

Semester I

B.SC. HONOURS CHEMISTRY SCHEME EFFECTIVE FROM 2018-19		
SEMESTER I		
Course Code	University Course Type	Course Name
CHY 138	Core Theory	Inorganic Chemistry-I
CHY 139	Core Theory	Physical Chemistry-I
CHY 140	Core Practical	Inorganic Chemistry-I Lab
CHY 141	Core Practical	Physical Chemistry-I Lab
CHY 103	Ability Enhancement Course	Environmental Science
PHY 109/ BOT 103	Generic Elective-1	Mechanics/ Biomolecules and Cell Biology
PHY 110/ BOT 104		Mechanics Lab/ Biomolecules and Cell Biology Lab
CHY 119	Skill Enhancement Course (SEC)	Basic Analytical Chemistry
CHY 128		Green Methods in Chemistry
CHY 110		Pharmaceutical Chemistry

CHY138
INORGANIC CHEMISTRY-I

L-T-P-C Structure 4-0-0-4

Course Type: Core Theory

MODULE-I

Atomic Structure: Recapitulation of Bohr's theory, its limitations and atomic spectrum of hydrogen atom. Wave mechanics: de Broglie equation, Heisenberg's Uncertainty Principle and its significance, Schrödinger's wave equation, significance of ψ and ψ^2 , Quantum numbers and their significance, Normalized and orthogonal wave functions, Sign of wave functions, Radial and angular wave functions for hydrogen atom, Radial and angular distribution curves, Shapes of s, p, d and f orbitals, Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau principle and its limitations.

MODULE-II

Periodicity of Elements: Brief discussion of the following properties of the elements, with reference to *s* & *p*-block and the trends shown:

- (a) Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table.
- (b) Atomic and ionic radii
- (c) Ionization enthalpy, Successive ionization enthalpies and factors affecting ionization enthalpy and trends in groups and periods.
- (d) Electron gain enthalpy and trends in groups and periods.
- (e) Electronegativity, Pauling's/ Allred Rochow's scales, Variation of electronegativity with bond order, partial charge, group electronegativity.

MODULE-III

Ionic bond: General characteristics, types of ions, size effects, radius ratio rule and its limitations, Packing of ions in crystals, Born-Landé equation with derivation and importance of Kapustinskii expression for lattice energy, Madelung constant, Born-Haber cycle and its application, Solvation energy.

MODULE-IV

Covalent bond: Lewis structure, Valence Bond theory (Heitler-London approach), Energetics of hybridization, equivalent and non-equivalent hybrid orbitals, Valence shell electron pair repulsion theory (VSEPR), shapes of the following simple molecules and ions containing lone pairs and bond pairs of electrons: H₂O, NH₃, PCl₃, PCl₅, SF₆, ClF₃, I₃⁻, BrF₂⁺, PCI₆⁻, ICl₂⁻, ICl₄⁻ and SO₄²⁻, Bent's rule, Resonance and resonance energy, Molecular orbital theory, Molecular

orbital diagrams of diatomic and simple polyatomic molecules N_2 , O_2 , C_2 , B_2 , F_2 , CO , NO , and their ions; HCl (idea of s-p mixing and orbital interaction to be given).

MODULE-V

Multiple bonding (σ and π bond approach) and bond lengths, Covalent character in ionic compounds, polarizing power and polarizability, Fajan's rules and consequences of polarization, Ionic character in covalent compounds: Bond moment and dipole moment, Percentage ionic character from dipole moment and electronegativity difference.

Metallic Bond: Qualitative idea of valence bond and band theories, Semiconductors and insulators, defects in solids.

Weak Chemical Forces: Van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interaction, Hydrogen bonding (theories of hydrogen bonding, valence bond treatment), Effects of weak chemical forces, melting and boiling points, solubility.

Books Suggested:

1. Lee, J.D. Concise Inorganic Chemistry, Pearson Education 2010
2. Huheey, J.E., Keiter, E.A., Keiter, R. L., Medhi, O.K. Inorganic Chemistry, Principles of Structure and Reactivity, Pearson Education 2006.
3. Douglas, B.E. and Mc Daniel, D.H., Concepts & Models of Inorganic Chemistry, Oxford, 1970
4. Shriver, D.D. & P. Atkins, *Inorganic Chemistry 2nd Ed.*, Oxford University Press, 1994.
5. Day, M.C. and Selbin, J. Theoretical Inorganic Chemistry, ACS Publications 1962.

CHY139
PHYSICAL CHEMISTRY-I

L-T-P-C Structure 4-0-0-4

Course Type: Core Theory

MODULE-I

Gaseous state: Kinetic molecular model of a gas: postulates and derivation of the kinetic gas equation, collision frequency, collision diameter, mean free path and viscosity of gases, including their temperature and pressure dependence, relation between mean free path and coefficient of viscosity, calculation of δ from η , variation of viscosity with temperature and pressure, Maxwell distribution and its use in evaluating molecular velocities (average, root mean square and most probable) and average kinetic energy, law of equipartition of energy, degrees of freedom and molecular basis of heat capacities.

MODULE-II

Behaviour of real gases: Deviations from ideal gas behaviour, compressibility factor, Z , and its variation with pressure and temperature for different gases, Causes of deviation from ideal behaviour, Van der Waals equation of state, its derivation and application in explaining real gas behaviour, calculation of Boyle temperature, Isotherms of real gases and their comparison with van der Waals isotherms, continuity of states, critical state, relation between critical constants and van der Waals constants, law of corresponding states.

MODULE-III

Liquid state: Qualitative treatment of the structure of the liquid state; physical properties of liquids; vapour pressure, surface tension and coefficient of viscosity, and their determination. Effect of addition of various solutes on surface tension and viscosity. Explanation of cleansing action of detergents. Temperature variation of viscosity of liquids and comparison with that of gases.

MODULE-IV

Solid state: Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, qualitative idea of point and space groups, seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg's law.

MODULE-V

Ionic equilibria: Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect; dissociation constants of mono and diprotic acids. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts.

Buffer solutions; derivation of Henderson equation and its applications. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle. Qualitative treatment of acid – base titration curves (calculation of pH at various stages). Theory of acid–base indicators; selection of indicators and their limitations.

Books Suggested:

1. Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry Ed., Oxford University Press 13 2006.
2. Ball, D. W. Physical Chemistry Thomson Press, India 2007.
3. Castellan, G. W. Physical Chemistry 4th Ed. Narosa 2004.
4. Mortimer, R. G. Physical Chemistry 3rd Ed. Elsevier: NOIDA, UP 2009.

CHY140
INORGANIC CHEMISTRY-I LAB

L-T-P-C Structure 0-0-4-2**Course Type: Core Practical****(Any Seven)****(A) Titrimetric Analysis**

- (i) Calibration and use of apparatus
- (ii) Preparation of solutions of titrants of different Molarity /Normality

(B) Acid-Base Titrations

Principles of acid-base titrations to be discussed.

- (i) Estimation of sodium carbonate using standardized HCl.
- (ii) Estimation of carbonate and hydroxide present together in a mixture.
- (iii) Estimation of carbonate and bicarbonate present together in a mixture.
- (iv) Estimation of free alkali present in different soaps/detergents

(C) Oxidation-Reduction Titrimetry

Principles of oxidation-reduction titrations (electrode potentials) to be discussed.

- (i) Estimation of Fe(II) and oxalic acid using standardized KMnO_4 solution
- (ii) Estimation of oxalic acid and sodium oxalate in a given mixture.
- (iii) Estimation of Fe(II) with $\text{K}_2\text{Cr}_2\text{O}_7$ using internal indicator (diphenylamine, N-phenylanthranilic acid) and discussion of external indicator.

Books Suggested:

1. Vogel, A.I. A Textbook of Quantitative Inorganic Analysis, ELBS, 4th Edition, 1978.

CHY141
PHYSICAL CHEMISTRY-I LAB
L-T-P-C Structure 0-0-4-2 **Course Type: Core Practical**

(Any Seven)

1. Surface tension measurements using stalagmometer.

- a. Determine the surface tension by (i) drop number (ii) drop weight method.
- b. Study the variation of surface tension with different concentration of detergent solutions. Determine CMC.

2. Viscosity measurement using Ostwald's viscometer.

- a. Determination of co-efficient of viscosity of an unknown aqueous solution.
- b. Study the variation of co-efficient of viscosity with different concentration of Poly Vinyl Alcohol (PVA) and determine molar of PVA.
- b. Study the variation of viscosity with different concentration of sugar solutions.

3. Solid State:

- a. Indexing of a given powder diffraction pattern of a cubic crystalline system.

4. pH metry:

- a. Study the effect of addition of HCl/NaOH on pH to the solutions of acetic acid, sodium acetate and their mixtures.
- b. Preparation of buffer solutions of different pH values i. Sodium acetate-acetic acid ii. Ammonium chloride-ammonium hydroxide
- c. pH metric titration of (i) strong acid with strong base, (ii) weak acid with strong base. Determination of dissociation constant of a weak acid.

Books Suggested:

1. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co. New Delhi 2011.
2. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry 8th Ed.; McGraw-Hill: New York 2003.

3. Halpern, A. M. & McBane, G. C. Experimental Physical Chemistry 3rd Ed.; W.H. Freeman & Co.: New York 2003.

CHY103
ENVIRONMENTAL SCIENCE

L-T-P-C Structure 2-0-0-2

Course Type: AEC

MODULE-I

Introduction and natural resources: Multidisciplinary nature and public awareness, renewable and non renewable resources and associated problems, forest, water, mineral, food, energy and land resources. Introduction to natural resources, conservation of natural resources and human role.

MODULE-II

Ecosystem: Ecological concepts, concept of ecosystems, types of ecosystems, ecosystem structure and functioning, energy flow, food chains and food webs, ecological pyramids

MODULE-III

Biodiversity and Conservation: Definition, genetic species and ecosystem diversity biogeographically, classification of Indian value of biodiversity at national and local levels, India as a mega-diversity nation, threats to biodiversity and endangered and endemic species of India, need for conservation of biodiversity.

MODULE-IV

Environmental pollution: Definition, causes, effect and control of air pollution, water pollution, soil pollution, marine pollution, noise pollution, thermal pollution, electromagnetic pollution, nuclear hazards, human role in prevention of pollution, solid waste management, disaster management, floods, earthquake, cyclone, and landslide

Firework Safety: Combustion of firework and pollution (noise, smoke, fireworks fallout and residue pollution), heavy metal toxicity due to fireworks and associated health effects.

MODULE-V

Social Issue and Environment: Unsuitable to suitable development, urban problem related to energy and water conservation, environment protection act, wild life protection act, forest conservation act, environmental issues, population explosion, and family welfare programme. Environmental and human health HIV, women and child welfare, role of information technology on environment and human health.

Corruption: definition and reasons, details of organizations/agencies working against corruption, role of individual against corruption and mode of action.

Ethics : Meaning, nature, determinants and objectives of ethics, ethics and its relation to values norms and morals, Indian ethos, Swami Vivekananda and ethics.

Books Suggested:

1. Agrawal, K.C.: Fundamentals of Environmental Biology, Nidhi Publishers Bikaner, 2001.
2. Odum, E.P. Fundamentals of Ecology. W.B. Saunders Co. USA, 1971.
3. Odum E.P.: Fundamentals of Ecology, Natraj Publisher, Dehradun, 1996
4. Chapman, J.L. & Reiss, M.J.: Ecology: Principles and Applications, Cambridge University Press, 1995.
5. Professional Ethics and Human Values, Govindarajan M, PHI Learning Private Limited, Delhi, 2001
6. Corruption and Reform in India By Jennifer Bussell, Cambridge University Press, 2007.

PHY109 MECHANICS

L-T-P-C Structure 4-0-0-4

Course Type: GE-1 Theory

MODULE-I

Vectors: Vector algebra. Scalar and vector products. Derivatives of a vector with respect to a parameter.

Ordinary Differential Equations: 1st Order homogeneous differential equations. 2nd Order homogeneous differential equations with constant coefficients.

MODULE-II

Laws of Motion: Frames of reference. Newton's Laws of motion. Dynamics of a system of particles Centre of Mass.

Momentum and Energy: Conservation of momentum. Work and energy. Conservation of energy. Motion of rockets.

Rotational Motion: Angular velocity and angular momentum. Torque. Conservation of angular momentum.

MODULE-III

Gravitation: Newton's Law of Gravitation. Motion of a particle in a central force field (motion is in a plane, angular momentum is conserved, areal velocity is constant). Kepler's Laws (statement only). Satellite in circular orbit and applications. Geosynchronous orbits. Weightlessness. Basic idea of global positioning system (GPS).

MODULE-IV

Oscillations: Simple harmonic motion. Differential equation of SHM and its solutions. Kinetic and Potential Energy, Total Energy and their time averages. Damped oscillations.

Elasticity: Hooke's law - Stress-strain diagram - Elastic moduli-Relation between elastic constants -Poisson's Ratio-Expression for Poisson's ratio in terms of elastic constants-Work done in stretching and work done in twisting a wire-Twisting couple on a cylinder - Determination of Rigidity modulus by static torsion - Torsional pendulum-Determination of Rigidity modulus and moment of inertia $-q, \eta$ and λ by Searles method

MODULE-V

Special Theory of Relativity: Constancy of speed of light. Postulates of Special Theory of Relativity. Length contraction. Time dilation. Relativistic addition of velocities.

Books Suggested:

1. University Physics. FW Sears, MW Zemansky and HD Young 13/e., Addison- Wesley, 1986
2. Mechanics Berkeley Physics course, v.1: Charles Kittel. et.al, TataMcGraw- Hill, .2007
3. Physics-Resnick, Halliday & Walker 9/e, Wiley, 2010.
4. Engineering Mechanics, Basudeb Bhattacharya, 2nd edn. Oxford University Press, 2015.

BOT 101
BIOMOLECULES AND CELL BIOLOGY
L-T-P-C Structure 4-0-0-4 **Course Type:GE-1 Theory**

MODULE-I

Carbohydrates: Nomenclature and classification; Role of monosaccharides (glucose, fructose, sugar alcohols – mannitol and sorbitol); Disaccharides (sucrose, maltose, lactose), Oligosaccharides and polysaccharides (structural-cellulose, hemicelluloses, pectin, chitin, mucilage; storage – starch)

Lipids: Definition and major classes of storage and structural lipids.. Fatty acids structure and functions. Essential fatty acids. Triacyl glycerols structure, functions and properties.. Phosphoglycerides:.. Lipid functions:

Proteins: Structure of amino acids; Peptide bonds; Levels of protein structure-primary, secondary, tertiary and quarternary; Isoelectric point; Biological roles of proteins.

MODULE-II

Nucleic acids: Structure of nitrogenous bases; Structure and function of nucleotides; Types of nucleic acids; Structure of A, B, Z types of DNA; Types of RNA; Structure of tRNA.

Bioenergenetics: Laws of thermodynamics, concept of free energy, endergonic and xergonic reactions, coupled reactions, redox reactions. ATP: structure, its role as a energy currency molecule.

MODULE-III

Enzymes: Structure of enzyme: holoenzyme, apoenzyme, cofactors, coenzymes and prosthetic group; Classification of enzymes; Features of active site, substrate specificity, mechanism of action activation energy, lock and key hypothesis, induced - fit theory), Michaelis – Menten equation, enzyme inhibition and factors affecting enzyme activity.

MODULE-IV

The cell: Cell as a unit of structure and function; Characteristics of prokaryotic and eukaryotic cells; Origin of eukaryotic cell (Endosymbiotic theory).

Cell wall and plasma membrane: Chemistry, structure and function of Plant Cell Wall. Overview of membrane function; fluid mosaic model; Chemical composition of membranes; Membrane transport – Passive, active and facilitated transport, endocytosis and exocytosis

MODULE-V

Cell organelles:

Nucleus: Structure-nuclear envelope, nuclear pore complex, nuclear lamina, nucleolus.

Cytoskeleton: role and structure of microtubules, microfilaments and intermediary filament.

Chloroplast, mitochondria and peroxisomes: Structural organization; Function; Semiautonomous nature of mitochondria and chloroplast.

Endomembrane system: Endoplasmic Reticulum –proteins in the ER, protein folding, smooth ER and lipid synthesis,; Golgi Apparatus – Organization, Role. Lysosomes.

Cell division: Eukaryotic cell cycle, mitosis and meiosis. Regulation of cell cycle.

Books Suggested:

1. Campbell, MK (2012) Biochemistry, 7th ed., Published by Cengage Learning
2. Campbell, PN and Smith AD (2011) Biochemistry Illustrated, 4th ed., Published by Churchill Livingstone
3. Tymoczko JL, Berg JM and Stryer L (2012) Biochemistry: A short course, 2nd ed., W.H.Freeman
4. Berg JM, Tymoczko JL and Stryer L (2011) Biochemistry, W.H.Freeman and Company
5. Nelson DL and Cox MM (2008) Lehninger Principles of Biochemistry, 5th Edition., W.H. Freeman and Company.
6. Karp, G. (2010). Cell Biology, John Wiley & Sons, U.S.A. 6th edition.
7. Hardin, J., Becker, G., Skliensmith, L.J. (2012). Becker's World of the Cell, Pearson Education Inc. U.S.A. 8th edition.
8. Cooper, G.M. and Hausman, R.E. 2009 The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.

PHY 110
MECHANICS LAB

L-T-P-C Structure 0-0-4-2

Course Type: GE-1 Practical

1. Measurements of length (ordiameter) using vernier caliper, screw gauge and travelling microscope.
2. To determine the Height of a Building using a Sextant.
3. To determine the Moment of Inertia of a Flywheel.
4. To determine the Young's Modulus of a Wire by Optical Lever Method.
5. To determine the Modulus of Rigidity of a Wireby Maxwell's needle.
6. To determine the Elastic Constants of a Wireby Searle's method.
7. To determine g by Bar Pendulum.
8. To determine g by Kater's Pendulum.
9. To determine g and velocity for a freely falling body using Digital Timing Technique
- 10.To study the Motion of a Spring and calculate(a) Spring Constant(b)Value of g

Books Suggested:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, Asia Publishing House,1971.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted Heinemann Educational Publishers,1985.
- 3.Engineering Practical Physics, S.Panigrahi & B . Mallick, Cengage Learning India Pvt. Ltd, 2015.
4. A Text Book of Practical Physics, Indu Prakash and Ramakrishna,11th Edition, Kitab Mahal, New Delhi, 2011.

