple and complex reactions and multiple reactor system, Introduction to thermal stability of reactors, Product distribution in multiple reaction system, temperature dependence and vessel size for maximum production.



(5) WATER MANAGEMENT (optional) (paper code – B190905T) Credit-4

Properties of water: Introduction, chemistry, uses, sources and quality of water, water for industry, water in human body, effect of water on rocks and minerals, organic, humic and colloidal matter in water. Water pollutants. Ground water pollution and its protection, Surface, river, sea and lake water pollution, Sewage, domestic, agricultural thermal, radioactive, industrial pollutants and siltation.

Water Management: Introduction, use and conservation of water resources, water quality management, rainwater harvesting, water management in agriculture rain fed systems, irrigated systems, industries, Sea water for agriculture, Effect of toxic metals, fertilizers, detergents and pesticides.

Purification of water: portability of water, removal of coarse, dispersed and colloidal impurities, clarification and coagulation of water, determination of hardness, Flocculants, Sterlization (Chemical and physical methods) fluoridation, defluoridation and disinfection of water, softening of water (Clark's, lime soda, modified lime soda, Permutit and ion exchange process) Demineralization, desalting (electro dialysis and reverse osmosis methods) and deoxygenation of water.

Prevention and analysis of water pollution: Prevention, control of water pollution and its best use, Chemical and physical examination and measurement of quality of water, Chlorine demand. Analysis of calcium, magnesium, iron, manganese, silver and zinc in water. Determination of nitrate, nitrite, sulphate, chloride and fluoride. Determination of arsenic, chromium, lead, and mercury.

Recommended Books:

1. F. A. Henglein: Chemical safety Management and Engineering (Pergamon).
2. B. K. Sharma, Environment Chemistry.
3. M. K. Hill; Understanding Environmental Pollution A Primer, Cambridge University Press, 2004.
4. I. L. Pepper, C. P. Gerba, M. L. Brusseau, Environmental & Pollution Science, Elsevier, 2006.
5. G. M. Masters, Introduction to Environmental Engineering and Science, Perason, 2004.



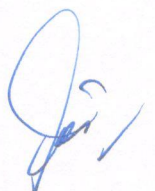
(6) INDUSTRIAL WASTE MANAGEMENT (optional) (paper code – B190906T)

Credit-4

Sources, classification and composition of solid, liquid and gaseous wastes, hazardous and non-hazardous wastes, special waste materials. Storage and transport of wastes. Transportation and collection systems. Management of wastes, minimization, reuse and recycling. Waste utilization and materials recovery. Treatment of wastes; biological treatment, composting, anaerobic digestion, combustion, incineration and landfills, ultimate disposal.

Recommended Books

1. H. S. Peavy, D.R. Rowe and G. Techbanoglous, Environmental Engineering, Mcgraw Hill Books Co., 1985.
2. R. A. Corbitt, Started Handbook A Environmental Engineering; Mcgraw Hill New York, 1990.
3. A. M. Martin (ed), Bio-conservation of waste Materials to Industrial Products; Elsevier, Amsterdam, 1991.
4. O.P. Kharbanda and E. A. Stellworthy, Waste Management- towards a Sustainable Society, Gower, 1990.
5. E. Mortensen, Introduction to Solid Waste, Lecture Notes to Graduate Diploma in Environmental Engineering, University College, Ireland, 1990



PRACTICALS (paper code – B190907P) Credit-4

Inorganic Chemistry

1- Preparation of selective inorganic complex (any one)

- Prussian Blue
- Ion exchange separation of oxidation state of V.
- Preparation of Fe (II) Chloride.
- Ferrocene
- Copper glycine Complex

2- Any one analysis from the followings:

- Determine the capacity of **cation exchange resin** of given sample of cation exchange resin in terms of milliequivalent/g of dry resin.
- Determine the capacity of **anion exchange resin** of given sample of anion exchange in terms of milliequivalent/g of dry resin.
- Prepare **Copper Ferrite (CuFe_2O_4)** & Find out percentage practical yield of the Copper Ferrite (CuFe_2O_4).
- To prepare **potash alum** & find out the percentage of **Aluminium** in the alum.
Determine the concentration in mg/lit of sulphate ion in the given sample of water nephelometrically

Organic Chemistry

1- TLC- Separation of Organic Compounds.

2-Organic Analysis: (Any one)

- Estimation of Phenol and Aniline by KBr/KBrO_3 method.
 - Estimation of Amino group.
 - Estimation of Hydroxyl group.
 - Estimation of Carbonyl group.
- Estimation of Reducing and non-reducing sugars.

