DIT UNIVERSITY

Dehradun

Detailed Course Structure

of

BSc (H) Chemistry

Approved by the Academic Council at its 6th Meeting held on 13.05.2017

Course Structure& Syllabus of BSc (H) Chemistry

Applicable for Batch: 2017-2020

Course Structure

Year: 1st **Semester: I**

Course Code	Category	Course Title	L	T	P	Credit
CH106	CC	Basic Inorganic Chemistry -1	3	1	0	3.5
CH107	CC	Physical Chemistry-1	3	1	4	5.5
CH108	CC	Chemo Informatics	3	0	0	3
HS101	AEC	Professional Communication	2	1	1	3
PY107	GEC	Mechanics	3	1	4	5.5
CH110	CC	Workshop/ Seminar*	0	0	2	1
		Total				**21.5**

Year: 1st **Semester: II**

Course Code	Category	Course Title	L	T	P	Credit
CH116	CC	Basic Organic Chemistry	3	1	4	5.5
CH117	CC	Physical Chemistry-II	3	1	4	5.5
CH118	CC	Analytical Clinical Biochemistry	3	0	0	3
MA116	GEC	Ordinary Differential Equation & Laplace Transform	3	1	0	3.5
HS102	SEC	Corporate Communication & Soft skills	2	1	1	3
		Total				**20.5**

Course Structure& Syllabus of BSc (H) Chemistry

Applicable for Batch: 2017-2020

Year: 2nd **Semester: III**

Course Code	Category	Course Name	L	T	P	Credit
CH206	CC	Inorganic Chemistry II	3	1	4	6
CH207	CC	Organic Chemistry II	3	1	4	6
CH208	CC	Physical Chemistry III	3	1	4	6
MA206	GEC	Computer based Numerical & Statistical Techniques	3	0	2	4
CA102	AEC	Programming in 'C'	3	0	2	4
		Total				**26**

Year: 2nd **Semester: IV**

Course Code	Category	Course Name	L	T	P	Credit
CH216	CC	Inorganic Chemistry III	3	1	4	6
CH217	CC	Organic Chemistry III	3	1	4	6
CH218	CC	Physical Chemistry IV	3	1	4	6
PY217	GEC	Elements of Modern Physics	3	1	4	6
CH201	AEC	Environmental Science	2	0	0	2
		Total				**26**

Course Structure& Syllabus of BSc (H) Chemistry

Applicable for Batch: 2017-2020

Year: 3rd **Semester: V**

Course Code	Category	Course Name	L	T	P	Credit
CH306	CC	Organic Chemistry - IV	3	1	2	5
CH307	CC	Physical Chemistry - V	3	1	2	5
CH308	CC	Inorganic Chemistry - IV	3	1	2	5
CH3*	DSE	DSE-I	3	0	0	3
CH3*	DSE	DSE-II	3	1	2	5
CH309	PRJT	Minor Project & Seminar	0	0	6	3
		Total				**26**

Year: 3rd **Semester: VI**

Course Code	Category	Course Name	L	T	P	Credit
CH326	CC	Organic Chemistry - V	3	1	2	5
CH327	CC	Inorganic Chemistry -V	3	1	2	5
CH3*	DSE	DSE-III	3	0	0	3
CH3*	DSE	DSE-IV	3	0	0	3
CH3*	DSE	DSE-V	3	0	0	3
CH329	PRJT	Major Project &Seminar	0	0	8	4
		Total				**23**

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Course Structure& Syllabus of BSc (H) Chemistry

Applicable for Batch: 2017-2020

Options for Discipline Specific Elective Courses (DSE)

Semester V	
DSE-I (Without Laboratory)	
CH346	Green Methods in Chemistry
CH347	Polymer Chemistry
DSE-II (With Laboratory)	
CH348	Fuel Chemistry
CH349	Analytical methods in Chemistry

Semester VI	
DSE-III (Without Laboratory)	
CH356	Business skills for Chemist and IPR
CH357	Pesticide Chemistry
DSE-IV (Without Laboratory)	
CH358	Medicinal Pharmaceutical Chemistry
CH359	Chemistry of Cosmetics and Perfumes
DSE-V (Without Laboratory)	
CH366	Green Chemistry
CH367	Forensic Chemistry