BOT 102
BIOMOLECULES AND CELL BIOLOGY LAB
L-T-P-C Structure 0-0-4-2 **Course Type: GE -1 Practical**

(Any Seven)

1. Qualitative tests for carbohydrates, reducing sugars, non-reducing sugars, lipids and proteins.
2. Study of plant cell structure with the help of epidermal peel mount of Onion/*Rhoeo*/*Crinum*.
3. Demonstration of the phenomenon of protoplasmic streaming in *Hydrilla* leaf.
4. Study the prokaryotic, eukaryotic cell and cell organelles by electron micro photographs
5. Study of cell and its organelles with the help of electron micrographs.
6. Introduction of techniques of slide preparation, stain preparation and staining
7. Study the effect of organic solvent and temperature on membrane permeability.
8. Study different stages of mitosis and meiosis.
9. Measurement of cell size by the technique of micrometry.

Books Suggested

1. Campbell, MK (2012) Biochemistry, 7th ed., Published by Cengage Learning
2. Tymoczko JL, Berg JM and Stryer L (2012) Biochemistry: A short course, 2nd ed., W.H.Freeman
3. Berg JM, Tymoczko JL and Stryer L (2011) Biochemistry, W.H.Freeman and Company
4. Nelson DL and Cox MM (2008) Lehninger Principles of Biochemistry, 5th Edition., W.H. Freeman and Company.

CHY119**BASIC ANALYTICAL CHEMISTRY****L-T-P-C Structure 0-0-2-1****Course Type: SEC**

Introduction: Introduction to Analytical Chemistry and its interdisciplinary nature. Concept of sampling. Importance of accuracy, precision and sources of error in analytical measurements. Presentation of experimental data and results, from the point of view of significant figures.

Analysis of soil: Composition of soil, Concept of pH and pH measurement, Complexometric titrations, Chelation, Chelating agents, use of indicators

- a. Determination of pH of soil samples.
- b. Estimation of Calcium and Magnesium ions as Calcium carbonate by complexometric titration.

Analysis of water: Definition of pure water, sources responsible for contaminating water, water sampling methods, water purification methods.

- a. Determination of pH, acidity and alkalinity of a water sample.
- b. Determination of dissolved oxygen (DO) of a water sample.

Analysis of food products: Nutritional value of foods, idea about food processing and food preservations and adulteration.

- a. Identification of adulterants in some common food items like coffee powder, asafoetida, chilli powder, turmeric powder, coriander powder and pulses,
- b. Analysis of preservatives and colouring matter.

Books Suggested :

1. Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. *Instrumental Methods of Analysis*. 7th Ed. Wadsworth Publishing Co. Ltd., Belmont, California, USA, 1988.
2. Skoog, D.A. Holler F.J. & Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Ed.
3. Skoog, D.A.; West, D.M. & Holler, F.J. *Fundamentals of Analytical Chemistry* 6th Ed., Saunders College Publishing, Fort Worth, 1992.
4. Harris, D. C. *Quantitative Chemical Analysis*, W. H. Freeman.
5. Dean, J. A. *Analytical Chemistry Notebook*, McGraw Hill.

6. Day, R. A. & Underwood, A. L. *Quantitative Analysis*, Prentice Hall of India.

7. Freifelder, D. *Physical Biochemistry 2nd Ed.*, W.H. Freeman and Co., N.Y. USA, 1982.

8. Cooper, T.G. *The Tools of Biochemistry*, John Wiley and Sons, N.Y. USA. 16, 1977.

CHY128

GREEN METHOD IN CHEMISTRY

L-T-P-C Structure 0-0-2-1

Course Type: SEC

Introduction: Definitions of Green Chemistry. Brief introduction of twelve principles of Green Chemistry, with examples, special emphasis on atom economy, reducing toxicity, green solvents, Green Chemistry and catalysis and alternative sources of energy, Green energy and sustainability

The following Real world Cases in Green Chemistry should be discussed:

1. Surfactants for carbon dioxide – Replacing smog producing and ozone depleting solvents with CO₂ for precision cleaning and dry cleaning of garments.
2. Designing of environmentally safe marine antifoulant.
3. Right fit pigment: Synthetic azo pigments to replace toxic organic and inorganic pigments.
4. An efficient, green synthesis of a compostable and widely applicable plastic (poly lactic acid) made from corn.

Practical

1. Preparation and characterization of biodiesel from vegetable oil.
2. Extraction of D-limonene from orange peel using liquid CO₂ prepared from dry ice.
3. Mechano chemical solvent free synthesis of azomethine.
4. Solvent free, microwave assisted one pot synthesis of phthalocyanine complex of copper(II).

Books Suggested:

1. Anastas, P.T. & Warner, J.K. *Green Chemistry- Theory and Practical*, Oxford University Press, 1998.
2. Matlack, A.S. *Introduction to Green Chemistry*, Marcel Dekker, 2001.
3. Cann, M.C. & Connely, M.E. *Real-World cases in Green Chemistry*, American Chemical Society, Washington, 2000.
4. Ryan, M.A. & Tinnesand, M. *Introduction to Green Chemistry*, American Chemical Society, Washington, 2002.
5. Sharma, R.K.; Sidhwani, I.T. & Chaudhari, M.K. *Green Chemistry Experiments: A monograph* I.K. International Publishing House Pvt Ltd. New Delhi, Bangalore.
6. Lancaster, M. *Green Chemistry: An introductory text* RSC publishing, 2nd Edition.

7. Sidhwani, I.T., Saini, G., Chowdhury, S., Garg, D., Malovika, Garg, N. Wealth from waste: A green method to produce biodiesel from waste cooking oil and generation of useful products from waste further generated.

CHY 110

PHARMACEUTICAL CHEMISTRY

L-T-P-C Structure 0-0-2-1

Course Type: SEC

Drugs & Pharmaceuticals

Drug discovery, design and development; Basic Retro synthetic approach. Synthesis of the representative drugs of the following classes: analgesics agents, antipyretic agents, anti-inflammatory agents (Aspirin, paracetamol, Ibuprofen); antibiotics (Chloramphenicol); antibacterial and antifungal agents (Sulphonamides; Sulphanethoxazol, Sulphacetamide, Trimethoprim); antiviral agents (Acyclovir), Central Nervous System agents (Phenobarbital, Diazepam), Cardiovascular (Glyceryl trinitrate), antilaprosy (Dapsone), HIV-AIDS related drugs (AZT- Zidovudine).

Fermentation

Aerobic and anaerobic fermentation. Production of

- (i) Ethyl alcohol and citric acid,
- (ii) Antibiotics; Penicillin, Cephalosporin, Chloromycetin and Streptomycin,
- (iii) Lysine, Glutamic acid, Vitamin B2, Vitamin B12 and Vitamin C.

Practical

1. Preparation of Aspirin and its analysis.
2. Preparation of magnesium bisilicate (Antacid).

Books Suggested:

1. G.L. Patrick: An Introduction to *Medicinal Chemistry*, Oxford University Press, 5th, 2013.
2. Hakishan, V.K. Kapoor: *Medicinal and Pharmaceutical Chemistry*, Vallabh Prakashan, Pitampura, New Delhi.

3. William O. Foye, Thomas L., Lemke , David A. William: *Principles of Medicinal Chemistry*, B.I. Waverly Pvt. Ltd. New Delhi, 6th Edition, 1996.

Semester II

B.SC. HONOURS CHEMISTRY SCHEME EFFECTIVE FROM 2018-19		
SEMESTER II		
Course Code	University Course Type	Course Name
CHY 142	Core Theory	Organic Chemistry-I
CHY 143	Core Theory	Physical Chemistry-II
CHY 144	Core Practical	Organic Chemistry-I Lab
CHY 145	Core Practical	Physical Chemistry-II Lab
ENG 106	Ability Enhancement Course	Professional Communication
ENG 107		Communication Technique Lab
PHY 111/ BOT105	Generic Elective -2	Electricity and Magnetism/ Biodiversity I - Algae, Fungi & Lichens
PHY112/ BOT 106		Electricity and Magnetism Lab/ Biodiversity I -Algae, Fungi & Lichens & Taxonomy Lab
CHY 113	Skill Enhancement	Chemistry of Cosmetics & Perfumes
CHY 137		Pesticide Chemistry

CHY 116	Course	Fuel Chemistry
SEP 200	Skill Enhancement Practical	Extra Curricular Activity (NSS/NCC/Scouting/ Club activity)

CHY142

ORGANIC CHEMISTRY-I

L-T-P-C Structure 4-0-0-4

Course Type: Core Theory

MODULE-I

Recapitulation of basics of Organic Chemistry: Hybridization, Shapes of molecules

Electronic Displacements: Inductive, electromeric, resonance and mesomeric effects, hyperconjugation dipole moment and hydrogen bonding (Applications to be discussed with relevant topics) Homolytic and Heterolytic fission with suitable examples. Curly arrow rules, formal charges; Electrophiles and Nucleophiles; Types, shape and relative stability of Carbocations, Carbanions, Free radicals and Carbenes.

Introduction to types of organic reactions: Addition, Elimination and Substitution reactions.

MODULE-II

Stereochemistry: Fischer, Newmann and Sawhorse Projection formulae and their interconversions; Geometrical isomerism: cis-trans, syn-anti and E/Z notations with C.I.P rules.

Optical Isomerism: Optical Activity, Specific Rotation, Chirality /Asymmetry, Enantiomers, Molecules with two or more chiral-centres, Distereoisomers, meso structures, Racemic mixture and their resolution. Relative and absolute configuration: D/L and R/S designations.

MODULE-III

Carbon-Carbon sigma bonds: General methods of preparation, physical and chemical properties of alkanes: Wurtz Reaction, Wurtz-Fittig Reactions, Free radical substitutions: Halogenation -relative reactivity and selectivity.

MODULE-IV

Carbon-Carbon pi bonds: General methods of preparation, physical and chemical properties of alkenes and alkynes, Mechanism of E1, E2, E1cb reactions. Saytzeff and Hofmann eliminations. Electrophilic additions their mechanisms (Markownikoff/ Anti Markownikoff addition), mechanism of oxymercuration-demercuration, hydroboration-oxidation, ozonolysis, reduction (catalytic and chemical), syn and anti-hydroxylation (oxidation). 1,2- and 1,4-addition reactions in conjugated dienes and Diels-Alder reaction; Allylic and benzylic bromination and mechanism, e.g. propene, 1-butene, toluene, ethyl benzene.

Reactions of alkynes: Acidity, Electrophilic and Nucleophilic additions. Hydration to form carbonyl compounds, Alkylation of terminal alkynes.

MODULE-V

Cycloalkanes and Conformational Analysis: Conformational analysis of alkanes: Relative stability and Energy diagrams. Types of cycloalkanes and their relative stability, Baeyer strain theory : Chair, Boat and Twist boat forms of cyclohexane with energy diagrams ; Relative stability of mono substituted cycloalkanes.

Aromatic Hydrocarbons: Aromaticity: Hückel's rule, aromatic character of arenes, cyclic carbocations/carbanions and heterocyclic compounds with suitable examples. Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acylation with their mechanism. Directing effects of the groups.

Books Suggested:

1. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Edu) 1997.
3. Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education) .
4. Eliel, E. L. & Wilen, S. H. Stereochemistry of Organic Compounds; Wiley: London, 1994.
5. Kalsi, P. S. Stereochemistry Conformation and Mechanism; New Age International, 2005.

CHY143**PHYSICAL CHEMISTRY-II****L-T-P-C Structure 4-0-0-4****Course Type: Core Theory****MODULE-I**

Chemical Thermodynamics: Intensive and extensive variables; state and path functions; isolated, closed and open systems.

First law: Concept of heat, Q , work, W , internal energy, U , and statement of first law; enthalpy, H , relation between heat capacities, calculations of Q , W , ΔU and ΔH for reversible, irreversible and free expansion of gases (ideal and van der Waals) under isothermal and adiabatic conditions. Thermochemistry: Heats of reactions: standard states; enthalpy of formation and enthalpy of combustion and its applications; effect of temperature (Kirchhoff's equations) and pressure on enthalpy of reactions.

MODULE-II

Second Law: Concept of entropy; thermodynamic scale of temperature, statement of the second law of thermodynamics. Calculation of entropy change for reversible and irreversible processes.

Third Law: Statement of third law, concept of residual entropy, calculation of absolute entropy of molecules. Free Energy Functions: Gibbs and Helmholtz energy; variation of S , G , A with T , V , P ; Free energy change and spontaneity. Relation between Joule-Thomson coefficient and other thermodynamic parameters; inversion temperature; Gibbs-Helmholtz equation; Maxwell relations; thermodynamic equation of state.

MODULE-III

Systems of Variable Composition: Partial molar quantities, dependence of thermodynamic parameters on composition; Gibbs Duhem equation, chemical potential of ideal mixtures, change in thermodynamic functions in mixing of ideal gases

MODULE-IV

Chemical Equilibrium: Criteria of thermodynamic equilibrium, degree of advancement of reaction, chemical equilibria in ideal gases. Thermodynamic derivation of relation between

Gibbs free energy of reaction and reaction quotient. Equilibrium constants and their quantitative dependence on temperature, pressure and concentration (Le Chatelier Principle, Quantitatively). Free energy of mixing and spontaneity. equilibrium between ideal gases and a pure condensed phase.

MODULE-V

Solutions and Colligative Properties: Dilute solutions; lowering of vapour pressure, Raoult's and Henry's Laws and their applications. Thermodynamic derivation using chemical potential to derive relations between the four colligative properties [(i) relative lowering of vapour pressure, (ii) elevation of boiling point, (iii) Depression of freezing point, (iv) osmotic pressure] and amount of solute. Applications in calculating molar masses of normal, dissociated and associated solutes in solution.

Books Suggested:

1. Peter, A. & Paula, J. de. Physical Chemistry 9th Ed., Oxford University Press 2011.
2. Castellan, G. W. Physical Chemistry 4th Ed., Narosa 2004.
3. Engel, T. & Reid, P. Physical Chemistry 3rd Ed., Prentice-Hall 2012.
4. McQuarrie, D. A. & Simon, J. D. Molecular Thermodynamics Viva Books Pvt. Ltd.: New Delhi 2004.
5. Assael, M. J.; Goodwin, A. R. H.; Stamatoudis, M.; Wakeham, W. A. & Will, S. Commonly Asked Questions in Thermodynamics. CRC Press: NY 2011.

CHY144
ORGANIC CHEMISTRY-I LAB
L-T-P-C Structure 0-0-4-2 **Course Type: Core Practical**

1. Checking the calibration of the thermometer
2. Purification of organic compounds by crystallization using the following solvents:
 - a. Water
 - b. Alcohol
 - c. Alcohol-Water
3. Determination of the melting points of unknown organic compounds (Kjeldahl method and electrically heated melting point apparatus)
4. Effect of impurities on the melting point – mixed melting point of two unknown organic compounds
5. Determination of boiling point of liquid compounds. (boiling point lower than and more than 100 °C by distillation and capillary method)
6. Chromatography
 - a. Separation of a mixture of two amino acids by ascending and horizontal paper chromatography
 - b. Separation of a mixture of two sugars by ascending paper chromatography
 - c. Separation of a mixture of o-and p-nitrophenol or o-and p-aminophenol by thin layer chromatography (TLC)
7. Detection of extra elements
8. Organic Preparations
 - (i) Bromination of acetanilide / aniline / phenol

(ii) Nitration of nitrobenzene / toluene.

Books Suggested:

1. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education 2009.
2. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson ,2012.

CHY145**PHYSICAL CHEMISTRY-II LAB****L-T-P-C Structure 0-0-4-2****Course Type: Core Practical****(Any Five)****Thermochemistry:**

- (a) Determination of heat capacity of a calorimeter for different volumes using
 - (i) change of enthalpy data of a known system (method of back calculation of heat capacity of calorimeter from known enthalpy of solution of sulphuric acid or enthalpy of neutralization),
 - (ii) heat gained equal to heat lost by cold water and hot water respectively
 - (b) Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
 - (c) Determination of the enthalpy of ionization of ethanoic acid.
 - (d) Determination of integral enthalpy (endothermic and exothermic) solution of salts.
 - (e) Determination of basicity of a diprotic acid by the thermochemical method in terms of the changes of temperatures observed in the graph of temperature versus time for different additions of a base. Also calculate the enthalpy of neutralization of the first step.
 - (f) Determination of enthalpy of hydration of salt.
 - (g) Study of the solubility of benzoic acid in water and determination of ΔH .
- Any other experiment carried out in the class.

Books Suggested

1. Khosla, B. D.; Garg, V. C. & Gulati, A., Senior Practical Physical Chemistry, R. Chand & Co.:

- Athawale, V. D. & Mathur, P. Experimental Physical Chemistry New Age International: New Delhi, 2001.

ENG 106 PROFESSIONAL COMMUNICATION

L-T-P-C Structure 2-0-0-2

Course Type: AEC

MODULE-I

Fundamentals of Communication:

- Introduction , Definition , Process , Importance, Different Forms and Purpose of Communication
- Barriers to Communication
- Organization and Interpersonal Communication

MODULE-II

Group Discussion

- Introduction to Group Discussion
- Types, Roles and Functions in Group Discussion
- Difference between GD and Debate
- Preparation Strategy
- Tips for a good GD

MODULE-III

Presentation:

- Fundamentals of Presentation
- Audience Analysis
- Organizing Material Effective Presentation
- Question –Answer Session

MODULE-IV

Professional Writing :

- Official Correspondence- Drafting E-mails, Memorandum, Notice, agenda, Minutes, Circulars
- Business Correspondence-Business letter writing, sales letters, Enquiry letters and replies to enquiry(enquiry about a product, service or information, asking for a quotation, placing an order and replies to the same) letters of Claim and Adjustment.

MODULE-V**Technical Writing**

- Report Writing- General and Technical report, Definition, Types, structure
- Technical proposals-Definitions, Types and Format

Books Suggested:

1. Communication Skills, Pushp Lata, Sanjay Kumar, Oxford Higher Education/Oxford University Press , 2011.
2. Technical Communication, Principles and Practice, Meenakshi Raman & Sangita Sharma, Oxford University Press
3. Effective Technical Communication, M Ashraf Rizvi, Tata McGraw –Hill Education
4. Basic Communication Skills for Technology, Andre J Rutherford , Person Education Asia.