Physical Chemistry (Any two):

- Fluorimetry:** To determine the amount of riboflavin in given B-complex tablet.
- Latent Heat of fusion:** To determine the latent heat of fusion of given solid.
- Polarography:** Study the effect of Oxygen supporting electrolyte and maximum suppressor and determine the half wave potential of Cd/Zn in given solution by Half wave potential method. Differential method and half wave equation method.
- Potentiometry:** To determine the dissociation constant of dibasic acid by potentiometric method.
- pH – metry:** To determine the dissociation constant of dibasic acid pH – metrically.
- pH – metry:** To determine pH value of various buffer using pH meter and determination of dissociation constant of acetic acid.

Photometric titration

SEMESTER 4

(1)PHARMACEUTICAL CHEMISTRY(paper code – B191001T) Credit-4

Drug Design: Development of new drugs, procedures followed in drug design, concepts of lead compound and lead modification, concepts of prodrugs and soft drugs, structureactivity relationship (SAR), factors affecting bioactivity, resonance, inductive effect, isosterism, non-isosterism, special considerations.

Theories of drug activity: occupancy theory, rate theory, induced fit theory. Quantitative structure activity relationship. History and development of QSAR.

Pharmacokinetics: Introduction to drug absorption, disposition, elimination using pharmacokinetics, important pharmacokinetic parameters in defining drug disposition and in therapeutics. Mention of uses of pharmacokinetics in drug development process.

Pharmacodynamics: Introduction, elementary treatment of enzyme stimulation, enzyme inhibition, sulphonamides, membrane active drugs, drug metabolism, xenobiotics, biotransformation, significance of drug metabolism in medicinal chemistry.

Cardiovascular Drugs: Introduction, cardiovascular diseases, drug inhibitors of peripheral sympathetic function, central intervention of cardiovascular output, Direct acting arteriolar dilators, Synthesis of amyl nitrate, sorbitrate, quinidine and methyldopa.

Local Anti-infective Drugs: Introduction, Synthesis of sulphonamides, ciprofloxacin, norfloxacin and chloroquin.

Psychoactive Drugs- The Chemotherapy of Mind: Introduction, neurotransmitters, CNS depressants, general anaesthetics, mode of action of hypnotics, sedatives, anti-anxiety drugs, benzodiazepines, buspirone, neurochemistry, of mental diseases. Antipsychotic drugs-the neuroleptics, antidepressants, butyrophenones, serendipity and drug development, stereochemical aspects of psychotropic drugs, Synthesis of diazepam, chlorazepam, alprazolam, phenytoin, ethosuximide, trimethadione, barbiturates, thiopental sodium, glutethimide.

Antibiotics: Introduction, Synthesis of penicillin G, ampicillin, amoxicillin, tetracycline and streptomycin.

Recommended Books:

1. Introduction to medicinal chemistry, A Gringuage, Wiley- VCH.
2. Wilson Gisvold's Text book of organic Medicinal and pharmaceutical Chemistry, Ed., Robert F.Dorge.
3. An introduction to drug design, S. S. Pandeya and J. R. Dimmock, New age International.
4. Burger's Medicinal Chemistry and Drug Discovery Volume 1 (Chap. 9 and Chap.14), Ed., M.E. Wolff, John Wiley.
5. Goodman and Gilman's Pharmacological Basis of Therapeutics, Mc Graw-Hill.
6. The organic Chemistry of Drug Design and drug action, R.B. Silverman, Academic press.
7. Strategies for Organic Drug synthesis and Design, D. Lednicer, John Wiley.

(2) POLYMER(paper code – B191002T) Credit-4

TYPES OF POLYMERS AND POLYMERISATION: Thermoplastics and thermosetting, functionality concept, Concept of cross-linking-linear, Branched and cross-linked polymers. Addition, Condensation, Ionic, Co-ordination, Addition-Polymerisation Mechanism (Initiation, propagation and termination processes), Initiators, Inhibitors, Mechanism of Ionic polymerization.

PROPERTIES OF POLYMERS: Viscosity, Solubility, Optical, Electrical, Thermal and mechanical properties of polymers.

POLYMER PROCESSING: Compression, Moulding, casting, Extrusion, Fibre spinning, Injection moulding, Thermoforming, Vulcanisation of elastomers.

Rheology of polymers : Viscous flow, kinetic theory of rubber elasticity, Viscoelasticity, The mechanical properties of polymer.