Summary of the Credit

Year	**Semester**	**Credit**
1	1	21.5
	2	20.5
2	3	26
	4	26
3	5	26
	6	23
Total		**143**

Approved by the Academic Council at its 6th Meeting held on 13.05.2017

Course Structure& Syllabus of BSc (H) Chemistry

Applicable for Batch: 2017-2020

Subject Code	CH-106	Subject Title	BASIC INORGANIC CHEMISTRY-I						
LTP	3 1 0	Credit	3.5	Subject Category	CC	Year	1st	Semester	I

Course Objectives: This course unit aims to develop an understanding of the fundamental chemistry of the atomic properties as guided by the electronic configurations of atoms at orbital levels; rules governing the periodicity of properties variance, understanding of VBT and molecular orbital theory to determine the geometry and bonding in polyatomic molecules.

UNIT-I: Atomic Structure **(08 Lectures)**

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**.**

UNIT-II:Periodicity of Elements(05 Lectures)

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 Potential

(d) Electronegativity, Pauling's/ Allred Rochow's scales. Variation of electronegativity with bond order, partial charge, hybridization, group electronegativity.

UNIT-III: Chemical Bonding (05 Lectures)

(i) 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.

(ii) Covalent bond: Lewis structure, Valence Bond theory (Heitler-London approach). Energetics of hybridization, equivalent and non-equivalent hybrid orbitals. Bent's rule**.**

UNIT-IV: Molecular Orbital Theory **(07 Lectures)**

Resonance and resonance energy, Molecular orbital theory. Molecular orbital diagrams of diatomic and simple polyatomic molecules N_2, O_2, F_2, CO, NO, and their ions; HCl (idea of s-p mixing and orbital interaction to be given). Formal charge, Valence shell electron pair repulsion theory (VSEPR), shapes of the following simple molecules and ions containing lone pairs and bond pairs of electrons: H_2O, NH_3, PCl_3, PCl_5, SF_6, ClF_3, I_3^-, BrF_2^+, PCl_6^-, $ICl_2^-ICl_4^-$ and SO_4^{2} 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**.**

UNIT-V: Weak Chemical Forces(05 Lectures)

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, energetics of dissolution process.

Learning outcomes: Students will develop an understanding of the fundamental chemistry of the atomic properties and electronic configurations of atoms at orbital levels and how different rules govern the periodicity of properties variance, understanding of VBT and molecular orbital theory to determine the geometry and bonding in polyatomic molecules, further they will learn the MOs representation of several polyatomic molecules to analyze their chemical reactivity.

Text Book:

1. Inorganic chemistry by Malik, Tuli and Madan. S. Chand and Co. 2010.

Reference Books:

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.

Course Structure& Syllabus of BSc (H) Chemistry

Applicable for Batch: 2017-2020

Subject Code	CH-107	Subject Title	PHYSICAL						CHEMISTRY-I
LTP	3 1 4	Credit	5.5	Subject Category	CC	Year	1st	Semester	I

Course Objectives: This is an introductory course that is designed to equip students with the basic understanding of topics on the states of materials and their intrinsic properties; ideal gases and real gases their molecular distribution with temperature, how the properties of liquids, like surface tension and viscosity can be employed to understand the different classes of surfactants and detergents, and their ionic equilibrium, finally, understanding of solid crystal states and principle of X-ray crystal determination.

UNIT-I: Gaseous state **(07 Lectures)**

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 ζ from η; variation of viscosity with temperature and pressure. Maxwell distribution and its use in evaluating molecular velocities (average, root meansquare and most probable) and average kinetic energy, law of equipartition of energy, degrees offreedom and molecular basis of heat capacities.

UNIT-II: Behavior of real gases: **(07 Lectures)**

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

UNIT-III: Liquid state **(06 Lectures)**

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

UNIT-IV: Solid state **(08 Lectures)**

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, a simple account of rotating crystal method and powder pattern method. Analysis of powder diffraction patterns of NaCl, CsCl and KCldipole moment. Percentage ionic character from dipole moment and electronegativity difference.