ENG 107**COMMUNICATION TECHNIQUE LAB****L-T-P-C Structure 0-0-2-1****Course Type: AEC**

- Phonetics Symbols and Transcriptions
- Methods of word formation
- Reading , Listening and speaking Skills
- Seminar Presentation
- Group Discussion
- Job Interview

Books Suggested:

1. Advanced Manual for Communication Laboratories and Technical report Writing, D.Sindha Rani, Pearson (New Delhi)
2. A Course in Phonetics and Spoken English , J. Sethi & P.V.Dhamija, PHI Learning Pvt. Ltd.
3. English Language Laboratories: A Comprehensive manual, Nira Konar , PHI Learning Pvt.Ltd.
4. Oxford English Learning Package (with CDs: Headway Series)
5. Tata McGraw hills English Learning package (with CDs), 2005
6. Oxford advanced Learners Dictionary by Oxford University Press (New Delhi)

PHY 111
ELECTRICITY AND MAGNETISM

L-T-P-C Structure 4-0-0-4

Course Type: GE-2 theory

MODULE-I

Vector Analysis: Review of vector algebra (Scalar and Vector product), gradient, divergence, Curl and their significance, Vector Integration, Line, surface and volume integrals of Vector fields, Gauss-divergence theorem and Stoke's theorem of vectors (statement only).

MODULE-II

Electrostatics: Gauss's theorem of electrostatics. Electric field due to point charge, infinite line of charge, uniformly charged spherical shell and solid sphere, plane charged sheet, charged conductor. Electric potential as line integral of electric field, potential due to a point charge, electric dipole, uniformly charged spherical shell and solid sphere. Parallel plate, spherical and cylindrical condenser. Energy per unit volume in electrostatic field. Displacement vector.

MODULE-III

Magnetism: Magnetostatics: Biot-Savart's law & its applications- straight conductor, circular coil, solenoid carrying current. Divergence and curl of magnetic field. Magnetic vector potential. Ampere's circuital law. Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility. Brief introduction of dia-, para- and ferro- magnetic materials.

MODULE-IV

Electromagnetic Induction: Faraday's laws of electromagnetic induction, Motional Emf, Lenz's law, Self and mutual inductance, L of single coil, M of two coils, Application of mutual inductance to transformer, Magnetic energy density.

MODULE-V

Maxwell's equations and Electromagnetic wave propagation: Equation of continuity of current, Displacement current, Maxwell's equations, Poynting vector, energy density in electromagnetic field, electromagnetic wave propagation through vacuum and isotropic dielectric medium, transverse nature of EM waves, polarization.

Books Suggested:

1. Electricity and Magnetism, Edward M. Purcell, McGraw-Hill Education, 1986.
2. Electricity and Magnetism, J.H. Fewkes & J.Yarwood.Vol.I, Oxford Univ. Press, 1991.
3. Electricity and Magnetism, D C Tayal, Himalaya Publishing House, 1988.
4. University Physics ,Ronald Lane Reese, Thomson Brooks/Cole, 2003.
5. D.J. Griffiths, Introduction to Electrodynamics, 3rd Edn, Benjamin Cummings, 1998.

BOT 105**BIODIVERSITY I -ALGAE, FUNGI & LICHENS****L-T-P-C Structure 4-0-0-4****Course Type: GE-2 Theory****Module -I**

Algae- General characteristics; Ecology and distribution; range of thallus organization; Cell structure and components; cell wall, pigment system, reserve food ; flagella; methods of reproduction. Classification; criteria, system of Fritsch, and evolutionary classification of Lee (only upto groups) Role of algae in the environment, agriculture, biotechnology and industry

Module-II

Chlorophytaceae-General characteristics; Occurrence; Range of thallus organization; Cell structure; Reproduction.Morphology and life-cycles of *Chlamydomonas*, *Volvox*, *Chara*.

Phaeophyceae- Characteristics; Occurrence; Range of thallus organization; Cell structure; Reproduction.Morphology and life-cycles of *Ectocarpus* & *Fucus*

Rhodophyceae- characteristics; Occurrence; Range of thallus organization; Cell structure; Reproduction. Morphology and life-cycles of Polysiphonia.

Xanthophyceae - characteristics; Occurrence; Range of thallus organization; Cell structure; Reproduction.Morphology and life-cycles of *Voucheria*

Module-III

Fungi- General characteristics; Affinities with plants and animals; Thallus organization; Cell wall composition; Nutrition; Classification

Chytridiomycotina- Characteristic features; Ecology and significance; Thallus organisation; Reproduction; Life cycle with reference to allomyces.

Oomycota- General characteristics; Ecology; Life cycle and classification with reference to *Phytophthora* ,*Albugo*.

Zygomycota- General characteristics; Ecology; Life cycle and classification with reference to *Mucor*, *Rhizopus*.

Module- IV

Ascomycota- Characteristic features; Ecology and significance; Thallus organisation; Reproduction; Life cycle with reference to *Saccharomyce*, *Penicillium*, *Aspergillus*.

Basidiomycota- - Characteristic features; Ecology and significance; Thallus organisation; Reproduction; Life cycle with reference to *Ustilago*, *Puccinia*.

Deuteromycotina- Characteristic features; Ecology and significance; Thallus organisation; Reproduction; Life cycle with reference to *Alterneria*.

Module- V

Lichens- Occurrence; General characteristics; Growth forms and range of thallus organization; Classification, Nature of associations of algal and fungal partners; Reproduction; Mycorrhiza- Ectomycorrhiza, Endomycorrhiza and their significance.

Books Suggested:-

1. Singh, V., Pandey, P. C. and Jain, D. K. 2001. A Text book of Botany. Rastogi Publication, Meerut
2. Vashitha, B. R. 2002. Botany for degree students (Algae and Bryophytes). S. Chand and Co. Ltd., New Delhi.
3. Bold, H.C. & Wayne, M.J. 1996 (2nd Ed.) Introduction to Algae.
4. Van den Hoek, C.; Mann, D. J. & Jahns, H.M. 1995. Algae: An introduction to Phycology.
5. Bold, H. C. and Wayne, M. J. 1996. Introduction to Algae. 2nd Edition. Prentice Hall, Inc. Englewood Cliffs, New Jersey.
6. Ghemawat, M. S., Kapoor, J. N. and Narayan, H. S. 1976. A Text book of Algae. Ramesh Book Depot., Jaipur.
7. Gilbert, M. S. 1985. Cryptogamic Botany. Vol. I and II second edition. Tata McGraw Hill Publishing Co. Ltd., New Delhi

PHY 112
ELECTRICITY AND MAGNETISUM LAB

L-T-P-C Structure 0-0-4-2

Course Type: Core Practical

1. To use a Multimeter for measuring
 - (a) Resistances,
 - (b) AC and DC Voltages,
 - (c) DC Current, and
 - (d) checking electrical fuses.
2. Ballistic Galvanometer:
 - (i) Measurement of charge and current sensitivity
 - (ii) Measurement of CDR
 - (iii) Determine a high resistance by Leakage Method
 - (iv) To determine Self Inductance of a Coil by Rayleigh's Method.
3. To compare capacitances using De'Sauty's bridge.
4. Measurement of field strength B and its variation in a Solenoid (Determine dB/dx).
5. To study the Characteristics of a Series RC Circuit.
6. To study the a series LCR circuit and determine its (a)Resonant Frequency,(b) Quality Factor
7. To study a parallel LCR circuit and determine its
 - (a)Anti-resonant frequency and
 - (b)Quality factor Q
8. To determine a Low Resistance by Carey Foster's Bridge.
9. To verify the venin and Norton theorem
- 10.To verify the Superposition, and Maximum Power Transfer Theorem

Books Suggested:

1. Advanced Practical Physics for students, B.L.Flint &H.T.Worsnop,1971,Asia Publishing House.
2. A Text Book of Practical Physics, Indu Prakash and Ramakrishna,11thEdition,2011, Kitab Mahal, New Delhi.
3. Engineering Practical Physics, S.Panigrahi & B.Mallick, 2015,Cengage Learning India Pvt. Ltd.
4. Advanced level Physics Practical's, Michael Nelson and Jon M. Ogborn, 4thEdition, reprinted 1985, Heinemann Educational Publishers

BOT106**BIODIVERSITY - I ALGAE, FUNGI & LICHENS LAB****L-T-P-C Structure 0-0-4-2****Course Type: GE-2 Practical**

- Introduction of handling and maintenance of laboratory equipments
- Double staining technique and technique for preparation of permanent slides.
- **Algae**- Study of the vegetative and reproductive structures in *Nostoc*, *Chlamydomonas*, *Volvox*, *Chara*, *Vaucheria*, *Polysiphonia*
- **Fungi**- Introduction to the world of fungi (Unicellular, coenocytic/septate mycelium, ascocarps & basidiocarps).
- Preparation of slides and study of following genera through temporary mounts and permanent slides:
Albugo, *Aspergillus*, *Puccinia*, *Ustilago*, *Alternaria* .
- **Lichens**: Study of growth forms of lichens (crustose, foliose and fruticose) on different substrates. Study of thallus and reproductive structures (soredia and apothecium) through permanent slides. Mycorrhizae: ectomycorrhiza and endomycorrhiza (Photographs)

Books Suggested:-

1. Singh, V., Pandey, P. C. and Jain, D. K. 2001. A Text book of Botany. Rastogi Publication, Meerut
2. Vashitha, B. R. 2002. Botany for degree students (Algae and Bryophytes). S. Chand and Co. Ltd., New Delhi.
3. Bold, H.C. & Wayne, M.J. 1996 (2nd Ed.) Introduction to Algae.
4. Van den Hoek, C.; Mann, D.J. & Jahns, H.M. 1995. Algae: An introduction to Phycology.

CHY113
CHEMISTRY OF COSMETICS & PERFUMES
L-T-P-C Structure 0-0-4-2 **Course Type: SEC**

A general study including preparation and uses of the following: Hair dye, hair spray, shampoo, suntan lotions, face powder, lipsticks, talcum powder, nail enamel, creams (cold, vanishing and shaving creams), antiperspirants and artificial flavours. Essential oils and their importance in cosmetic industries with reference to Eugenol, Geraniol, sandalwood oil, eucalyptus, rose oil, 2-phenyl ethyl alcohol, Jasmone, Civetone, Muscone.

Practical

1. Preparation of talcum powder.
2. Preparation of shampoo.
3. Preparation of enamels.
4. Preparation of hair remover.
5. Preparation of face cream.
6. Preparation of nail polish and nail polish remover.

Books Suggested:

1. E. Stocchi: *Industrial Chemistry*, Vol -I, Ellis Horwood Ltd. UK.
2. P.C. Jain, M. Jain: *Engineering Chemistry*, Dhanpat Rai & Sons, Delhi.
3. Sharma, B.K. & Gaur, H. *Industrial Chemistry*, Goel Publishing House, Meerut 1996

CHY137
PESTICIDE CHEMISTRY

L-T-P-C Structure 0-0-4-2

Course Type: SEC

General introduction to pesticides (natural and synthetic), benefits and adverse effects, changing concepts of pesticides, structure activity relationship, synthesis and technical manufacture and uses of representative pesticides in the following classes: Organochlorines (DDT, Gammexene,); Organophosphates (Malathion, Parathion); Carbamates (Carbofuran and carbaryl); Quinones (Chloranil), Anilides (Alachlor and Butachlor).

Practicals

- 1 To calculate acidity/alkalinity in given sample of pesticide formulations as per BIS specifications.
- 2 Preparation of simple organophosphates, phosphonates and thiophosphates

Books Suggested:

1. Cremllyn, R. *Pesticides. Preparation and Modes of Action*, John Wiley & Sons, New York, 1978.

CHY116
FUEL CHEMISTRY

L-T-P-C Structure 0-0-4-2

Course Type: SEC

Review of energy sources (renewable and non-renewable). Classification of fuels and their calorific value.

Coal: Uses of coal (fuel and nonfuel) in various industries, its composition, carbonization of coal. Coal gas, producer gas and water gas—composition and uses. Fractionation of coal tar, uses of coal tar bases chemicals, requisites of a good metallurgical coke, Coal gasification (Hydro gasification and Catalytic gasification), Coal liquefaction and Solvent Refining.

Petroleum and Petrochemical Industry: Composition of crude petroleum, Refining and different types of petroleum products and their applications.

Fractional Distillation (Principle and process), Cracking (Thermal and catalytic cracking), Reforming Petroleum and non-petroleum fuels (LPG, CNG, LNG, bio-gas, fuels derived from biomass), fuel from waste, synthetic fuels (gaseous and liquids), clean fuels. Petrochemicals: Vinyl acetate, Propylene oxide, Isoprene, Butadiene, Toluene and its derivatives Xylene.

Lubricants: Classification of lubricants, lubricating oils (conducting and non-conducting) Solid and semisolid lubricants, synthetic lubricants. Properties of lubricants (viscosity index, cloud point, pour point) and their determination.

Books Suggested :

1. Stocchi, E. *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK ,1990.
2. Jain, P.C. & Jain, M. *Engineering Chemistry* Dhanpat Rai & Sons, Delhi.
3. Sharma, B.K. & Gaur, H. *Industrial Chemistry*, Goel Publishing House, Meerut , 1996.

Semester III

B.SC. HONOURS CHEMISTRY SCHEME EFFECTIVE FROM 2018-19		
SEMESTER III		
Course Code	University Course Type	Course Name
CHY 146	Core Theory	Inorganic Chemistry-II
CHY 147	Core Theory	Organic Chemistry-II
CHY 148	Core Theory	Physical Chemistry-III
CHY 149	Core Practical	Inorganic Chemistry-II Lab
CHY 150	Core Practical	Organic Chemistry-II Lab

CHY 151	Core Practical	Physical Chemistry-III Lab
PHY 113/ BOT 113	Generic Elective -3	Thermal Physics and Statistical Mechanics /Microbiology
PHY114/ BOT 114		Thermal Physics & Statistical Mechanics Lab /Microbiology Lab

CHY 146**INORGANIC CHEMISTRY-II****L-T-P-C Structure 4-0-0-4****Course Type: Core theory****MODULE-I**

General Principles of Metallurgy: Chief modes of occurrence of metals based on standard electrode potentials. Ellingham diagrams for reduction of metal oxides using carbon and carbon monoxide as reducing agent. Electrolytic Reduction, Hydrometallurgy with reference to cyanide process for silver and gold. Methods of purification of metals: Electrolytic process, van Arkel-de Boer process and Mond's process, Zone refining.

MODULE-II**Chemistry of s Block Elements:**

- (i) General characteristics: melting point, flame colour, reducing nature, diagonal relationships and anomalous behavior of first member of each group.
- (ii) Reactions of alkali and alkaline earth metals with oxygen, hydrogen, nitrogen and water.
- (iii) Common features such as ease of formation, thermal stability and solubility of the following alkali and alkaline earth metal compounds: hydrides, oxides, peroxides, superoxides, carbonates, nitrates, sulphates.
- (iv) Solutions of alkali metals in liquid ammonia and their properties.

MODULE-III**Chemistry of p Block Elements:**

Electronic configuration, atomic and ionic size, metallic/non-metallic character, melting point, ionization enthalpy, electron gain enthalpy, electronegativity, Allotropy of C, P, S; inert pair effect, diagonal relationship between B and Si and anomalous behaviour of first member of each group.

MODULE-IV

Structure, bonding and properties: acidic/basic nature, stability, ionic/covalent nature, oxidation/reduction, hydrolysis, action of heat of the following:

Hydrides: hydrides of Group 13 (only diborane), Group 14, Group 15 (EH₃ where E =N, P, As, Sb, Bi), Group 16 and Group 17. Oxides: oxides of phosphorus, sulphur and chlorine
Oxoacids: oxoacids of phosphorus and chlorine; peroxyacids of sulphur
Halides: halides of silicon and phosphorus

MODULE-V

Preparation, properties, structure and uses of the following compounds:

Borazine, Silicates, silicones, Phosphonitrilic halides {(PNCl₂)_n where n = 3 and 4}, Interhalogen and pseudohalogen compounds, Clathrate compounds of noble gases, xenon fluorides (MO treatment of XeF₂).

Books Suggested :

1. Lee, J.D. Concise Inorganic Chemistry, Pearson Education 2010
2. Douglas, B.E; Mc Daniel, D.H. & Alexander, J.J. *Concepts & Models of Inorganic Chemistry 3rd Ed.*, John Wiley Sons, N.Y. 1994.
3. Greenwood, N.N. & Earnshaw. *Chemistry of the Elements*, Butterworth- Heinemann.1997.
4. Cotton, F.A. & Wilkinson, G. *Advanced Inorganic Chemistry*, Wiley, VCH, 1999.
5. Miessler, G. L. & Donald, A. Tarr. *Inorganic Chemistry 3rd Ed.(adapted)*, Pearson, 2009
6. Shriver, D.F., Atkins P.W and Langford, C.H., *Inorganic Chemistry 2nd Ed.*, OxfordUniversity Press, 1994

CHY 147

ORGANIC CHEMISTRY-II

L-T-P-C Structure 4-0-0-4

Course Type: Core theory

MODULE-I

Chemistry of Halogenated Hydrocarbons:

Alkyl halides: Methods of preparation and properties, nucleophilic substitution reactions – S_N1, S_N2 and S_Ni mechanisms with stereochemical aspects and effect of solvent etc.; nucleophilic substitution vs. elimination.

Aryl halides: Preparation (including preparation from diazonium salts) and properties, nucleophilic aromatic substitution; S_NAr, Benzyne mechanism. Relative reactivity of alkyl, allyl, benzyl, vinyl and aryl halides towards nucleophilic substitution reactions.

Organometallic compounds of Mg (Grignard reagent) – Use in synthesis of organic compounds.

MODULE-II

Alcohols: Preparation, properties and relative reactivity of 1°, 2°, 3° alcohols, Bouvaelt-Blanc Reduction; Oxidation of diols by periodic acid and lead tetraacetate, Pinacol-Pinacolone rearrangement

MODULE-III

Phenols, Ethers and Epoxides:

Phenols: Preparation and properties; Acidity and factors effecting it, Ring substitution reactions, Reimer–Tiemann and Kolbe’s–Schmidt Reactions, Fries and Claisen rearrangements with mechanism.