Morphology of polymers : Configuration of polymer chain-crystal structure, Morphology of crystalline polymers, Strain induced morphology.

Polymer processing by molding and other processing methods, plasticizers and other additives, fibres manufacture technology.

Degradation of polymers by thermal, oxidative, Mechanical and chemical methods.

Detailed study of the following thermosetting polymers with respect to synthesis, Chemical properties and applications:

- (i) Phenol formaldehyde resins.
 - (ii) Amino resins- urea-formaldehyde and melamine-formaldehyde reaction, polyurethanes.
 - (iii) Polycarbonates and silicones.
- Elastomers- polyisoprene, Neoprene.

Detailed study of the following thermoplastic polymers with respect to synthesis, chemistry, properties and applications:

- (i) Polyolefins- Polyethylenes,
- (ii) Polyvinyl Chlorides- PVC, Teflon.
- (iii) Polyamines- Nylon-6, Nylon-66.

Polyethers and polyesters- Terephthalates.

Solid and gas phase polymerization. Group transfer polymerization. Living free radical polymerization. Butyl rubber. Nitrile rubber. Styrene butadiene rubber. Telechelic polymers. Hetero-chain polymers. Ethylene propylene diene rubber (EPDM). Nanocomposites.

Foams. Thermosetting Resins. Ionomers. Hydro-gel. Polymeric liquid crystals. Polymeric gel. Heat resistant polymers. Multiphase polymers. Multiphase polymeric systems. Interpenetrating networks. Graft and block copolymers. Molecular composites.

Conducting polymer: Types of conducting polymers. Chemical and electrochemical routes of synthesis. Doping and dedoping of conjugated polymers. Solatron and polaron formation in conducting polymers. Conduction mechanism.

Bio and natural polymers: Proteins, nucleic acids, lipids, cellulose and polysaccharides. Medicinal and biomedical applications of polymers. Introduction of Inorganic Polymers and application. Biodegradable polymers. Polymer waste management.

Recommended Books:

Billmeyer, Textbook of polymer science, John Wiley and sons.

D.D. Deshpande, Physical Chemistry of macromolecules, Vishal Publications, New Delhi, 1985.

Polymer Science, V.R. Gowarikar, N.V. Vishwanathan and J. Sreedhan,
Wiley Eastern Ltd., 1986.

(3) RADIATION CHEMISTRY(paper code – B191003T) Credit-4

Classification of nuclides, nuclear stability, binding energy and nuclear models. Characteristics of radioactive decay, decay kinetics, parent-daughter decay growth relationships, detection and measurement of radioactivity, advances in the solid and liquid scintillation counting techniques, methods for the determination of half life period of single and mixed radionuclides. Nuclear fission, nuclear fuels and nuclear reactors, nuclear fuel reprocessing, fast breeder reactors, radiological safety aspects and radioactive waste managements. Interaction of radiation with matter, effect of ionizing/ non-ionizing radiations on water, aqueous solutions and on organic compounds, radiation dosimetry. Preparation and separation of radioactive isotopes, application of radioisotopes and radiations in various fields, isotopic dilution techniques, neutron activation analysis and its applications.

Introduction to Chemical Reaction Engineering.

Rate of reaction, Elementary and Non-elementary reactions, Molecularity and Order of reaction, Mechanism of reaction, Temperature dependency from thermodynamics, Arrhenius and Collision theories.

Chemical Reactor Analysis.

Integral and differential methods for analyzing kinetic data, Interpretation of constant volume batch reactor data for zero, first, second and third order reactions, Half life period, Auto catalytic reaction, Interpretation of variable volume batch reactor data for zero, first and second order reactions, enzyme catalyzed reactions.

Introduction to Reactor Design.

Industrial reactors, Space time and Space velocity. Design of single ideal reactor - Batch, CSTR, PFR using graphical procedure. Multiple reactor system and optimum reactor size, Recycle reactors, Temperature and Pressure effects, Optimum temperature progression in a chemical reaction, Adiabatic and Non adiabatic reaction conditions and conversion.

Multiple Reaction System and Design

Multiple reactions: Independent, Parallel and Series reactions, Instantaneous and over all fractional yield, Choice of reactors for simple and complex reactions and multiple reactor system, Introduction to thermal stability of reactors, Product distribution in multiple reaction system, temperature dependence and vessel size for maximum production.