UNIT-V: Ionic Equilibria **(10 Lectures)**

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. Salthydrolysis-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.

Learning Outcomes: Students will learn the basic understanding of topics on the states of materials and their intrinsic properties; ideal gases and real gases their molecular distribution with temperature, also they will learn the calculations of ionic equilibria of salts in different medium and enable to comprehend the basis of selection of properties of liquids, like surface tension and viscosity for the different classes of surfactants and detergents. Finally, they will learn the theoretical and practical methodology of solid states X-ray crystal determination.

Text Books:

1. Principles of Physical Chemistry by Puri, Sharma and Pathania. SLNC and Co.
2. Essentials of Physical Chemistry by Behl and Tuli. S. Chand and Co.

Reference Books:

1. Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry Ed., Oxford University Press (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).

Course Structure& Syllabus of BSc (H) Chemistry

Applicable for Batch: 2017-2020

Subject Code	CH-108	Subject Title	CHEMO INFORMATICS					
LTP	3 0 0	Credit	3.0	Subject Category	CC	Year	1st	Semester	I

Course Objectives: This course is a 3-credit course intended to provide an introduction to the cheminformatics. The course objectives are to introduce different methods of molecular representations and chemical database searching their energetic calculations with particular emphasis on applications including modern drug discovery.

UNIT – I : Introduction to Chemoinformatics **(05 Lectures)**

History and evolution of chemoinformatics, Use of chemoinformatics, Prospects of chemoinformatics, Molecular Modelling and Structure elucidation.

UNIT – II : Representation of molecules and chemical reactions **(06 Lectures)**

Nomenclature, Different types of notations, SMILES coding, Matrix representations, Structure of Molfiles and Sdfiles, Libraries and toolkits, Different electronic effects, Reaction classification**.**

UNIT – III : Searching chemical structures **(06 Lectures)**

Full structure search, sub-structure search, basic ideas, similarity search, three dimensional search methods, basics of computation of physical and chemical data and structure descriptors, data visualization.

UNIT- IV: Applications **(08 Lectures)**

Prediction of Properties of Compounds; Linear Free Energy Relations; Quantitative Structure-Property Relations; Descriptor Analysis; Model Building; Modeling Toxicity; Structure-Spectra correlations; Prediction of NMR, IR and Mass spectra; Computer Assisted Structure elucidations; Computer Assisted Synthesis Design.

UNIT- V: Drug Design **(10 Lectures)**

Introduction to drug design; Target Identification and Validation; Lead Finding and Optimization; Analysis of HTS data; Virtual Screening; Design of Combinatorial Libraries; Ligand-Based and Structure Based Drug design; Application of Chemoinformatics in Drug Design.

Learning Outcomes: Students will learn the different basic methods of molecular representations and chemical database searching their energetic calculations with particular emphasis on applications including modern drug discovery.

Reference and Text Books:

1. Andrew R. Leach & Valerie, J. Gillet (2007) An introduction to Chemoinformatics. Springer.
2. Gasteiger, J. & Engel, T. (2003) Chemoinformatics: A text-book. Wiley-VCH.
3. Gupta, S. P. (2011) QSAR & Molecular Modeling. Anamaya Pub.: New Delhi.

Course Structure& Syllabus of BSc (H) Chemistry

Applicable for Batch: 2017-2020

Subject Code	HS101	Subject Title	Professional Communication						
LTP	2 1 1	Credit	3.0	Subject Category	AEC	Year	1st	Semester	I

OBJECTIVES

- To promote efficiency in English Language with the development of the four skills of communication i.e., LSRW (Listening, Speaking, Reading & Writing).
- To help students perform better in all academic subjects through greater command over the English language.
- To develop technical writing skills with a focus on critical thinking, rhetorical analysis, effective writing & effective document design.

Unit-I

Communication 6 hrs

Communication: Meaning, Types of Communication: General & Technical Communication
Barriers to Communication, Overcoming strategies.