Ethers and Epoxides: Preparation and reactions with acids. Reactions of epoxides with alcohols, ammonia derivatives and LiAlH₄

MODULE-IV

Carbonyl Compounds: Structure, reactivity, preparation and properties; Nucleophilic additions, Nucleophilic addition-elimination reactions with ammonia derivatives with mechanism; Mechanisms of Aldol and Benzoin condensation, Knoevenagel condensation, Claisan-Schmidt,

Perkin, Cannizzaro and Wittig reaction, Beckmann and Benzil- Benzilic acid rearrangements, haloform reaction and Baeyer Villiger oxidation, α – substitution reactions, oxidations and reductions (Clemmensen, Wolff-Kishner, LiAlH_4 , NaBH_4 , MPV, PDC) Addition reactions of α , β - unsaturated carbonyl compounds: Michael addition.

Active methylene compounds: Keto-enol tautomerism. Preparation and synthetic applications of diethyl malonate and ethyl acetoacetate.

MODULE-V

Carboxylic Acids and their Derivatives: General methods of preparation, physical properties and reactions of monocarboxylic acids, effect of substituents on acidic strength. Typical reactions of dicarboxylic acids, hydroxy acids and unsaturated acids. Preparation and reactions of acid chlorides, anhydrides, esters and amides; Comparative study of nucleophilic substitution at acyl group -Mechanism of acidic and alkaline hydrolysis of esters Claisen condensation, Dieckmann and Reformatsky reactions, Hofmann- bromamide degradation and Curtius rearrangement.

Books Suggested :

1. Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).2000
2. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).2001
3. Graham Solomons, T.W. Organic Chemistry, John Wiley & Sons, Inc.2005

CHY 148

PHYSICAL CHEMISTRY-III

L-T-P-C Structure 4-0-0-4

Course Type: Core theory

MODULE-I

Phase Equilibria: Concept of phases, components and degrees of freedom, derivation of Gibbs Phase Rule for nonreactive and reactive systems; Clausius-Clapeyron equation and its applications to solid-liquid, liquid-vapour and solid-vapour equilibria, phase diagram for one component systems (H_2O and S), with applications. Phase diagrams for systems of solid-liquid equilibria involving eutectic, congruent and incongruent melting points.

MODULE-II

Three component systems: triangular plots, water-chloroform-acetic acid system. Binary solutions: Gibbs-Duhem- Margules equation, its derivation and applications to fractional distillation of binary miscible liquids (ideal and non ideal), azeotropes, lever rule, partial miscibility of liquids, CST, miscible pairs, steam distillation. Nernst distribution law: its derivation and applications.

MODULE-III

Electrochemical Cells: Rules of oxidation/reduction of ions based on half-cell potentials, applications of electrolysis in metallurgy and industry. Chemical cells, reversible and irreversible cells with examples. Electromotive force of a cell and its measurement, Nernst equation; Standard electrode (reduction) potential and its application to different kinds of half-cells.

MODULE-IV

Application of EMF measurements: in determining (i) free energy, enthalpy and entropy of a cell reaction, (ii) equilibrium constants, and (iii) pH values, using hydrogen, quinone-hydroquinone, glass and $\text{SbO/Sb}_2\text{O}_3$ electrodes. Concentration cells with and without transference, liquid junction potential; determination of activity coefficients and transference numbers. Qualitative discussion of potentiometric titrations (acid-base, redox, precipitation).

MODULE-V

Surface chemistry: Physical adsorption, chemisorption, adsorption isotherms (Langmuir and Freundlich). nature of adsorbed state. Qualitative discussion of BET.

Books Suggested :

1. Peter Atkins & Julio De Paula, Physical Chemistry 9th Ed., Oxford University Press 2010.
2. Castellan, G. W. Physical Chemistry, 4th Ed., Narosa 2004.
3. McQuarrie, D. A. & Simon, J. D., Molecular Thermodynamics, Viva Books Pvt. Ltd.: New Delhi 2004
4. Engel, T. & Reid, P. Physical Chemistry 3rd Ed., Prentice-Hall 2012.
5. Zundhal, S.S. Chemistry concepts and applications Cengage India 2011.
6. Mortimer, R. G. Physical Chemistry 3rd Ed., Elsevier: NOIDA, UP 2009.
7. Levine, I. N. Physical Chemistry 6th Ed., Tata McGraw-Hill 2011.
8. Metz, C. R. Physical Chemistry 2nd Ed., Tata McGraw-Hill 2009.

CHY 149

INORGANIC CHEMISTRY-II LAB

L-T-P-C Structure 0-0-4-2

Course Type: Core practical

(A) Iodo / Iodimetric Titrations

- (i) Estimation of Cu(II) and $K_2Cr_2O_7$ using sodium thiosulphate solution(Iodometrically).
- (ii) Estimation of antimony in tartar-emetic iodimetrically

(B) Complexometric titrations using disodium salt of EDTA

- (i) Estimation of Mg^{2+} , Zn^{2+}
- (ii) Estimation of Ca^{2+} by substitution method

(C) Inorganic preparations

- (i) Cuprous Chloride, Cu_2Cl_2
- (ii) Manganese(III) phosphate, $MnPO_4 \cdot H_2O$
- (iii) Aluminium potassium sulphate $KAl(SO_4)_2 \cdot 12H_2O$ (Potash alum) or Chrome alum.

Books Suggested :

1. Vogel, A.I. *A Textbook of Quantitative Inorganic Analysis*, ELBS. 1978
2. Marr, G. and Rockett, R.W. *Practical Inorganic Chemistry*, Van Nostrand Reinhold. 1972.

CHY 150
ORGANIC CHEMISTRY-II LAB
L-T-P-C Structure 0-0-4-2 **Course Type: Core practical**

1. Functional group tests for alcohols, phenols, carbonyl and carboxylic acid group.
2. Organic preparations:
 - i. Acetylation of one of the following compounds: amines (aniline, o-, m-, p- toluidines and o-, m-, p-anisidine) and phenols (β -naphthol, vanillin, salicylic acid) by any one method:
 - a. Using conventional method.
 - b. Using green approach
 - ii. Benzoylation of one of the following amines (aniline, o-, m-, p- toluidines and o-, m-, p-anisidine) and one of the following phenols (β -naphthol, resorcinol, p- cresol) by Schotten-Baumann reaction.
 - iii. Oxidation of ethanol/ isopropanol (Iodoform reaction).
 - iv. Selective reduction of meta dinitrobenzene to m-nitroaniline.
 - v. Hydrolysis of amides and esters.
 - vi. Semicarbazone of any one of the following compounds: acetone, ethyl methyl ketone, cyclohexanone, benzaldehyde.
 - vii. S-Benzylisothiuronium salt of one each of water soluble and water insoluble acids (benzoic acid, oxalic acid, phenyl acetic acid and phthalic acid).
 - viii. Aldol condensation using either conventional or green method.

The above derivatives should be prepared using 0.5-1g of the organic compound. The solid Samples must be collected and may be used for recrystallization and melting point.

Books Suggested :

1. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education 2009
2. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson 2012
3. Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press 2000.
4. Ahluwalia, V.K. & Dhingra, S. Comprehensive Practical Organic Chemistry: Qualitative Analysis, University Press 2000.

CHY 151

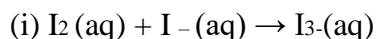
PHYSICAL CHEMISTRY-III LAB

L-T-P-C Structure 0-0-4-2

Course Type: Core practical

Phase Equilibria:

- I. Determination of critical solution temperature and composition at CST of the phenol water system and to study the effect of impurities of sodium chloride and succinic acid on it.
- II. Phase equilibria: Construction of the phase diagram using cooling curves or ignition tube method: a. simple eutectic and b. congruently melting systems.
- III. Distribution of acetic/ benzoic acid between water and chloroform or cyclohexane.
- IV. Study the equilibrium of at least one of the following reactions by the distribution method:



Potentiometry:

- V. Perform the following potentiometric titrations:
 - i. Strong acid vs. strong base
 - ii. Weak acid vs. strong base
 - iii. Dibasic acid vs. strong base
 - iv. Potassium dichromate vs. Mohr's salt

Suggested Books:

1. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi 2011.
2. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry 8th Ed.; McGraw-Hill: New York 2003.

3. Halpern, A. M. & Mc Bane, G. C. Experimental Physical Chemistry 3rd Ed.; W.H.Freeman & Co.: New York 2003.

PHY113

THERMAL PHYSICS AND STATISTICAL MECHANICS

L-T-P-C Structure 4-0-0-4

Course Type: GE-3 theory

MODULE-I

Laws of Thermodynamics: Thermodynamic Description of system: Zeroth Law of thermodynamics and temperature. First law and internal energy, conversion of heat into work, Various Thermodynamical Processes, Applications of First Law: General Relation between CP & CV, Work Done during Isothermal and Adiabatic Processes, Compressibility & Expansion Coefficient.

MODULE-II

Reversible & irreversible processes, Second law & Entropy, Carnot's cycle & theorem, Entropy changes in reversible & irreversible processes, Entropy-temperature diagrams, Third law of thermodynamics, Unattainability of absolute zero. Thermodynamic Potentials: Enthalpy, Gibbs, Helmholtz and Internal Energy functions, Maxwell's relations & applications.

MODULE-III

Joule-Thompson Effect, Clausius- Clapeyron Equation, Expression for $(C_P - C_V)$, C_P/C_V , TdS equations. Kinetic Theory of Gases: Derivation of Maxwell's law of distribution of velocities and its experimental verification, Mean free path (Zeroth Order), Transport Phenomena: Viscosity, Conduction and Diffusion (for vertical case).

MODULE-IV

Law of equipartition of energy (no derivation) and its applications to specific heat of gases; mono-atomic and diatomic gases.

Theory of Radiation: Blackbody radiation, Spectral distribution, Concept of Energy Density, Derivation of Planck's law, Deduction of Wien's distribution law, Rayleigh- Jeans Law, Stefan Boltzmann Law and Wien's displacement law from Planck's law.

MODULE-V

Statistical Mechanics: Phase space, Macrostate and Microstate, Entropy and Thermodynamic probability, Maxwell-Boltzmann law - distribution of velocity - Quantum statistics - Fermi-Dirac distribution law - electron gas - Bose-Einstein distribution law - photon gas - comparison of three statistics.

Books Suggested:

1. Thermal Physics, S. Garg, R. Bansal and C. Ghosh, , Tata McGraw-Hill,1993.
2. A Treatise on Heat, Meghnad Saha, and B.N. Srivastava, Indian Press,1969,.
3. Thermodynamics, Enrico Fermi, Courier Dover Publications,1956,.
4. Heat and Thermodynamics, M.W.Zemasky and R. Dittman, , McGraw Hill,1981

**BOT 113
MICROBIOLOGY**

L-T-P-C Structure 4-0-0-4

Course Type: GE-3 theory

Module -I

General Microbiology History and development of Microbiology -Introduction to microbial world, microbial nutrition, growth and metabolism.

Contribution of eminent scientists (Antony Van Leeuwenhoek, Louis Pasteur, Robert Koch, Elie Metchnikoff, Paul Ehrlich, Alexander Flemming, Selman A. Waksman, Edward Jenner), spontaneous generation, biogenesis, germ theory of disease, vaccination and discovery of antibiotics, microbial nutrition and scope of microbiology.

Module –II

Viruses -_Discovery, physiochemical and biological characteristics; Classification; replication, lytic and lysogenic. Transmission and management of diseases caused by viruses on plants. Bacteriophages. DNA virus (T-phage), RNA virus (TMV).

Economic importance of viruses with reference to vaccine production, role in research, medicine and diagnostics.

Module –III

Bacteria -Discovery, general characteristics; Types- archaeobacteria, eubacteria) Cell structure; Nutritional types; Reproduction-vegetative, asexual and recombination (conjugation, transformation and transduction). Gram positive and Gram negative Bacteria,Economic importance of bacteria with reference to their role in agriculture and industry.

Module –IV

Role of microbes in fermentation. Microbes in composting Food ,Basic concept of food spoilage and food preservation microbial spoilage and food preservation, Biodegradation of pesticides.

Plant microbe interaction. Rhizosphere and phyllosphere microflora. Beneficial microorganism in agriculture: biofertilizers – Rhizobium, mycorrhiza, azolla, PSB, Azospirillum, BGA, Azotobacter.

Module –IV

Applied microbiology-Microbial culturing technique, culture media, and microbial growth. environmental management and industry, Indian Institutes and their research activities in microbiology. Role of microbes in medicine.

Books Suggested :

1. Agrawal, K. and Sharma, J. 2014. A Text book of Mycology, Microbiology and Plant Pathology. CBH publisher, Jaipur.
2. Aneja, K. R. 2003. Experiment in Microbiology, Plant Pathology and Biotechnology. New age international (P) Ltd. Publishers, New Delhi.
3. Biswas, S. B. and Biswas, A. 2000. An introduction of Viruses. Vikas publications, New Delhi.
4. Dubey, R. C. and Maheswari, D. K., 2002. A Text Book of Microbiology. S. Chand and Co., New Delhi.
5. Pelczar, M.J. (2001) Microbiology, 5th edition, Tata McGraw-Hill Co, New Delhi.
6. Pandey, S. N. and Trivedi, P. C. 2005. A text book of Fungi, Bacteria and Virus. Vikas Publishing House, New Delhi.
7. Pelczar, M.J. Microbiology. *5th edition*, Tata Mc Graw-Hill Co., New Delhi.

PHY114

THERMAL PHYSICS AND STATISTICAL MECHANICS LAB

L-T-P-C Structure 0-0-4-2

Course Type: GE-3 practical

1. To determine Mechanical Equivalent of Heat, J , by Callender and Barne's constant flow method.
2. Measurement of Planck's constant using black body radiation.
3. To determine Stefan's Constant.
4. To determine the coefficient of thermal conductivity of copper by Searle's Apparatus.
5. To determine the Coefficient of Thermal Conductivity of Cu by Angstrom's Method.
6. To determine the coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method.
7. To determine the temperature co-efficient of resistance by Platinum resistance thermometer.
8. To study the variation of thermo emf across two junctions of a thermocouple with temperature.
9. To record and analyze the cooling temperature of an hot object as a function of time using a thermocouple and suitable data acquisition system
10. To calibrate Resistance Temperature Device (RTD) using Null Method/Off-Balance Bridge

Books Suggested :

1. Advanced Practical Physics for students, B.L.Flint & H.T.Worsnop, Asia Publishing House,1971.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted Heinemann Educational Publishers, 1985.
3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, Kitab Mahal, New Delhi, 2011.
4. A Laboratory Manual of Physics for Undergraduate Classes, D.P. Khandelwal, Vani Publication,1985.

BOT 114
MICROBIOLOGY LAB

L-T-P-C Structure 0-0-4-2

Course Type: GE-3 practical

- Study of the types of bacteria from temporary/permanent slides/photographs.
- Electron micrographs of bacteria, binary fission, endospore, conjugation,
- Gram's staining of bacteria from curd.
- To study sterilization techniques.
- Preparation of microbiological culture media (potato dextrose agar, nutrient agar)
- Measurement of number of microbial cells by the use of haemocytometer
- Electron micrographs/Models of viruses – T-Phage and TMV, Line drawings/ Photographs of Lytic and Lysogenic Cycle
- Isolation of bacteria from soil.
- Endospore staining with malachite green using(endospores taken from soil bacteria)

Books Suggested :

1. Agrawal, K. and Sharma, J. 2014. A Text book of Mycology, Microbiology and Plant Pathology. CBH publisher, Jaipur.
2. Aneja, K. R. 2003. Experiment in Microbiology, Plant Pathology and Biotechnology. New age international (P) Ltd. Publishers, New Delhi.
3. Biswas, S. B. and Biswas, A. 2000. An introduction of Viruses. Vikas publications, New Delhi.

4. Dubey, R. C. and Maheswari, D. K., 2002. A Text Book of Microbiology. S. Chand and Co., New Delhi.
5. Pelczar, M.J. (2001) Microbiology, 5th edition, Tata McGraw-Hill Co, New Delhi.

Semester IV

B.SC. HONOURS CHEMISTRY SCHEME EFFECTIVE FROM 2018-19		
SEMESTER IV		
Course Code	University Course Type	Course Name
CHY 152	Core Theory	Inorganic Chemistry-III
CHY 153	Core Theory	Organic Chemistry-III
CHY 154	Core Theory	Physical Chemistry-IV
CHY 155	Core Practical	Inorganic Chemistry-III Lab
CHY 156	Core Practical	Organic Chemistry-III Lab
CHY 157	Core Practical	Physical Chemistry-IV Lab

PHY 115/ BOT 119	Generic Elective -4	Wave and Optics/ Economic Botany
PHY 116/ BOT 120		Wave and Optics Lab/ Economic Botany Lab

CHY 152 INORGANIC CHEMISTRY-III

L-T-P-C Structure 4-0-0-4

Course Type: Core Theory

MODULE-I

Coordination Chemistry: Werner's theory, valence bond theory (inner and outer orbital complexes), electroneutrality principle and back bonding. Crystal field theory, measurement of $10 Dq$ (Δ_o), CFSE in weak and strong fields, pairing energies, factors affecting the magnitude of $10 Dq$ (Δ_o , Δ_t). Octahedral vs. tetrahedral coordination, tetragonal distortions from octahedral geometry Jahn-Teller theorem, square planar geometry. Qualitative aspect of Ligand field and MO Theory.

MODULE-II

Nomenclature of Coordination Compounds: IUPAC nomenclature of coordination compounds, isomerism in coordination compounds. Stereochemistry of complexes with 4 and 6 coordination numbers. Chelate effect, polynuclear complexes, Labile and inert complexes

MODULE-III

Transition Elements: General group trends with special reference to electronic configuration, colour, variable valency, magnetic and catalytic properties, ability to form complexes. Stability of various oxidation states and e.m.f. (Latimer diagrams) Different between the first, second and third transition series. Chemistry of Cr, Mn, Fe and Co in various oxidation states with special reference to the following compounds: peroxo compounds of chromium, potassium dichromate,

potassium permanganate, potassium ferrocyanide, potassium ferricyanide, sodium nitroprusside and sodium cobaltinitrite.