Recommended Books

1. G. Friendlander, J.W. Kennedy & J.M. Miller Nuclear and Radiochemistry, Wiley Interscience, New York.
2. B.G. Harvey, Introduction to Nuclear Physics & Chemistry, Prentice - Hall, Englewood Cliffs (N.J)/ Prentice-Hall, India, 3rd Edn.
3. R.T. Overman, Basic concept of Nuclear Chemistry, Chapman & Hall.
4. A. N. Nesmeyanov, Radiochemistry, MIR Publication, Moscow.
5. J.W.T. Spinks & R.J. Woods, An Introduction to Radiation Chemistry, Wiley, New York.
6. H. J. Arnikaar, Essentials of Nuclear Chemistry, Wiley Eastern Ltd., 2nd Edition.

(4) CORROSION (paper code – B191004T) Credit-4

Corrosion: Phenomenon of corrosion, Direct chemical corrosion and its mechanism, Electrochemical corrosion and its mechanism, various type of Corrosion, Factors influencing corrosion, corrosion control. thermodynamics of corrosion–Pourbaix diagrams, immunity,corrosivity and passivation.

Mechanism and kinetics of corrosion. Evan's diagrams. Intrinsic and extrinsic corrosion. Electrochemical methods for corrosion testing. Corrosion prevention by metallic, organic, inorganic coatings, corrosion inhibitors. Cathodic and anodic protection techniques. Corrosion in industries with reference to thermal power plants, concrete, mining and petroleum industries, prevention of microbial corrosion.

Economic Impact of corrosion, corrosion rate Expressions and Allowances, Corrosion Reactions and Free – Energy change, Characteristics of corrosions Environments, Biologically Influenced Corrosion, corrosion control by Cathodic and Anodic Protection.

Recommended Books

1. M.G. Fontana, Corrosion Engineering, McGraw Hill International Book Co, London.
 2. L.L. Shreir, Corrosion, Vol I and Vol II, Newness Butterworths, Edward Arnold Ltd, London.
- J. C. Scully, Fundamental of Corrosion, Pargmon Press Inc. New York



(5)SYNTHETIC ORGANIC CHEMISTRY (paper code – B191005T) Credit-4

Introduction to synthesis, strategies of synthesis, basic principles for designing of conventional and green synthesis, techniques for synthesis of organic compounds. Important reagents (such as dimethyl carbonate polymer supported per acids poly N-Bromosuccinimide etc) and reactions. of synthetic importance. Application of ionic liquids in organic synthesis. Identification of organic compounds by chemical and spectroscopic methods (IR, UV, NMR and Mass).

Dyes:

- Classification of dyes according to the mode of applications and according to the chemical constitution.
- Methods of preparation of commercial dyes of different classes with suitable examples, typical manufacturing processes of dyes.
- Fluorescent brightening agents.
- Dyes industries in India.

Introduction, varnishes and related products mechanism of Polymerization Deterioration of Applied Films constitution, Preparation and applications.

Production techniques, functions of ingredients and desirable characteristics of the following cosmetic products: Dentifrices, face creams, face powders Talcum Powders, hair dyes, shampoos, sharing creams, lipistics, nail polishes, deplitories etc.

Agrochemical:

- Organo Chlorine pesticides: BHC, Aldrin, Dieldrin, Endosulphan.
- Organo phosphorus pesticides: Malathion, moocrotophos, Dimethoate, chloropyriphos.
- Carbamates: Carbaryl, Bygon, Ziram Zineb, Maneb.
- Insect pheromones and Repellants; Pheromone, general introduction and application in integrated pest management (no synthesis), Repellent: benzamide, N,N, Diethylenebenzamide, 2-ethyl-1,3, hexanediol, butopytranexyl, Dimethylcarbamate, Dimethylphthalate.
- Agrochemical industries in India.

Introduction, Petroleum refining, outline of chemicals derived from methane, ethylene, propylene and butlenes; benzene, toluene and xylene; manufacture of petrochemicals, petrochemical industries in India.

Introduction, Manufacturing processes of Acetic Acid, oxalic acid, citric acid, acetic anhydride, furfural from bagasse, anhydrous alcohol, sugar based chemical industries in India.

Recommended books

- PT Anastas & J C Warner, Green Chemistry Theory & Practice ,Oxford University Press 1999.
- B.S. Furniss, A.J. Hannaford, P.W.G. Smith and A. R. Tuchell, Vogel's Text book of Practical Organic Chemistry ;
- J.R. Dyer, Applications of Absorption Spectroscopy of Organic compounds; Prentice-Hall, Englewood Cliffs, N.J., 1965
- I. Flemming and D.H. Williams, Spectroscopic methods in organic Chemistry; (4th edition),, McGraw-Hill Book company (UK) Limited, 1987.