Unit II

Non Verbal Communication 3 hrs

Knowledge and adoption of Non Verbal cues of communication: Kinesics, Proxemics, Chronemics, Oculesics, Haptics, Paralinguistics

Unit III

Listening & Speaking Skills 6 hrs

Listening Comprehension: identifying General & Specific information, Note taking and drawing inferences
Introduction to Phonetics: Articulation of consonants and vowel sounds.
Public Speaking
Discussion Techniques

Unit IV

Reading Skills 4 hrs

Reading Strategies and Vocabulary Building
Reading Comprehension

Unit V

Technical Writing Skills 7 hrs

Paragraph development
Technical Articles, Research Articles, Plagiarism
Intra office Correspondence: Notice, Agenda, Minutes and Memorandum,
Technical Proposal & Report

LEARNING OUTCOMES

- Build confidents of the students through practice of the basic skills of the basic skills of communication.
- The students will be equipped to comprehend a variety of content & develop deeper insight.
- Enable the students to effectively create standard formats used to construct meaningful documents.

TEXT BOOKS

1. Rizvi, Ashraf. Effective Technical Communication, McGraw Hill, New Delhi. 2005.
2. Lata, Pushp and Sanjay Kumar, Communication Skills, Oxford University Press, New Delhi. 2011.

REFERENCE BOOKS

1. Aslam, Mohammad. Introduction to English Phonetics and Phonology Cambridge.2003.
2. Ford A, Ruther. Basic Communication Skills; Pearson Education, New Delhi.2013.
3. Gupta, Ruby. Basic Technical Communication, Cambridge University Press, New Delhi.2012.
4. Kameswari, Y. Successful Career Soft Skills and Business English, BS Publications, Hyderabad.2010.
5. Tyagi, Kavita & Padma Misra. Basic Technical Communication, PHI, New Delhi. 2011.

Course Structure& Syllabus of BSc (H) Chemistry

Applicable for Batch: 2017-2020

Subject Code	PY107	Subject Title	Mechanics						
LTP	3 1 4	Credit	5.5	Subject Category	GEC	Year	1st	Semester	I

Course Objective: The aim of this course is to introduce students to both elementary classical mechanics and the basic ideas of Special Relativity.

Unit-I

Work and Energy: Work and Kinetic Energy Theorem. Conservative and nonconservative forces. Potential Energy. Energy diagram. Stable and unstable equilibrium. Elastic potential energy. Force as gradient of potential energy. Work & Potential energy. Work done by non-conservative forces. Law of conservation of Energy.

(4 Lectures)

Collisions: Elastic and inelastic collisions between particles. **(2 Lectures)**

Unit-II

Rotational Dynamics: Angular momentum of a particle and system of particles. Torque. Principle of conservation of angular momentum. Rotation about a fixed axis. Moment of Inertia. Calculation of moment of inertia for rectangular, cylindrical and spherical bodies. Kinetic energy of rotation. Motion involving both translation and rotation.

(8 Lectures)

Elasticity: Relation between Elastic constants. Twisting torque on a Cylinder or Wire.

(2 Lectures)

Fluid Motion: Kinematics of Moving Fluids: Poiseuille's Equation for Flow of a Liquid through a Capillary Tube.

(2 Lectures)

Unit-III

Gravitation and Central Force Motion: Law of gravitation. Gravitational potential energy. Inertial and gravitational mass. Potential and field due to spherical shell and solid sphere. **(3 Lectures)**

Motion of a particle under a central force field. Two-body problem and its reduction to one-body problem and its solution. The energy equation and energy diagram. Kepler's Laws. Satellite in circular orbit and applications. Geosynchronous orbits. Weightlessness. Basic idea of global positioning system (GPS). Physiological effects on astronauts. **(6 Lectures)**

Unit-IV

Non-Inertial Systems: Non-inertial frames and fictitious forces. Uniformly rotating frame. Laws of Physics in rotating coordinate systems. Centrifugal force. Coriolis force and its applications. Components of Velocity and Acceleration in Cylindrical and Spherical Coordinate Systems. **(4 Lectures)**

Unit-V

Special Theory of Relativity: Postulates of Special Theory of Relativity. Lorentz Transformations. Simultaneity and order of events. Lorentz contraction. Time dilation. Relativistic transformation of velocity, frequency and wave number. Relativistic addition of velocities. Variation of mass with velocity. Massless Particles. Mass-energy Equivalence. Transformation of Energy and Momentum. **(9 Lectures)**

Learning Outcome: Having successfully completed this module, the student will be able to demonstrate knowledge and understanding of:

- To know Newton's laws of motion, potentials, conservation of energy, momentum and angular momentum, and be able to apply them to projectiles, circular motion, and gravity.
- To understand the postulates of Special Relativity and their consequences in terms of Time dilation and length contraction.
- To understand Lorentz transformations, relativistic kinematics and the relation between mass and energy.