MODULE-IV

Lanthanides and Actinides: Electronic configuration, oxidation states, colour, spectral and magnetic properties, lanthanide contraction, separation of lanthanides (ion-exchange method only).

MODULE-V

Inorganic Reaction Mechanism: Introduction to inorganic reaction mechanisms. Substitution reactions in square planar complexes, Trans- effect, theories of trans effect. Thermodynamic and Kinetic stability.

Suggested Books:

1. Purcell, K.F & Kotz, J.C., Inorganic Chemistry W.B. Saunders Co, 1977.
2. Huheey, J.E., Inorganic Chemistry, Prentice Hall, 1993.
3. Cotton, F.A. & Wilkinson, G., Advanced Inorganic Chemistry Wiley-VCH, 1999
4. Basolo, F, and Pearson, R.C., Mechanisms of Inorganic Chemistry, John Wiley & Sons, NY, 1967.
5. Greenwood, N.N. & Earnshaw A., Chemistry of the Elements, Butterworth-Heinemann, 1997.
6. Miessler, G. L. & Tarr, Donald A. Inorganic Chemistry 3rd Ed.(adapted), Pearson, 2009

CHY 153

ORGANIC CHEMISTRY-III

L-T-P-C Structure 4-0-0-4

Course Type: Core Theory

MODULE-I

Nitrogen Containing Functional Groups: Preparation and important reactions of nitro compounds, nitriles and isonitriles.

Amines: Preparation and properties: Effect of substituent and solvent on basicity; Gabriel phthalimide synthesis, Carbylamine reaction, Mannich reaction, Hoffmann's exhaustive methylation, Hofmann-elimination reaction; Distinction between 1°, 2° and 3° amines with Hinsberg reagent and nitrous acid.

Diazonium Salts: Preparation and their synthetic applications.

MODULE-II

Polynuclear Hydrocarbons: Aromaticity of polynuclear hydrocarbons, structure elucidation of naphthalene; Preparation and properties of naphthalene, phenanthrene and anthracene.

MODULE-III

Heterocyclic Compounds: Classification and nomenclature, Structure, aromaticity in 5-membered and 6-membered rings containing one heteroatom; Synthesis, reactions and mechanism of substitution reactions of: Furan, Pyrrole (Paal-Knorr synthesis, Knorr pyrrole synthesis, Hantzsch synthesis), Thiophene, Pyridine (Hantzsch synthesis), Indole (Fischer indole synthesis and Madelung synthesis), Quinoline and isoquinoline, (Skraup synthesis, Friedlander's synthesis, Knorr quinoline synthesis, Doebner- Miller synthesis, Bischler-Napieralski reaction, Pictet-Spengler reaction, Pomeranz-Fritsch reaction

MODULE-IV

Alkaloids: Natural occurrence, General structural features, Isolation and their physiological action, Hoffmann's exhaustive methylation, Emde's modification; Structure elucidation and synthesis of Nicotine. Medicinal importance of Nicotine, Hygrine, Quinine, Morphine, Cocaine, and Reserpine

MODULE-V

Terpenes: Occurrence, classification, isoprene rule; Elucidation of structure and synthesis of Citral.

Books Suggested:

1. Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
4. Acheson, R.M. Introduction to the Chemistry of Heterocyclic compounds, John Wiley & Sons 1976.
5. Kalsi, P. S. Textbook of Organic Chemistry 1st Ed., New Age International (P) Ltd. Pub.
7. Clayden, J.; Greeves, N.; Warren, S.; Wothers, P.; Organic Chemistry, Oxford University Press.
8. Singh, J.; Ali, S.M. & Singh, J. Natural Product Chemistry, Prajati Parakashan, 2010.

CHY 154**PHYSICAL CHEMISTRY-IV****L-T-P-C Structure 4-0-0-4****Course Type: Core Theory****MODULE-I**

Conductance: Quantitative aspects of Faraday's laws of electrolysis Arrhenius theory of electrolytic dissociation. Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Molar conductivity at infinite dilution. Kohlrausch law of independent migration of ions. Debye-Hückel-Onsager equation, Debye-Falkenhagen effect, Walden's rules.

MODULE-II

Conductance Measurement : Ionic velocities, mobilities and their determinations, transference numbers and their relation to ionic mobilities, determination of transference numbers using Hittorf and Moving Boundary methods. Applications of conductance measurement:

- (i) degree of dissociation of weak electrolytes,
- (ii) ionic product of water
- (iii) solubility and solubility product of sparingly soluble salts,
- (iv) conductometric titrations, and
- (v) hydrolysis constants of salts.

MODULE-III

Chemical Kinetics: Order and molecularity of a reaction, rate laws in terms of the advancement of a reaction, differential and integrated form of rate expressions up to second order reactions, experimental methods of the determination of rate laws, kinetics of complex reactions (integrated

rate expressions up to first order only): (i) Opposing reactions (ii) parallel reactions and (iii) consecutive reactions and their differential rate equations (steady-state approximation in reaction mechanisms) (iv) chain reactions. Temperature dependence of reaction rates; Arrhenius equation; activation energy. Collision theory of reaction rates, Lindemann mechanism, qualitative treatment of the theory of absolute reaction rates.

MODULE-IV

Catalysis: Types of catalyst, specificity and selectivity, mechanisms of catalyzed reactions at solid surfaces. Enzyme catalysis, Michaelis-Menten mechanism, acid-base catalysis.

MODULE-V

Photochemistry: Characteristics of electromagnetic radiation, Lambert-Beer's law and its limitations, physical significance of absorption coefficients. Laws, of photochemistry, quantum yield, actinometry, examples of low and high quantum yields, photochemical equilibrium and the differential rate of photochemical reactions, photosensitised reactions, quenching. Role of photochemical reactions in biochemical processes, photostationary states, chemiluminescence.

Books Suggested :

1. Atkins, P.W & Paula, J.D. Physical Chemistry, 9th Ed., Oxford University Press 2011.
2. Castellan, G. W. Physical Chemistry 4th Ed., Narosa 2004.
3. Mortimer, R. G. Physical Chemistry 3rd Ed., Elsevier: NOIDA, UP 2009.
4. Barrow, G. M., Physical Chemistry 5th Ed., Tata McGraw Hill: New Delhi 2006.
5. Engel, T. & Reid, P. Physical Chemistry 3rd Ed., Prentice-Hall 2012.
6. Rogers, D. W. Concise Physical Chemistry Wiley 2010.

CHY 155

INORGANIC CHEMISTRY –III LAB

L-T-P-C Structure 0-0-4-2

Course Type: Core Practical

Gravimetric Analysis:

- i. Estimation of nickel (II) using Dimethylglyoxime (DMG).
- ii. Estimation of copper as CuSCN
- iii. Estimation of iron as Fe₂O₃ by precipitating iron as Fe(OH)₃.
- iv. Estimation of Al(III) by precipitating with oxine and weighing as Al(oxine)₃ (aluminium oxinate).

Inorganic Preparations:

- i. Tetraamminecopper (II) sulphate, [Cu(NH₃)₄]SO₄.H₂O
- ii. Acetylacetonate complexes of Cu²⁺/Fe³⁺
- iii. Tetraamminecarbonatocobalt (III) nitrate
- iv. Potassium tri(oxalato)ferrate(III)

Properties of Complexes

- i. Measurement of 10 Dq by spectrophotometric method
- ii. Verification of spectrochemical series.
- iii. Synthesis of ammine complexes of Ni(II) and its ligand exchange reactions (e.g. bidentate ligands like acetylacetonone, DMG, glycine) by substitution method.

Books Suggested :

1. Vogel, A.I. A text book of Quantitative Analysis, ELBS 1986.

2. G. Marr and B.W. Rockett, Practical Inorganic Chemistry, Van Nostrand Reinhold 1972

CHY 156
ORGANIC CHEMISTRY–III LAB

L-T-P-C Structure 0-0-4-2

Course Type: Core Practical

1. Functional group test for nitro, amine and amide groups.
2. Qualitative analysis of unknown organic compounds containing simple functional groups (alcohols, carboxylic acids, phenols , carbonyl compounds and esters)

Books Suggested:

1. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education 2009
2. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson 2012
3. Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press 2000.
4. Ahluwalia, V.K. & Dhingra, S. Comprehensive Practical Organic Chemistry: Qualitative Analysis, University Press 2000.

CHY 157
PHYSICAL CHEMISTRY–IV LAB

L-T-P-C Structure 0-0-4-2

Course Type: Core Practical

Conductometry:

- I. Determination of cell constant
- II. Determination of conductivity, molar conductivity, degree of dissociation and dissociation constant of a weak acid.
- III. Perform the following conductometric titrations:
 - i. Strong acid vs. strong base
 - ii. Weak acid vs. strong base
 - iii. Mixture of strong acid and weak acid vs. strong base
 - iv. Strong acid vs. weak base

Chemical Kinetics:

- IV. Study the kinetics of the following reactions.
 1. Iodide-persulphate reaction (i) Initial rate method; (ii) Integrated rate method
 2. Acid hydrolysis of methyl acetate with hydrochloric acid.
 3. Saponification of ethyl acetate.
 4. Comparison of the strengths of HCl and H₂SO₄ by studying kinetics of hydrolysis of methyl acetate.

Books Suggested:

1. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi 2011.
2. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry 8th Ed.; McGraw-Hill: New York 2003.
3. Halpern, A. M. & McBane, G. C. Experimental Physical Chemistry 3rd Ed.; W.H. Freeman & Co.: New York 2003.

PHY115
WAVES AND OPTICS

L-T-P-C Structure 4-0-0-4

Course Type: GE-4 Theory

MODULE-I

Superposition of Two Collinear Harmonic oscillations: Linearity and Superposition Principle. (1) Oscillations having equal frequencies and (2) Oscillations having different frequencies (Beats). **Superposition of Two Perpendicular Harmonic Oscillations:** Graphical and Analytical Methods. Lissajous Figures with equal and unequal frequency and their uses. **Waves Motion- General:** Transverse waves on a string. Travelling and standing waves on a string. Normal Modes of a string. Group velocity, Phase velocity. Plane waves. Spherical waves, Wave intensity.

MODULE-II

Fluids: Surface Tension: Synclastic and anticlastic surface - Excess of pressure - Application to spherical and cylindrical drops and bubbles - variation of surface tension with temperature - Jaegar's method. Viscosity: Viscosity - Rate flow of liquid in a capillary tube - Poiseuille's formula - Determination of coefficient of viscosity of a liquid - Variations of viscosity of a liquid with temperature lubrication. Physics of low pressure - production and measurement of low pressure - Rotary pump - Diffusion pump - Molecular pump - Knudsen absolute gauge - penning and pirani gauge – Detection of leakage.

MODULE-III

Sound: Simple harmonic motion - forced vibrations and resonance - Fourier's Theorem - Application to saw tooth wave and square wave - Intensity and loudness of sound - Decibels - Intensity levels - musical notes - musical scale. Acoustics of buildings: Reverberation and time of reverberation - Absorption coefficient - Sabine's formula - measurement of reverberation time - Acoustic aspects of halls and auditoria.

MODULE-IV

Wave Optics: Electromagnetic nature of light. Definition and Properties of wave front. Huygens Principle. **Interference:** Interference: Division of amplitude and division of wavefront. Lloyd's Mirror and Fresnel's Biprism. Phase change on reflection: Stokes' treatment. Interference in Thin Film, Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings and its applications. Michelson's Interferometer: Idea of form of fringes (no theory needed) and its applications

MODULE-V

Diffraction: Fraunhofer diffraction: Single slit, multiple slits & Diffraction grating. Fresnel Diffraction: Half-period zones. Zone plate. Fresnel Diffraction pattern of a straight edge, a slit and a wire using half-period zone analysis. **Polarization:** Transverse nature of light waves. Plane polarized light – production and analysis. Circular and elliptical polarization.

Books Suggested:

1. Fundamentals of Optics, F A Jenkins and H E White, McGraw-Hill, 1976.
2. Principles of Optics, B.K. Mathur, Gopal Printing, 1995
3. Fundamentals of Optics, H.R. Gulati and D.R. Khanna, R. Chand Publication, 1991

BOT 119 ECONOMIC BOTANY

L-T-P-C Structure 4-0-0-4

Course Type: GE-4 Theory

Module -I

Origin of Cultivated Plants - Concept of Centres of Origin, their importance with reference to Vavilov's work. Examples of major plant introductions; Crop domestication and loss of genetic diversity; evolution of new crops/varieties, importance of germplasm diversity.

Cereals - Wheat and Rice (origin, morphology, processing & uses); Brief account of millets.

Module -II

Legumes - Origin, morphology and uses of Chick pea, Pigeon pea and fodder legumes. Importance to man and ecosystem.

Sources of sugars and starches - Morphology and processing of sugarcane, products and by-products of sugarcane industry. Potato – morphology, propagation & uses.

Spices - Listing of important spices, their family and part used. Economic importance with special reference to fennel, saffron, clove and black pepper

Module -III

Beverages - Tea, Coffee (morphology, processing & uses)

Sources of oils and fats - General description, classification, extraction, their uses and health implications groundnut, coconut, linseed, soybean, mustard and coconut (Botanical name, family & uses). Essential Oils: General account, extraction methods, comparison with fatty oils & their uses.

Module -IV

Natural Rubber -Para-rubber: tapping, processing and uses.

Drug-yielding plants -Therapeutic and habit-forming drugs with special reference to *Cinchona*, *Digitalis*, *Papaver* and *Cannabis*; Tobacco (Morphology, processing, uses and health hazards)

Module –V

Timber plants- General account with special reference to teak and pine.

Fibers -Classification based on the origin of fibers; Cotton, Coir and Jute (morphology, extraction and uses.)

Books Suggested-

1. Gupta, S.K. and Kaushik, M.P. 1973. An Introduction to Economic Botany. K. Nath and Co., Meerut.
2. Hill, A.W. 1952. Economic Botany. McGraw Hill Book Co., New York.
3. Jain, S.K. 1981. Glimpses of Indian Ethnobotany. Oxford and IBH, New Delhi.
4. Jain, S.K. 1987. A Manual on Ethnobotany. Scientific Publisher, Jodhpur.
5. Prakash, G., Sharma, S. K. 1975. Introductory Economic Botany. Jai Prakash Nath and Cosec, Meerut.
6. Sambamurthy, A.V.V.S. and Subrahmanyam, N.S. 1989. A Text Book of Economic Botany. Wiley Eastern Ltd., New Delhi.
7. Sen, S. 1992. Economic botany. New Central Book Agency, Calcutta.
8. Singh, V., Pandey, P.C. and Jain, D.K. 1998-99. Economic Botany. Rastogi Publications, Meerut.
9. Verma, V. 1974. A Text Book of Economic Botany. Emkay Publications, New Delhi

PHY116**WAVES AND OPTICS LAB****L-T-P-C Structure 0-0-2-2****Course Type: GE-4 Practical**

1. To investigate the motion of coupled oscillators
2. To determine the Frequency of an Electrically Maintained Tuning Fork by Melde's Experiment and to verify $\lambda^2 - T$ Law.
3. To study Lissajous Figures
4. To determine the Refractive Index of the Material of a given Prism using Sodium Light.
5. To determine Dispersive Power of the Material of a given Prism using Mercury Light
6. To determine the value of Cauchy Constants of a material of a prism.
7. To determine the Resolving Power of a Prism.
8. To determine wavelength of sodium light using Fresnel Biprism.
9. To determine wavelength of sodium light using Newton's Rings.
10. To determine the Resolving Power of a Plane Diffraction Grating.

Books Suggested:

1. Advanced Practical Physics for students, B.L. Flint & H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers

3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi

BOT120
ECONOMIC BOTANY LAB

L-T-P-C Structure 0-0-2-2

Course Type: GE-4 Practical

(Any seven)

- **Cereals:** Wheat (habit sketch, L. S/T.S. grain, starch grains, micro-chemical tests)Rice (Habit sketch, study of paddy and grain, starch grains, micro-chemical tests).
- **Legumes:** Soybean, Groundnut, (habit, fruit, seed structure, micro-chemical tests).
- **Sources of sugars and starches:** Sugarcane (habit sketch; cane juice- micro-chemical tests),
- **Potato**(habit sketch, tuber morphology, T.S. tuber to show localization of starch grains, starch grains, micro-chemical tests).
- **Spices:** Black pepper, Fennel and Clove (habit and sections).
- **Beverages:** Tea (plant specimen, tea leaves), Coffee (plant specimen, beans).
- **Sources of oils and fats:** Coconut- T.S. nut, Mustard–plant specimen, seeds; tests for fats in crushed seeds.
- **Essential oil-yielding plants:** Habit sketch of *Rosa*, *Vetiveria*, *Santalum* and *Eucalyptus* (specimens/photographs).
- **Rubber:** specimen, photograph/model of tapping, samples of rubber products.
- **Drug-yielding plants:** Specimens of *Digitalis*, *Papaver* and *Cannabis*.

- **Tobacco:** specimen and products of Tobacco.
- **Woods:** *Tectona, Pinus*: Specimen, Section of young stem.
- **Fiber-yielding plants:** Cotton (specimen, whole mount of seed to show lint and fuzz; whole mount of fiber and test for cellulose), Jute (specimen, transverse section of stem, test for lignin on transverse section of stem and fiber).
- Submission of economically important plants and plant products (cereals, pulses, spices, fibers, condiments, fat and oils, tea, coffee, wood, dyes, tobacco).
- Field trip to economically important place

Books Suggested:

1. Kochhar, S.L. (2012). Economic Botany in Tropics, MacMillan & Co. New Delhi, India.
2. Wickens, G.E. (2001). Economic Botany: Principles & Practices. Kluwer Academic Publishers, The Netherlands.
3. Chrispeels, M.J. and Sadava, D.E. 1994 Plants, Genes and Agriculture. Jones & Bartlett

Semester V

B.SC. HONOURS CHEMISTRY SCHEME EFFECTIVE FROM 2018-19		
SEMESTER V		
Course Code	University Course Type	Course Name
CHY 158	Core Theory	Organic Chemistry-IV
CHY 159	Core Theory	Physical Chemistry-V
CHY 160	Core Practical	Organic Chemistry-IV Lab
CHY 161	Core Practical	Physical Chemistry-V Lab

CHY 120	Discipline Specific Elective -1	Analytical Methods in Chemistry
CHY 122		Quantum & Photo chemistry
CHY 124	Discipline Specific Elective -1 Practical	Analytical Methods in Chemistry Lab
CHY 126		Quantum & Photo chemistry lab
CHY 121	Discipline Specific Elective -2	Chemistry of Representative Elements
CHY 123		Polymer Chemistry
CHY 125	Discipline Specific Elective -2 Practical	Chemistry of Representative Elements Lab
CHY 127		Polymer Chemistry Lab

CHY158**ORGANIC CHEMISTRY-IV****L-T-P-C Structure 4-0-0-4****Course Type: Core Theory****MODULE-I**

Nucleic Acids: Components of nucleic acids, Nucleosides and nucleotides; Structure, synthesis and reactions of: Adenine, Guanine, Cytosine, Uracil and Thymine; Structure of polynucleotides (DNA and RNA).