(6) PETROCHEMICALS (paper code – B191006T) Credit-4

An overview of chemistry of petroleum, primary raw materials for petrochemicals, hydrocarbon intermediates, crude oil processing and production of hydrocarbon intermediates. Non- hydrocarbon intermediates, chemicals based on methane, ethane and higher paraffin's- ethylene, propylene, C₄ olefins and diolefins-, benzene, toluene, and xylenes, Synthetic petroleum-based polymers. .

Recommended Books:

S.Matar,L.F. Hatch; Chemistry of petrochemical process, Second edition(Mcgraw-Hill Handbook)
Robert A. Meyers; Handbook of Petrochemicals Production Processes (Mcgraw-Hill Handbook);



(7) ENZYME/ MICROBIAL ENGINEERING (paper code – B191007T) Credit-4

Source and structure of enzyme; Biosynthesis, regulation and control of enzyme in microorganisms
Kinetics of enzymatic reaction, Single and multiple substrate systems, systems, Inhibition – substrate, product and inhibitors, Analysis of kinetic data, Active and legend binding sites, Mechanism of enzyme activity; Immobilization of enzyme and whole cells; Process design and operation strategies for immobilized enzyme reactors; External and diffusional mass transfer limitation, Effectiveness factor and modulus; stabilization of enzyme, synzyme, Immobilization of multiple enzyme system; protein engineering; application of enzyme – Industrial, analytical and Medical.

Microbiological Engineering

Microbial growth; Aerobic and anaerobic growth phenomena; Synchronous culture; Mathematical modeling of microbial growth; product synthesis kinetics: Batch, fed-batch and continuous culture cultivation techniques; Growth and non-growth associated product formation; principles and mechanism of media sterilization – Thermal and membrane filtration; Batch and continuous sterilization of media; Air sterilization – Principle and design; Characteristics of biological fluids.

Fundamentals of Microbiology and Biochemistry

Isolation, identification and preservation of industrial microorganisms; Physiology and morphology of bacteria, yeast and fungi; Characteristics of viruses; bioenergetics of metabolic pathways; Elementary mass balance; Energy balance; ATP generation and YATP, Energy yielding and consuming metabolic pathway; Detoxification of Xenophobic compound; Steroid transformation.

(8) NANOMATERIALS AND NANOSTRUCTURES (paper code B191008T) Credit-4

Preparation methods: thermal and ultrasound decomposition methods. Reduction methods. Coprecipitation, spray drying, sol-gel and hydrothermal methods. Capped semiconductor nanoparticles. High energy ball milling and mechanical attrition. Thermal evaporation. Sputtering. Laser ablation. Chemical vapour deposition. Molecular beam epitaxy. Thermal spraying. Electro and electroless deposition.

Characterization techniques: TEM, SEM, AFM and STM. Optical and vibrational spectroscopy. Properties: quantum wells, wires and dots. Size and dimensionality effects. Excitons. Single electron tunneling. Applications in infrared detectors and quantum dot lasers. Magnetic properties of nanocrystalline materials. Nanostructured ferroelectric materials and nanocomposites. Nanostructured materials in catalysis and electrocatalysis. Carbon clusters compounds, Preparation and properties of carbon nanotubes. Inorganic nanotubes and nanorods, nanoporous materials.

Recommended Books:

1. Nanostructures and Nanomaterials, G. Cao.
 2. Introduction to Nanotechnology, Charles P. Poole Jr. and F.J. Owens.
- Nanostructured Materials, Carl C. Koch.



PRACTICALS (paper code – B191009P) Credit-4

Preparation: (one from each)

1. Dye: Eosin, Fluorescene
2. Drugs: Paracetamol, Aspirin, Urotropine, Oil of Wintergreen.
3. Fragrance: Oil of Nerol.
4. Soap: Simple soap.

Determinations

1. Vitamin C in citrus fruit juice.
2. Total reducing sugar Lane & Eynon method.
3. Pectin content guava fruit.
4. Hg in air, water, and fish

Extraction:

1. a. Caseine from milk.
2. b. Citral from lemon grass.
3. c. Caffeine from tea leaves.
4. d. Eugenol from clove.

Analysis

1. acid value and iodine value of in given fat/oil.
2. percentage of acetic acid in a sample of vinegar.
3. purity of commercial benzoid by IR.
4. identification of drugs by TLC.