Text Books:

1. An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.
2. Mechanics, D.S. Mathur, S. Chand and Company Limited, 2000
3. Mechanics, Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al. 2007, Tata McGraw-Hill.
4. Concepts of Modern Physics, Arthur Beiser, Sixth Edition, Tata McGraw-Hill

Reference Books:

1. Analytical Mechanics, G.R. Fowles and G.L. Cassiday. 2005, Cengage Learning
2. Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons
3. University Physics. F.W Sears, M.W Zemansky, H.D Young 13/e, 1986, Addison Wesley
4. Theoretical Mechanics, M.R. Spiegel, 2006, Tata McGraw Hill.

Course Structure& Syllabus of BSc (H) Chemistry

Applicable for Batch: 2017-2020

Subject Code	CH116	Subject Title	Basic Organic Chemistry						
LTP	3 1 4	Credit	5.5	Subject Category	CC	Year	1st	Semester	II

Course Objectives: This course aims to develop an understanding of the basic principles of organic chemistry which include organic skeleton build-up, hybridization states, their stereo-electronic properties and different mechanisms involved in organic transformations. The course will develop an insight on the stereochemistry and mechanism of different classes of organic compounds.

UNIT-I: Basics of Organic Chemistry **(08 Lectures)**

Organic Compounds: Classification, and Nomenclature, Hybridization, Shapes of molecules, Influence of hybridization on bond properties. Electronic Displacements: Inductive, electromeric, resonance and mesomeric effects, hyperconjugation and their applications; Dipole moment; Organic acids and bases; their relative strength. Homolytic and Heterolytic fission with suitable examples. Curly arrow rules, formal charges; Electrophiles and Nucleophiles; Nucleophlicity and basicity; Types, shape and their relative stability of Carbocations, Carbanions, Free radicals and Carbenes. Introduction to types of organic reactions and their mechanism: Addition, Elimination and Substitution reactions**.**

UNIT-II: Stereochemistry **(08 Lectures)**

Fischer Projection, Newmann and Sawhorse Projection formulae and their interconversions; Geometrical isomerism: cis–trans and, syn-anti isomerism 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 resolution. Relative and absolute configuration: D/L and R/S designations.

UNIT-III: Chemistry of Aliphatic Hydrocarbons **(10 Lectures)**

Chemistry of alkanes: Formation of alkanes, Wurtz Reaction, Wurtz-Fittig Reactions, Free radical substitutions: Halogenation -relative reactivity and selectivity.Formation of alkenes and alkynes by elimination reactions, Mechanism of E1, E2, E1cb reactions. Saytzeff and Hofmann eliminations.

Reactions of alkenes: 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 benzylicbromination 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**.**

UNIT-IV: Cycloalkanes and Conformational Analysis **(05 Lectures)**

Types of cycloalkanes and their relative stability, Baeyer strain theory, Conformation analysis of alkanes: Relative

stability: Energy diagrams of cyclohexane: Chair, Boat and Twist boat forms; Relative stability with energy diagrams.