MODULE-II

Amino Acids, Peptides and Proteins: Amino acids, Peptides and their classification. α -Amino Acids - Synthesis, ionic properties and reactions. Zwitterions, pK_a values, isoelectric point and electrophoresis; Study of peptides: determination of their primary structures-end group analysis, methods of peptide synthesis. Synthesis of peptides using N-protecting, C-protecting and C-activating groups, Solid-phase synthesis; primary, secondary and tertiary structures of proteins, Denaturation

MODULE-III

Enzymes: Introduction, classification and characteristics of enzymes. Salient features of active site of enzymes. Mechanism of enzyme action (taking trypsin as example), factors affecting enzyme action, coenzymes and cofactors, specificity of enzyme action (including stereospecificity), enzyme inhibitors and their importance.

MODULE-IV

Lipids: Introduction to oils and fats; common fatty acids present in oils and fats, Hydrogenation of fats and oils, Saponification value, acid value, iodine number. Reversion and rancidity.

MODULE-V

Concept of Energy in Biosystems: Cells obtain energy by the oxidation of foodstuff (organic molecules). Introduction to metabolism (catabolism, anabolism). ATP: The universal currency of cellular energy, ATP hydrolysis and free energy change. Agents for transfer of electrons in biological redox systems: NAD⁺, FAD. Conversion of food to energy: Outline of catabolic pathways of carbohydrate- glycolysis, fermentation, Krebs cycle. Caloric value of food, standard caloric content of food types.

Books Suggested :

1. Berg, J.M., Tymoczko, J.L. and Stryer, L. Biochemistry. VIth Edition. W.H. Freeman and Co. 2006
2. Nelson, D.L., Cox, M.M. and Lehninger, A.L. Principles of Biochemistry. IV Edition. W.H. Freeman and Co 2009..
3. Murray, R.K., Granner, D.K., Mayes, P.A. and Rodwell, V.W. Harper's Illustrated Biochemistry. XXVIII edition. Lange Medical Books/ McGraw-Hill. 2009.

CHY159

PHYSICAL CHEMISTRY-V

L-T-P-C Structure 4-0-0-4

Course Type: Core Theory

MODULE-I

Quantum Chemistry: Postulates of quantum mechanics, quantum mechanical operators and commutation rules, Schrödinger equation and its application to free particle and —particle-in-a box (rigorous treatment), quantization of energy levels, zero-point energy and Heisenberg Uncertainty principle; wave functions, probability distribution functions, nodal properties, Extension to two and three dimensional boxes, separation of variables, degeneracy.

MODULE-II

Qualitative treatment of simple harmonic oscillator model of vibrational motion: Setting up of Schrödinger equation and discussion of solution and wave functions. Vibrational energy of diatomic molecules and zero-point energy. Angular momentum. Rigid rotator model of rotation of diatomic molecule. Schrödinger equation in Cartesian and spherical polar (Derivation not required). Separation of variables. Spherical harmonics. Discussion of solution (Qualitative).

MODULE-III

Qualitative treatment of hydrogen atom and hydrogen-like ions: setting up of Schrödinger equation in spherical polar coordinates, radial part, quantization of energy (only final energy expression). Average and most probable distances of electron from nucleus. Setting up of Schrödinger equation for many-electron atoms (He, Li). Need for approximation methods. Statement of variation theorem and application to simple systems (particle-in-a-box, harmonic oscillator, hydrogen atom).

MODULE-IV

Molecular Spectroscopy: Interaction of electromagnetic radiation with molecules and various types of spectra; Born Oppenheimer approximation. Rotation spectroscopy: Selection rules, intensities of spectral lines, determination of bond lengths of diatomic and linear triatomic molecules, isotopic substitution. Vibrational spectroscopy: Classical equation of vibration, computation of force constant, amplitude of diatomic molecular vibrations, anharmonicity, Morse potential, dissociation energies, fundamental frequencies, overtones, hot bands, degrees of freedom for polyatomic molecules, modes of vibration, concept of group frequencies.

MODULE-V

Electronic spectroscopy: Franck-Condon principle, electronic transitions, singlet and triplet states, fluorescence and phosphorescence, dissociation and predissociation, calculation of electronic transitions of polyenes using free electron model.

Books Suggested:

1. Chandra, A. K. Introductory Quantum Chemistry Tata McGraw-Hill 2001.
2. House, J. E. Fundamentals of Quantum Chemistry 2nd Ed. Elsevier: USA 2004.
3. Lowe, J. P. & Peterson, K. Quantum Chemistry, Academic Press 2005.
4. Banwell, C. N. & McCash, E. M. Fundamentals of Molecular Spectroscopy 4th Ed. Tata McGraw-Hill: New Delhi 2006.

CHY160

ORGANIC CHEMISTRY-IV LAB

L-T-P-C Structure 0-0-4-2

Course Type: Core Practical

1. Estimation of glycine by Sorenson's formalin method.
2. Study of the titration curve of glycine.
3. Estimation of proteins by Lowry's method.
4. Study of the action of salivary amylase on starch at optimum conditions.
5. Effect of temperature on the action of salivary amylase.
6. Saponification value of an oil or a fat.
7. Determination of Iodine number of an oil/ fat.
8. Isolation and characterization of DNA from onion/ cauliflower/peas.

Suggested Books:

1. Manual of Biochemistry Workshop, Department of Chemistry, University

of Delhi 2010.

2. Arthur, I. V. Quantitative Organic Analysis, Pearson.

CHY161
PHYSICAL CHEMISTRY-V LAB

L-T-P-C Structure 0-0-4-2

Course Type: Core Practical

Colorimetry :(any three)

- I. Verify Lambert-Beer's law and determine the concentration of $\text{CuSO}_4/\text{KMnO}_4/\text{K}_2\text{Cr}_2\text{O}_7$ in a solution of unknown concentration
- II. Determine the concentrations of KMnO_4 and $\text{K}_2\text{Cr}_2\text{O}_7$ in a mixture.
- III. Study the kinetics of iodination of propanone in acidic medium.
- IV. Determine the amount of iron present in a sample using 1, 10-phenanthroline.
- V. Determine the dissociation constant of an indicator (phenolphthalein).
- VI. Study the kinetics of interaction of crystal violet/ phenolphthalein with sodium hydroxide.
- VII. Analysis of the given vibration-rotation spectrum of $\text{HCl}(\text{g})$
- VIII. Verify the Freundlich and Langmuir isotherms for adsorption of acetic acid on activated charcoal.

UV/Visible spectroscopy:

- I. Study the 200-500 nm absorbance spectra of KMnO_4 and $\text{K}_2\text{Cr}_2\text{O}_7$ (in 0.1 M H_2SO_4) and determine the λ_{max} values.

- II. Study the pH-dependence of the UV-Vis spectrum (200-500 nm) of $K_2Cr_2O_7$.
- III. Record the 200-350 nm UV spectra of the given compounds (acetone, acetaldehyde, 2-propanol, acetic acid) in water. Comment on the effect of structure on the UV spectra of organic compounds.

Books Suggested:

1. Khosla, B. D.; Garg, V. C. & Gulati, A., Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi 2011.
2. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry 8th Ed.; McGraw-Hill: New York 2003.
3. Halpern, A. M. & McBane, G. C. Experimental Physical Chemistry 3rd Ed.; W.H. Freeman & Co.: New York 2003.

CHY120**ANALYTICAL METHODS IN CHEMISTRY****L-T-P-C Structure 4-0-0-4****Course Type: DSE-1****MODULE-I**

Qualitative and quantitative aspects of analysis: Sampling, evaluation of analytical data, errors, accuracy and precision, methods of their expression, normal law of distribution of indeterminate errors, statistical test of data; F, Q and t test, rejection of data, and confidence intervals.

MODULE-II

Optical methods of analysis: Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules, validity of Beer-Lambert's law.

UV-Visible Spectrometry: Basic principles of instrumentation (choice of source, monochromator and detector) for single and double beam instrument and application in quantitative analysis: estimation of metal ions from aqueous solution, geometrical isomers, keto-enol tautomers.

Flame Atomic Absorption and Emission Spectrometry: Basic principles of instrumentation (choice of source, monochromator, detector, choice of flame and Burner designs. Techniques of atomization and sample introduction; Method of background correction, sources of chemical

interferences and their method of removal. Techniques for the quantitative estimation of trace level of metal ions from water samples.

MODULE-III

Electroanalytical methods: Classification of electroanalytical methods, basic principle of pH metric, potentiometric and conductometric titrations. Techniques used for the determination of equivalence points. Techniques used for the determination of pK_a values.

MODULE-IV

Thermal methods of analysis: Theory of thermogravimetry (TG), basic principle of instrumentation. Techniques for quantitative estimation of Ca and Mg from their mixture.

MODULE-V

Separation techniques: Solvent extraction: Classification, principle and efficiency of the technique. Mechanism of extraction: extraction by solvation and chelation. Technique of extraction: batch, continuous and counter current extractions Qualitative and quantitative aspects of solvent extraction: extraction of metal ions from aqueous solution, extraction of organic species from the aqueous and nonaqueous media.

Books Suggested:

1. Vogel's, Arthur I: A Text book of Quantitative Inorganic Analysis (Rev. by G.H.Jeffery and others) 5th Ed. The English Language Book Society of Longman .
2. Willard, Hobart H. et al.: Instrumental Methods of Analysis, 7th Ed. Wardsworth Publishing Company, Belmont, California, USA, 1988.
3. Christian, Gary D; Analytical Chemistry, 6th Ed. John Wiley & Sons, New York, 2004.
4. Harris, Daniel C: Exploring Chemical Analysis, Ed. New York, W.H. Freeman, 2001.
5. Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age, International Publisher, 2009.
6. Skoog, D.A., Holler F.J. and Nieman, T.A. Principles of Instrumental Analysis, Thomson Asia Pvt. Ltd. Singapore, 1998.

CHY122

QUANTUM AND PHOTOCHEMISTRY

L-T-P-C Structure 4-0-0-4

Course Type: DSE-1 Theory

MODULE-I

Quantum Chemistry: Postulates of quantum mechanics, quantum mechanical operators, Schrödinger equation and its application to free particle and "particle-in-a-box" (rigorous treatment), quantization of energy levels, zero-point energy and Heisenberg Uncertainty principle; wavefunctions, probability distribution functions, nodal properties,

MODULE-II

Two and Three Dimensional boxes: Extension to two and three dimensional boxes, separation of variables, degeneracy. Qualitative treatment of simple harmonic oscillator model of vibrational motion: Setting up of Schrödinger equation and discussion of solution and wavefunctions. Vibrational energy of diatomic molecules and zero-point energy.

MODULE-III

Angular momentum: Commutation rules, quantization of square of total angular momentum and z-component. Rigid rotator model of rotation of diatomic molecule. Schrödinger equation, transformation to spherical polar coordinates. Separation of variables. Spherical harmonics. Discussion of solution..

MODULE-IV

Qualitative treatment of hydrogen atom and hydrogen-like ions: setting up of Schrödinger equation in spherical polar coordinates, radial part, quantization of energy (only final energy expression). Average and most probable distances of electron from nucleus. Setting up of Schrödinger equation for many-electron atoms (He, Li). Need for approximation methods. Statement of variation theorem and application to simple systems (particle-in-a-box, harmonic oscillator, hydrogen atom).

MODULE-V

Photochemistry: Characteristics of electromagnetic radiation, Lambert-Beer's law and its limitations, physical significance of absorption coefficients. Laws, of photochemistry, quantum yield, actinometry, examples of low and high quantum yields, photochemical equilibrium and the differential rate of photochemical reactions, photosensitised reactions, quenching. Role of photochemical reactions in biochemical processes, photostationary states, chemiluminescence.

Books Suggested:

1. Banwell, C. N. & McCash, E. M. Fundamentals of Molecular Spectroscopy 4th Ed. Tata McGraw-Hill: New Delhi 2006.
2. Chandra, A. K. Introductory Quantum Chemistry Tata McGraw-Hill 2001.
3. House, J. E. Fundamentals of Quantum Chemistry 2nd Ed. Elsevier: USA 2004.
4. Lowe, J. P. & Peterson, K. Quantum Chemistry, Academic Press 2005.
5. Kakkar, R. Atomic & Molecular Spectroscopy: Concepts & Applications, Cambridge university Press 2015.

CHY124

ANALYTICAL METHODS IN CHEMISTRY LAB

L-T-P-C Structure 0-0-4-2

Course Type: DSE-1 Practical

I. Separation Techniques (any two)

- (i) Paper chromatographic separation of Co^{2+} and Ni^{2+} .
- (ii) Separation and identification of the amino acids present in the given mixture by paper chromatography. Reporting the R_f values.
- (iii) To separate a mixture of Ni^{2+} & Fe^{2+} by complexation with DMG and extracting the Ni^{2+} - DMG complex in chloroform, and determine its concentration by spectrophotometry.

II Analysis of soil (any three)

- (i) Determination of pH of soil.
- (ii) Total soluble salt
- (iii) Estimation of calcium, magnesium
- (iv) Qualitative detection of nitrate, phosphate

III Spectrophotometry

Verification of Lambert-Beer's law and determination of concentration of a coloured species (CuSO_4 , KMnO_4)

Books Suggested :

1. Vogel, Arthur I: A Text book of Quantitative Inorganic Analysis (Rev. by G.H.Jeffery and others) 5thEd. The English Language Book Society of Longman.
2. Willard, Hobart H. et al.: Instrumental Methods of Analysis, 7th Ed. Wardsworth Publishing Company, Belmont, California, USA, 1988.
3. Harris, Daniel C: Exploring Chemical Analysis, Ed. New York, W.H. Freeman, 2001.
6. Skoog, D.A. Holler F.J. and Nieman, T.A. Principles of Instrumental Analysis, Thomson Asia Pvt. Ltd. Singapore, 1998.
7. Mikes, O. & Chalmers, R.A. Laboratory Hand Book of Chromatographic & Allied Methods, Elles Horwood Ltd. London.

CHY126

QUANTUM & PHOTO CHEMISTRY LAB

L-T-P-C Structure 0-0-4-2

Course Type: DSE-1 Practical

UV/Visible spectroscopy (any two)

I. Study the 200-500 nm absorbance spectra of KMnO_4 and $\text{K}_2\text{Cr}_2\text{O}_7$ (in 0.1 M H_2SO_4) and determine the λ_{max} values. Calculate the energies of the two transitions in different units (J molecule^{-1} , kJ mol^{-1} , cm^{-1} , eV).

II. Study the pH-dependence of the UV-Vis spectrum (200-500 nm) of $\text{K}_2\text{Cr}_2\text{O}_7$

III. Record the 200-350 nm UV spectra of the given compounds (acetone, acetaldehyde, 2-propanol, acetic acid) in water. Comment on the effect of structure on the UV spectra of organic compounds.

Colourimetry(any four)

I. Verify Lambert-Beer's law and determine the concentration of

KMnO₄ / K₂Cr₂O₇ / CuSO₄ in a solution of unknown concentration

- II. Determine the concentrations of KMnO₄ and K₂Cr₂O₇ in a mixture.
- III. Study the kinetics of iodination of propanone in acidic medium.
- IV. Determine the amount of iron present in a sample using 1,10-phenanthroline.
- V. Determine the dissociation constant of an indicator (phenolphthalein).
- VI. Study the kinetics of interaction of crystal violet/ phenolphthalein with sodium hydroxide.
- VII. Analyse the given vibration-rotation spectrum of HCl(g)

Books Suggested:

1. Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009.
2. Khosla, B. D.; Garg, V. C. & Gulati, A., Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi 2011.
3. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry 8th Ed.; McGraw-Hill: New York 2003.
4. Halpern, A. M. & McBane, G. C. Experimental Physical Chemistry 3rd Ed.; W.H. Freeman & Co.: New York 2003.

CHY121

CHEMISTRY OF REPRESENTATIVE ELEMENTS

L-T-P-C Structure 4-0-0-4

Course Type: DSE

Theory

MODULE-I

Acids and Bases: Brønsted–Lowry concept, conjugate acids and bases, relative strengths of acids and bases, effects of substituent and solvent, differentiating and levelling solvents. Lewis acid-base concept, classification of Lewis acids and bases, Lux-Flood concept and solvent system concept. Hard and soft acids and bases (HSAB concept), applications of HSAB process.

MODULE-II

General Principles of Metallurgy: Chief modes of occurrence of metals based on standard electrode potentials, Ellingham diagrams for reduction of metal oxides using carbon and carbon monoxide as reducing agents. Hydrometallurgy with reference to cyanide process for gold and silver. Methods of purification of metals (Al, Pb, Ti, Fe, Cu, Ni, Zn, Au): electrolytic refining, zone refining, van Arkel-de Boer process, Parting Process, Mond's process and Kroll Process.

MODULE-III

s- and p-Block Elements-I: Periodicity in s- and p-block elements with respect to electronic configuration, atomic and ionic size, ionization enthalpy, electron gain enthalpy, electronegativity (Pauling scale). General characteristics of s-block metals like density, melting and boiling points, flame colour and reducing nature. Oxidation states of s- and p-block elements, inert-pair effect, diagonal relationships and anomalous behavior of 1st member of each group.

MODULE-IV

s- and p-Block Elements-II: Allotropy in C, P and S. Complex forming tendency of s block elements and a preliminary idea of crown ethers and cryptates, structures of basic beryllium acetate, salicylaldehyde/ acetylacetonato complexes of Group 1 metals. Solutions of alkali metals and their properties. Common features, such as ease of formation, solubility and stability of oxides, peroxides, superoxides, sulphates and carbonates of s-block metals.

MODULE-V

Structure, bonding and properties (acidic/ basic nature, oxidizing/ reducing nature and hydrolysis of the following compounds and their applications in industrial and environmental chemistry wherever applicable: Diborane and concept of multicentre bonding, hydrides of Groups 13 (EH₃), 14, 15, 16 and 17. Oxides of N and P, Oxoacids of P, S and Cl. Halides and oxohalides of P and S (PCl₃, PCl₅, SOCl₂ and SO₂Cl₂) Interhalogen compounds. A brief idea of pseudohalides **Noble gases** Rationalization of inertness of noble gases, clathrates, preparation and properties of XeF₂, XeF₄ and XeF₆, bonding in these compounds using VBT and shapes of noble gas compounds using VSEPR Theory

Books Suggested:

1. Lee, J.D. *Concise Inorganic Chemistry* ELBS, 1991.
2. Cotton, F.A., Wilkinson, G. & Gaus, P.L. *Basic Inorganic Chemistry*, 3rd ed., Wiley.
3. Greenwood, N.N. & Earnshaw. *Chemistry of the Elements*, Butterworth- Heinemann. 1997.
4. Rodger, G.E. *Inorganic and Solid State Chemistry*, Cengage Learning India Edition, 2002.
5. Miessler, G. L. & Donald, A. Tarr. *Inorganic Chemistry* 4th Ed., Pearson,

CHY123

POLYMER CHEMISTRY

L-T-P-C Structure 4-0-0-4

Course Type: DSE-2 Theory

MODULE-I

Introduction and history of polymeric materials:

Different schemes of classification of polymers, Polymer nomenclature, Molecular forces and chemical bonding in polymers, Texture of Polymers.

Glass transition temperature (T_g) and determination of T_g, Free volume theory, WLF equation, Factors affecting glass transition temperature (T_g).

MODULE-II

Functionality and its importance:

Criteria for synthetic polymer formation, classification of polymerization processes, Relationships between functionality, extent of reaction and degree of polymerization. Bifunctional systems, Poly-functional systems.

MODULE-III

Kinetics of Polymerization:

Mechanism and kinetics of step growth, radical chain growth, ionic chain (both cationic and anionic) and coordination polymerizations, Mechanism and kinetics of copolymerization, polymerization techniques.

MODULE-IV

Crystallization and crystallinity:

Determination of crystalline melting point and degree of crystallinity, Morphology of crystalline polymers, Factors affecting crystalline melting point.

MODULE-V

Molecular weight of polymers: Determination of molecular weight of polymers (M_n , M_w , etc) by end group analysis, viscometry, light scattering and osmotic pressure methods. Molecular weight distribution and its significance. Polydispersity index.

Books Suggested:

1. Seymour's Polymer Chemistry, Marcel Dekker, Inc, 1996.
2. G. Odian: Principles of Polymerization, John Wiley.
3. F.W. Billmeyer: Text Book of Polymer Science, John Wiley, 2nd edition, 1971.
4. P. Ghosh: Polymer Science & Technology, Tata Mcgraw-Hill, 2001.
5. R.W. Lenz: Organic Chemistry of Synthetic High Polymers

CHY125

CHEMISTRY OF REPRESENTATIVE ELEMENTS LAB

L-T-P-C Structure 0-0-4-2

Course Type: DSE Practical

1. Iodometric estimation of potassium dichromate and copper sulphate
2. Iodometric estimation of antimony in tartaremetic
3. Estimation of amount of available chlorine in bleaching powder and household bleaches
4. Estimation of iodine in iodized salts.
5. Iodometric estimation of ascorbic acid in fruit juices.
6. Estimation of dissolved oxygen in water samples.
7. Gravimetric estimation of sulphate as barium sulphate.
8. Gravimetric estimation of aluminium as oximate complex

9. Preparation of the following: potash alum, chrome alum, tetraamminecopper(II) sulphate monohydrate, potassium trioxalatoferrate(III) (any two, including one double salt and one complex).

Books Suggested:

1. Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012.
2. Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009.

**CHY127
POLYMER CHEMISTRY LAB**

L-T-P-C Structure 0-0-4-2

Course Type: DSE-2 Practical

(Any seven experiments)

Polymer synthesis

1. Free radical solution polymerization of styrene (St) / Methyl Methacrylate (MMA) / Methyl Acrylate (MA) / Acrylic acid (AA).

a. Purification of monomer

b. Polymerization using benzoyl peroxide (BPO) / 2,2'-azo-bis-isobutyronitrile (AIBN)

2. Preparation of nylon 66/6

1. Interfacial polymerization, preparation of polyester from isophthaloyl chloride (IPC) and phenolphthalein

- a. Preparation of IPC
- b. Purification of IPC
- c. Interfacial polymerization
3. Redox polymerization of acrylamide
4. Precipitation polymerization of acrylonitrile
5. Preparation of urea-formaldehyde resin
6. Preparations of novalac resin/resold resin.
7. Microscale Emulsion Polymerization of Poly(methylacrylate).

Polymer characterization

1. Determination of molecular weight by viscometry:
 - (a) Polyacrylamide-aq. NaNO_2 solution
 - (b) (Poly vinyl propylidene (PVP) in water
2. Determination of the viscosity-average molecular weight of poly(vinyl alcohol) (PVOH) and the fraction of —head-to-head— monomer linkages in the polymer.
3. Determination of molecular weight by end group analysis: Polyethylene glycol (PEG) (OH group).
4. Testing of mechanical properties of polymers.
5. Determination of hydroxyl number of a polymer using colorimetric method.

Polymer analysis

1. Estimation of the amount of HCHO in the given solution by sodium sulphite method
2. Instrumental Techniques
3. IR studies of polymers
4. DSC analysis of polymers
5. Preparation of polyacrylamide and its electrophoresis

Books Suggested:

1. Malcolm P. Stevens, Polymer Chemistry: An Introduction, 3rd Ed.
2. Harry R. Allcock, Frederick W. Lampe and James E. Mark, Contemporary Polymer Chemistry, 3rd ed. Prentice-Hall, 2003.
3. Fred W. Billmeyer, Textbook of Polymer Science, 3rd ed. Wiley-Interscience, 1984.
4. Joel R. Fried, Polymer Science and Technology, 2nd ed. Prentice-Hall, 2003.
5. Petr Munk and Tejraj M. Aminabhavi, Introduction to Macromolecular Science, 2nd ed. John Wiley & Sons, 2002.

Semester VI

B.SC. HONOURS CHEMISTRY SCHEME EFFECTIVE FROM 2018-19		
SEMESTER VI		
Course Code	University Course Type	Course Name
CHY 162	Core Theory	Inorganic Chemistry-IV
CHY 163	Core Theory	Organic Chemistry-V
CHY 164	Core Practical	Inorganic Chemistry-IV Lab
CHY 165	Core Practical	Organic Chemistry-V Lab
CHY 131	Discipline Specific Elective -3	Green Chemistry
CHY 130		Bioinorganic Chemistry
CHY 135	Discipline Specific Elective -3 Practical	Green Chemistry Lab
CHY 134		Bioinorganic Chemistry Lab
CHY 129	Discipline Specific Elective-4	Physical and Organic spectroscopy
CHY 132		Inorganic Materials of Industrial Importance
CHY 133	Discipline Specific Elective -4 Practical	Physical and Organic spectroscopy Lab
CHY 136		Inorganic Materials of Industrial Importance Lab

CHY162
INORGANIC CHEMISTRY -IV

L-T-P-C Structure 4-0-0-4

Course Type: Core Theory

MODULE-I

Theoretical Principles in Qualitative Analysis (H₂S Scheme): Basic principles involved in analysis of cations and anions. Solubility products, common ion effect. Principles involved in separation of cations into groups and choice of group reagents. Interfering anions (fluoride, borate, oxalate and phosphate) and need to remove them after Group II.

MODULE-II

Definition and classification of organometallic compounds on the basis of bond type. Concept of hapticity of organic ligands. Zeise's salt: Preparation and structure, evidences of synergic effect and comparison of synergic effect with that in carbonyls.

MODULE-III

Metal carbonyls: 18 electron rule, electron count of mononuclear, polynuclear and substituted metal carbonyls of 3d series. General methods of preparation (direct combination, reductive carbonylation, thermal and photochemical decomposition) of mono and binuclear carbonyls of 3d series. Structures of mononuclear and binuclear carbonyls of Cr, Mn, Fe, Co and Ni using VBT. π -acceptor behaviour of CO (MO diagram of CO to be discussed), synergic effect and use of IR data to explain extent of back bonding.

MODULE-IV

Metal Alkyls: Important structural features of methyl lithium (tetramer) and trialkyl aluminium (dimer), concept of multicentre bonding in these compounds.

Ferrocene: Preparation and reactions (acetylation, alkylation, metallation, Mannich Condensation). Structure and aromaticity. Comparison of aromaticity and reactivity with that of benzene.

MODULE-V

Catalysis by Organometallic Compounds

Study of the following industrial processes and their mechanism:

1. Alkene hydrogenation (Wilkinson's Catalyst)
2. Synthetic gasoline (Fischer Tropsch reaction)
3. Polymerisation of ethene using Ziegler-Natta catalyst

Books Suggested:

1. Vogel, A.I. *Qualitative Inorganic Analysis*, Longman, 1972
2. Svehla, G. *Vogel's Qualitative Inorganic Analysis*, 7th Edition, Prentice Hall, 1996-03-07.
3. Lippard, S.J. & Berg, J.M., *Principles of Bioinorganic Chemistry* Panima Publishing Company 1994.
4. Cotton, F.A., Wilkinson, G., & Gaus, P.L. *Basic Inorganic Chemistry 3rd Ed.*; Wiley India.
5. Huheey, J. E.; Keiter, E.A. & Keiter, R.L. *Inorganic Chemistry, Principles of Structure and Reactivity 4th Ed.*, Harper Collins 1993, Pearson, 2006.
6. Sharpe, A.G. *Inorganic Chemistry*, 4th Indian Reprint (Pearson Education) 2005
7. Douglas, B. E.; McDaniel, D.H. & Alexander, J.J. *Concepts and Models in Inorganic Chemistry 3rd Ed.*, John Wiley and Sons, NY, 1994.
8. Greenwood, N.N. & Earnshaw, A. *Chemistry of the Elements 2nd Ed*, Elsevier, 1997 (Ziegler Natta Catalyst and Equilibria in Grignard Solution).

CHY163

ORGANIC CHEMISTRY-V

L-T-P-C Structure 4-0-0-4

Course Type: Core Theory

MODULE-I

Carbohydrates: Occurrence, classification and their biological importance.

Monosaccharides: Constitution and absolute configuration of glucose and fructose, epimers and anomers, mutarotation, determination of ring size of glucose and fructose, Haworth projections and conformational structures; Interconversions of aldoses and ketoses; Killiani-Fischer synthesis and Ruff degradation;

MODULE-II

Disaccharides – Structure elucidation of maltose, lactose and sucrose.

Polysaccharides – Elementary treatment of starch, cellulose and glycogen.

MODULE-III

Dyes: Classification, Colour and constitution; Mordant and Vat Dyes; Chemistry of dyeing; Synthesis and applications of: Azo dyes – Methyl orange; Triphenyl methane dyes - Malachite green and Rosaniline ; Phthalein Dyes – Phenolphthalein; Natural dyes – structure elucidation and synthesis of Alizarin and Indigotin; Edible Dyes with examples

MODULE-IV

Polymers: Introduction and classification including di-block, tri-block and amphiphilic polymers; Polymerisation reactions -Addition and condensation -Mechanism of cationic, anionic and free radical addition polymerization; Metallocene-based Ziegler-Natta polymerisation of alkenes; Preparation and applications of plastics – thermosetting (phenol-formaldehyde, Polyurethanes) and thermosoftening (PVC, polythene);

MODULE-V

Fabrics – natural and synthetic (acrylic, polyamido, polyester); Rubbers – natural and synthetic: Buna-S, Chloroprene and Neoprene; Vulcanization; Polymer additives; Introduction to; Biodegradable and conducting polymers with examples.

Books Suggested:

1. Kalsi, P. S. Textbook of Organic Chemistry 1st Ed., New Age International (P) Ltd. Pub.
2. Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Billmeyer, F. W. Textbook of Polymer Science, John Wiley & Sons, Inc.
4. Gowariker, V. R.; Viswanathan, N. V. & Sreedhar, J. Polymer Science, New Age International (P) Ltd. Pub.
5. Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

CHY164 INORGANIC CHEMISTRY-IV LAB

L-T-P-C Structure 0-0-4-2

Course Type: Core Practical

Qualitative semimicro analysis of mixtures containing 3 anions and 3 cations. Emphasis should be given to the understanding of the chemistry of different reactions. The following radicals are suggested:

CO₃⁻, NO₂⁻, S₂⁻, SO₃²⁻, S₂O₃²⁻, CH₃COO⁻, F⁻, Cl⁻, Br⁻, I⁻, NO₃⁻, BO₃³⁻, C₂O₄²⁻, PO₄³⁻, NH₄⁺, K⁺, Pb²⁺, Cu²⁺, Cd²⁺, Bi³⁺, Sn²⁺, Sb³⁺, Fe³⁺, Al³⁺, Cr³⁺, Zn²⁺, Mn²⁺, Co²⁺, Ni²⁺, Ba²⁺, Sr²⁺, Ca²⁺, Mg²⁺

Mixtures should preferably contain one interfering anion, **or** insoluble component (BaSO₄, SrSO₄, PbSO₄, CaF₂ or Al₂O₃) **or** combination of anions e.g. CO₃²⁻ and SO₃²⁻, NO₂⁻ and NO₃⁻, Cl⁻ and Br⁻, Cl⁻ and I⁻, Br⁻ and I⁻, NO₃⁻ and Br⁻, NO₃⁻ and I⁻.

Spot tests should be done whenever possible.

Principles involved in chromatographic separations. Paper chromatographic separation of following metal ions:

i. Ni (II) and Co (II)

ii. Cu(II) and Cd(II)

Books Suggested:

1. *Vogel's Qualitative Inorganic Analysis*, Revised by G. Svehla.
2. Vogel, A.I. *A Textbook of Quantitative Analysis*, ELBS. 1986

CHY165

ORGANIC CHEMISTRY–V LAB

L-T-P-C Structure 0-0-4-2

Course Type: Core Practical

1. Extraction of caffeine from tea leaves.
2. Preparation of urea formaldehyde resin.
3. Qualitative analysis of unknown organic compounds containing monofunctional groups

(carbohydrates, aryl halides, aromatic hydrocarbons, nitro compounds, amines and amides) and simple bifunctional groups, e.g. salicylic acid, cinnamic acid, nitrophenols etc.

4. Identification of simple organic compounds by IR spectroscopy and NMR spectroscopy (Spectra to be provided).

5. Preparation of methyl orange.

Books Suggested:

1. Vogel, A.I. Quantitative Organic Analysis, Part 3, Pearson, 2012.
2. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education, 2009
3. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson, 2012.
4. Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press, 2000.
5. Ahluwalia, V.K. & Dhingra, S. Comprehensive Practical Organic Chemistry: Qualitative Analysis, University Press, 2000.

CHY131

GREEN CHEMISTRY

L-T-P-C Structure 4-0-0-4

Course Type: DSE-3 Theory

MODULE-I

Introduction to Green Chemistry: What is Green Chemistry? Need for Green Chemistry. Goals of Green Chemistry. Limitations/ Obstacles in the pursuit of the goals of Green Chemistry

MODULE-II

Principles of Green Chemistry and Designing a Chemical synthesis:

- Twelve principles of Green Chemistry with their explanations and examples and special emphasis on the following:
- Designing a Green Synthesis using these principles; Prevention of Waste/byproducts; maximum incorporation of the materials used in the process into the final

products, Atom Economy, calculation of atom economy of the rearrangement, addition, substitution and elimination reactions.

MODULE-III

- Prevention/ minimization of hazardous/ toxic products reducing toxicity. risk = (function) hazard \times exposure; waste or pollution prevention hierarchy
- Green solvents– supercritical fluids, water as a solvent for organic reactions, ionic liquids, fluorous biphasic solvent, PEG, solventless processes, immobilized solvents and how to compare greenness of solvents.

MODULE-IV

- Energy requirements for reactions – alternative sources of energy: use of microwaves and ultrasonic energy.
- Selection of starting materials; avoidance of unnecessary derivatization –careful use of blocking/protecting groups.
- Use of catalytic reagents (wherever possible) in preference to stoichiometric reagents; catalysis and green chemistry, comparison of heterogeneous and homogeneous catalysis, biocatalysis, asymmetric catalysis and photocatalysis.

MODULE-V

Examples of Green Synthesis/ Reactions and some real world cases

1. Green Synthesis of the following compounds: adipic acid, catechol, disodium iminodiacetate (alternative to Strecker synthesis)
2. Microwave assisted reactions in water: Hofmann Elimination, methyl benzoate to benzoic acid, oxidation of toluene and alcohols; microwave assisted reactions in organic solvents Diels-Alder reaction and Decarboxylation reaction
3. Ultrasound assisted reactions: sonochemical Simmons-Smith Reaction (Ultrasonic alternative to Iodine)
4. Surfactants for carbon dioxide – replacing smog producing and ozone depleting solvents with CO₂ for precision cleaning and dry cleaning of garments.
5. Designing of Environmentally safe marine antifoulant.
6. Right fit pigment: synthetic azopigments to replace toxic organic and inorganic pigments.
7. An efficient, green synthesis of a compostable and widely applicable plastic (poly lactic acid) made from corn.
8. Healthier fats and oil by Green Chemistry: Enzymatic interesterification for production of no Trans-Fats and Oils
9. Development of Fully Recyclable Carpet: Cradle to Cradle Carpeting

Books Suggested:

1. Ahluwalia, V.K. & Kidwai, M.R. New Trends in Green Chemistry, Anamalaya Publishers, 2005.
2. Anastas, P.T. & Warner, J.K.: Green Chemistry - Theory and Practical, Oxford University Press, 1998.
3. Matlack, A.S. Introduction to Green Chemistry, Marcel Dekker 2001.
4. Cann, M.C. & Connely, M.E. Real-World cases in Green Chemistry, American Chemical Society, Washington, 2000.
5. Ryan, M.A. & Tinnensand, M. Introduction to Green Chemistry, American Chemical Society, Washington 2002.
6. Lancaster, M. Green Chemistry: An Introductory Text RSC Publishing, 2nd Edition, 2010.

CHY130
BIOINORGANIC CHEMISTRY

L-T-P-C Structure 4-0-0-4

Course Type: DSE-3 Theory

MODULE-I

Chemistry of 3d metals: Oxidation states displayed by Cr, Fe, Co, Ni and Co.

A study of the following compounds (including preparation and important properties); Peroxo compounds of Cr, $K_2Cr_2O_7$, $KMnO_4$, $K_4[Fe(CN)_6]$, sodium nitroprusside, $[Co(NH_3)_6]Cl_3$, $Na_3[Co(NO_2)_6]$.

MODULE-II

Organometallic Compounds: Definition and Classification with appropriate examples based on nature of metal-carbon bond (ionic, s, p and multicentre bonds). Structures of methyl lithium, Zeiss salt and ferrocene. EAN rule as applied to carbonyls. Preparation, structure, bonding and properties of mononuclear and polynuclear carbonyls of 3d

metals. p-acceptor behaviour of carbon monoxide. Synergic effects (VB approach)- (MO diagram of CO can be referred to for synergic effect to IR frequencies).

MODULE-III

Bio-Inorganic Chemistry: A brief introduction to bio-inorganic chemistry. Role of metal ions present in biological systems with special reference to Na^+ , K^+ and Mg^{2+} ions: Na/K pump; Role of Mg^{2+} ions in energy production and chlorophyll. Role of Ca^{2+} in blood clotting, stabilization of protein structures and structural role (bones).

MODULE-IV

Polynuclear and heteronuclear aromatic compounds: Properties of the following compounds with reference to electrophilic and nucleophilic substitution: Naphthalene, Anthracene, Furan, Pyrrole, Thiophene, and Pyridine.

Active methylene compounds: *Preparation:* Claisen ester condensation. Keto-enol tautomerism.

Reactions: Synthetic uses of ethylacetoacetate (preparation of non-heteromolecules having upto 6 carbon).

MODULE-V

Application of Spectroscopy to Simple Organic Molecules

Application of visible, ultraviolet and Infrared spectroscopy in organic molecules. Electromagnetic radiations, electronic transitions, λ_{max} & ϵ_{max} , chromophore, auxochrome, bathochromic and hypsochromic shifts. Application of electronic spectroscopy and Woodward rules for calculating λ_{max} of conjugated dienes and α, β – unsaturated compounds.

Infrared radiation and types of molecular vibrations, functional group and fingerprint region. IR spectra of alkanes, alkenes and simple alcohols (inter and intramolecular hydrogen bonding), aldehydes, ketones, carboxylic acids and their derivatives (effect of substitution on $>\text{C}=\text{O}$ stretching absorptions).

Books Suggested:

1. James E. Huheey, Ellen Keiter & Richard Keiter: *Inorganic Chemistry: Principles of Structure and Reactivity*, Pearson Publication.
2. G.L. Miessler & Donald A. Tarr: *Inorganic Chemistry*, Pearson Publication.
3. J.D. Lee: *A New Concise Inorganic Chemistry*, E.L.B.S.
4. F.A. Cotton & G. Wilkinson: *Basic Inorganic Chemistry*, John Wiley & Sons.

CHY135

GREEN CHEMISTRY LAB

L-T-P-C Structure 0-0-4-2

Course Type: DSE-3 Practical

(Any five)

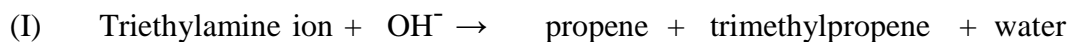
1. Safer starting materials: Preparation and characterization of nanoparticles of gold using tea leaves.

2. Using renewable resources: Preparation of biodiesel from vegetable/ waste cooking oil.

3. Avoiding waste: Principle of atom economy.

1. Use of molecular model kit to stimulate the reaction to investigate how the atom economy can illustrate Green Chemistry.

2. Preparation of propene by two methods can be studied



1. Use of enzymes as catalysts

Benzoin condensation using Thiamine Hydrochloride as a catalyst instead of cyanide.

5. Alternative Green solvents

Extraction of D-limonene from orange peel using liquid CO₂ prepared from dry ice.

Mechano chemical solvent free synthesis of azomethines

6. Alternative sources of energy

1. Solvent free, microwave assisted one pot synthesis of phthalocyanine complex of copper (II).

2. Photoreduction of benzophenone to benzopinacol in the presence of sunlight.

Books Suggested:

1. Anastas, P.T & Warner, J.C. *Green Chemistry: Theory and Practice*, Oxford University Press 1998.

2. Kirchoff, M. & Ryan, M.A. *Greener approaches to undergraduate chemistry experiment*. American Chemical Society, Washington DC 2002.

3. Ryan, M. A. *Introduction to Green Chemistry*, Tinnesand; (Ed), American Chemical Society, Washington DC, 2002.

4. Sharma, R. K.; Sidhwani, I.T. & Chaudhari, M. K. I.K. *Green Chemistry Experiment: A monograph International Publishing House Pvt Ltd. New Delhi. Bangalore* CISBN 978-93-81141-55-7 2013.

5. Cann, M.C. & Connelly, M. E. *Real world cases in Green Chemistry*, American Chemical Society 2008.

6. Cann, M. C. & Thomas, P. *Real world cases in Green Chemistry*, American Chemical Society 2008.

CHY134

BIOINORGANIC CHEMISTRY LAB

L-T-P-C Structure 0-0-4-2

Course Type: DSE-3 Practical

Section A: Inorganic Chemistry

1. Separation of mixtures by chromatography: Measure the R_f value in each case (Combination of two ions to be given)

Paper chromatographic separation of Fe³⁺, Al³⁺ and Cr³⁺ or

Paper chromatographic separation of Ni²⁺, Co²⁺, Mn²⁺ and Zn²⁺

2. Preparation of any two of the following complexes and measurement of their conductivity:

(i) tetraamminecarbonatocobalt (III) nitrate

- (ii) tetraamminecopper (II) sulphate
- (iii) potassium trioxalatoferrate (III) trihydrate

Compare the conductance of the complexes with that of M/1000 solution of NaCl, MgCl₂ and LiCl₃.

Section B: Organic Chemistry

Systematic Qualitative Organic Analysis of Organic Compounds possessing monofunctional groups (-COOH, phenolic, aldehydic, ketonic, amide, nitro, amines) and preparation of one derivative.

Books Suggested:

1. A.I. Vogel: Qualitative Inorganic Analysis, Prentice Hall, 7th Edn.
2. A.I. Vogel: Quantitative Chemical Analysis, Prentice Hall, 6th Edn.
3. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996.
4. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman, 1960.

CHY129

PHYSICAL AND ORGANIC SPECTROSCOPY

L-T-P-C Structure 4-0-0-4

Course Type: DSE Theory

MODULE-I

Introduction to spectroscopic methods of analysis:

Recap of the spectroscopic methods covered in detail in the core chemistry syllabus: Treatment of analytical data, including error analysis. Classification of analytical methods and the types of instrumental methods. Consideration of electromagnetic radiation.

UV-Visible/Near IR– emission, absorption, fluorescence and photo acoustic. Excitation sources(lasers, time resolution), wave length dispersion (gratings, prisms, interference filters, laser, placement of sample relative to dispersion, resolution), Detection of signal(photocells, photomultipliers, diode arrays, sensitivity and S/N), Single and Double Beam instruments,

Interpretation(quantification, mixtures, absorption vs. fluorescence and the use of time, photoacoustic, fluorescent tags).

MODULE-II

Molecular spectroscopy:

Infrared spectroscopy: Interactions with molecules: absorption and scattering. Means of excitation (light sources), separation of spectrum (wave length dispersion, time resolution), detection of the signal (heat, differential detection), interpretation of spectrum (qualitative, Mixtures, resolution), advantages of Fourier Transform(FTIR). Samples and results expected. Applications: Issues of quality assurance and quality control, Special problems for portable instrumentation and rapid detection.

MODULE-III

Atomic spectroscopy: Atomic absorption, Atomic emission, and Atomic fluorescence. Excitation and getting sample in to gas phase (flames, electrical discharges, plasmas), Wavelength separation and resolution (dependence on technique), Detection of radiation (simultaneous/scanning, signal noise), Interpretation (errors due to molecular and ionic species, matrix effects, other interferences).

NMR spectroscopy: Principle, Instrumentation, Factors affecting chemical shift, Spin-spin coupling, Applications.

MODULE-IV

Mass spectroscopy: Making the gaseous molecule into an ion (electron impact, chemical ionization), Making liquids and solids into ions (electrospray, electrical discharge, laser desorption, fast atom bombardment), Separation of ions on basis of mass to charge ratio, Magnetic, Time of flight, Electric quadrupole. Resolution, time and multiple separations, Detection and interpretation(how this is linked to excitation).

MODULE-V

Raman Spectrum: Basic principles and applications, concept of polarizability, pure rotational and pure vibrational Raman spectra of diatomic molecules, selection rules.

Books Suggested:

1. Skoog, D. A. Holler F.J. & Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Ed.
2. Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. *Instrumental Methods of Analysis*, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.
3. P.W. Atkins: *Physical Chemistry*.
4. G.W. Castellan: *Physical Chemistry*.
5. C.N. Banwell: *Fundamentals of Molecular Spectroscopy*.
6. Brian Smith: *Infrared Spectral Interpretations: A Systematic Approach*.
7. W.J. Moore: *Physical Chemistry*.

CHY129

INSTRUMENTAL METHODS OF ANALYSIS

L-T-P-C Structure 4-0-0-4

Course Type: DSE-4 Theory

MODULE-I

Introduction to spectroscopic methods of analysis:

Recap of the spectroscopic methods covered in detail in the core chemistry syllabus: Treatment of analytical data, including error analysis. Classification of analytical methods and the types of instrumental methods. Consideration of electromagnetic radiation.

MODULE-II

Infrared spectroscopy: Interactions with molecules: absorption and scattering. Means of excitation (light sources), separation of spectrum (wavelength dispersion, time

resolution), detection of the signal (heat, differential detection), interpretation of spectrum(qualitative, mixtures, resolution), advantages of Samples and results expected. Applications: Issues of quality assurance and quality control, Special problems for portable instrumentation and rapid detection.

MODULE-III

UV-Visible/ Near IR : emission, absorption, fluorescence and photoacoustic. Excitation sources (lasers, time resolution), wavelength dispersion (gratings, prisms, interference filters, laser, placement of sample relative to dispersion, resolution), Detection of signal (photocells, photomultipliers, diode arrays, sensitivity and S/N), Single and Double Beam instruments, Interpretation (quantification, mixtures, absorption vs. fluorescence and the use of time, photoacoustic, fluorescent tags).

MODULE-IV

Mass spectroscopy: Making the gaseous molecule into an ion (electron impact, chemical ionization), Making liquids and solids into ions (electrospray, electrical discharge, laser desorption, fast atom bombardment), Separation of ions on basis of mass to charge ratio, Magnetic, Time of flight, Electric quadrupole. Resolution, time and multiple separations, Detection and interpretation (how this is linked to excitation).

MODULE-V

Electroanalytical Methods: Potentiometry & Voltammetry

Radiochemical Methods X-ray analysis and electron spectroscopy (surface analysis)

Atomic spectroscopy: Atomic absorption, Atomic emission, and Atomic fluorescence. Excitation and getting sample into gas phase (flames, electrical discharges, plasmas), Wavelength separation and resolution (dependence on technique), Detection of radiation (simultaneous/scanning, signal noise), Interpretation (errors due to molecular and ionic species, matrix effects, other interferences).

Books Suggested

1. Skoog, D.A. Holler F.J. & Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Ed.
2. Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. *Instrumental Methods of Analysis*, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.
3. P.W. Atkins: *Physical Chemistry*.
4. G.W. Castellan: *Physical Chemistry*.
5. C.N. Banwell: *Fundamentals of Molecular Spectroscopy*.
6. Brian Smith: *Infrared Spectral Interpretations: A Systematic Approach*.
7. W.J. Moore: *Physical Chemistry*.

CHY132

INORGANIC MATERIALS OF INDUSTRIAL IMPORTANCE

L-T-P-C Structure 4-0-0-4

Course Type: DSE -4 Theory

MODULE-I

Silicate Industries: Glass: Glassy state and its properties, classification (silicate and non-silicate glasses). Manufacture and processing of glass. Composition and properties of the following types of glasses: Soda lime glass, lead glass, armoured glass, safety glass, borosilicate glass, fluorosilicate, coloured glass, photosensitive glass.

Ceramics: Important clays and feldspar, ceramic, their types and manufacture. High technology ceramics and their applications, superconducting and semiconducting oxides, fullerenes carbon nanotubes and carbon fibre.

Cements: Classification of cement, ingredients and their role, Manufacture of cement and the setting process, quick setting cements.

MODULE-II

Fertilizers: Different types of fertilizers. Manufacture of the following fertilizers: Urea, ammonium nitrate, calcium ammonium nitrate, ammonium phosphates; polyphosphate, superphosphate, compound and mixed fertilizers, potassium chloride, potassium sulphate.

MODULE-III

Surface Coatings: Objectives of coatings surfaces, preliminary treatment of surface, classification of surface coatings. Paints and pigments-formulation, composition and related properties. Oil paint, Vehicle, modified oils, Pigments, toners and lakes pigments, Fillers, Thinners, Enamels, emulsifying agents. Special paints (Heat retardant, Fire retardant, Eco-friendly paint, Plastic paint), Dyes, Wax polishing, Water and Oil paints, additives, Metallic coatings (electrolytic and electroless), metal spraying and anodizing.

MODULE-IV

Alloys: Classification of alloys, ferrous and non-ferrous alloys, Specific properties of elements in alloys. Manufacture of Steel (removal of silicon decarbonization, demanganization, desulphurization dephosphorisation) and surface treatment (argon treatment, heat treatment, nitriding, carburizing). Composition and properties of different types of steels.

MODULE-V

Chemical explosives: Origin of explosive properties in organic compounds, preparation and explosive properties of lead azide, PETN, cyclonite (RDX). Introduction to rocket propellants.

Books Suggested:

1. E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK.
2. R. M. Felder, R. W. Rousseau: *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi.
3. W. D. Kingery, H. K. Bowen, D. R. Uhlmann: *Introduction to Ceramics*, Wiley Publishers, New Delhi.
4. J. A. Kent: *Riegel's Handbook of Industrial Chemistry*, CBS Publishers, New Delhi, 1997.
5. P. C. Jain & M. Jain: *Engineering Chemistry*, Dhanpat Rai & Sons, Delhi.
6. R. Gopalan, D. Venkappayya, S. Nagarajan: *Engineering Chemistry*, Vikas Publications, New Delhi.
7. B. K. Sharma: *Engineering Chemistry*, Goel Publishing House, Meerut, 2011.

CHY133**PHYSICAL AND ORGANIC SPECTROSCOPIC LAB****L-T-P-C Structure 0-0-4-2****Course Type: DSE Practical****Any ten**

1. Safety Practices in the Chemistry Laboratory
2. Determination of the isoelectric pH of a protein.
3. Titration curve of an amino acid.
4. Determination of the void volume of a gel filtration column.
5. Determination of a Mixture of Cobalt and Nickel (UV/Vis spec.)
6. Study of Electronic Transitions in Organic Molecules (i.e., acetone in water)
7. IR Absorption Spectra (Study of Aldehydes and Ketones)
8. Determination of Calcium, Iron, and Copper in Food by Atomic Absorption

9. Quantitative Analysis of Mixtures by Gas Chromatography (i.e., chloroform and carbon tetrachloride)
10. Separation of Carbohydrates by HPLC
11. Determination of Caffeine in Beverages by HPLC
12. Potentiometric Titration of a Chloride-Iodide Mixture
13. Cyclic Voltammetry of the Ferrocyanide/Ferricyanide Couple
14. Nuclear Magnetic Resonance
15. Use of fluorescence to do “presumptive tests” to identify blood or other body fluids.
16. Use of “presumptive tests” for anthrax or cocaine
17. Collection, preservation, and control of blood evidence being used for DNA testing
18. Use of capillary electrophoresis with laser fluorescence detection for nuclear DNA (Y chromosome only or multiple chromosome)
19. Use of sequencing for the analysis of mitochondrial DNA
20. Laboratory analysis to confirm anthrax or cocaine
21. Detection in the field and confirmation in the laboratory of flammable accelerants or explosives
22. Detection of illegal drugs or steroids in athletes
23. Detection of pollutants or illegal dumping
24. Fibre analysis

At least 10 experiments to be performed.

Books Suggested:

1. Skoog, D.A. Holler F.J. & Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Ed.
2. Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. *Instrumental Methods of Analysis*, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.

CHY136

INORGANIC MATERIALS OF INDUSTRIAL IMPORTANCE LAB

L-T-P-C Structure 0-0-4-2

Course Type: DSE-4 Practical

1. Determination of free acidity in ammonium sulphate fertilizer.
2. Estimation of calcium in calcium ammonium nitrate fertilizer.
3. Estimation of phosphoric acid in superphosphate fertilizer.
4. Electroless metallic coatings on ceramic and plastic material.
5. Determination of composition of dolomite (by complexometric titration).
6. Analysis of (Cu, Ni); (Cu, Zn) in alloy or synthetic samples.
7. Analysis of Cement.
8. Preparation of pigment (zinc oxide).

REFERNCE BOOKS:

1. E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK.
2. R. M. Felder, R. W. Rousseau: *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi.
3. W. D. Kingery, H. K. Bowen, D. R. Uhlmann: *Introduction to Ceramics*, Wiley Publishers, New Delhi.
4. J. A. Kent: *Riegel's Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.
5. P. C. Jain, M. Jain: *Engineering Chemistry*, Dhanpat Rai & Sons, Delhi.
6. R. Gopalan, D. Venkappayya, S. Nagarajan: *Engineering Chemistry*, Vikas Publications, New Delhi.
7. Sharma, B.K. & Gaur, H. *Industrial Chemistry*, Goel Publishing House, Meerut 1996.