UNIT-V: Aromatic Hydrocarbons **(07 Lectures)**

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**.**

Learning Outcomes: Students will have an understanding of the basic chemistry of organic compounds, their stereo-electronic properties and nucleophilic-electrophilic nature and stereochemistry, appreciation of how the mechanisms of organic reactions are described and determined. Have an appreciation of how mechanism are used in other branches of organic chemistry and have an appreciation of mechanisms of heterocyclic syntheses

Text Books:

1. Organic Chemistry by Behl and Behl. S. Chand and Co. New Delhi.

Reference Books:

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

ORGANIC CHEMISTRY
LABORATORY-I EXPERIMENTS

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 above compounds and 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)

Reference Books

- Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009)
- Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5thEd., Pearson(2012)

Course Structure& Syllabus of BSc (H) Chemistry

Applicable for Batch: 2017-2020

Subject Code	CH117	Subject Title	Physical Chemistry-II						
LTP	3 1 4	Credit	5.5	Subject Category	CC	Year	1st	Semester	II

Course Objectives: This course aims to connect the principles, concepts, and laws of classical and statistical thermodynamics to applications that require quantitative knowledge of thermodynamic properties of substances at macroscopic and molecular level. It covers the basic postulates of classical thermodynamics and their applications to transient open and closed systems, criteria of thermodynamic stability and equilibria of chemical mixing and determination of composition and their colligative properties.

UNIT-I: Chemical Thermodynamics **(10 Lectures)**

Intensive and extensive variables; state and path functions; isolated, closed and open systems; zeroth law of thermodynamics.

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, U and H for reversible, irreversible and free expansion of gases (ideal and van der Waals) under isothermal and adiabatic.

Second Law: Concept of entropy; thermodynamic scale of temperature, statement of the second law of thermodynamics; molecular and statistical interpretation of entropy. 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.

UNIT- II: Thermochemistry **(05 Lectures)**

Heats of reactions: standard states; enthalpy of formation of molecules and ions and enthalpy of combustion and its applications; calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data, effect of temperature (Kirchhoff's equations) and pressure on enthalpy of reactions. Adiabatic flame temperature, explosion temperature.

UNIT-III: Solutions and Colligative Properties **(06 Lectures)**

Dilute solutions; lowering of vapour pressure, Raoult's and Henry's Laws and their applications. Excess thermodynamic functions. 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.

UNIT-IV: Chemical Equilibrium **(08 Lectures)**

Criteria of thermodynamic equilibrium, degree of advancement of reaction, chemical equilibria in ideal gases, concept of fugacity. Thermodynamic derivation of relation between Gibbs free energy of reaction and reaction quotient. Coupling of exoergic and endoergic reactions. Equilibrium constants and their quantitative dependence

on temperature, pressure and concentration. Free energy of mixing and spontaneity; thermodynamic derivation of relations between the various equilibrium constants K_p, K_C and K_X. Le Chatelier principle (quantitative treatment); equilibrium between ideal gases and a pure condensed phase.

UNIT-V: Systems of Variable Composition **(05 Lectures)**

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.

Learning Outcomes: Students will understand the principles, concepts, and laws of classical and statistical thermodynamics to applications of thermodynamic properties of substances at macroscopic and molecular level. They will learn the basic postulates of classical thermodynamics and their applications to transient open and closed systems, criteria of thermodynamic stability and able to calculate the composition and equilibria of chemical mixing and their colligative properties.

Text Books:

1. Principles of Physical Chemistry by Puri, Sharma and Pathania. SLNC and Co.

2. Essentials of Physical Chemistry by Behl and Tuli. S. Chand and Co.

Reference Books

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).

6. Levine, I .N. Physical Chemistry 6th Ed., Tata McGraw Hill(2010).

7. Metz, C.R. 2000 solved problems in chemistry, Schaum Series (2006

(iii) **LABORATORY EXPERIMENTS**

Thermochemistry

(a) Determination of heat capacity of a calorimeter for different volumes using change of enthalpy data of a known system (method of back calculation of heat capacity of calorimeter from known enthalpy of solution or enthalpy of neutralization).

(b) Determination of heat capacity of the calorimeter and enthalpy of neutralization of hydrochloric acid with sodium hydroxide.

(c) Calculation of the enthalpy of ionization of ethanoic acid.

(d) Determination of heat capacity of the calorimeter and integral enthalpy (endothermic and exothermic) solution of salts.

(e) Determination of basicity/proticity of a polyprotic 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 copper sulphate.

(g) Study of the solubility of benzoic acid in water and determination of ΔH.

Any other experiment carried out in the class.

Reference Books

- Khosla, B. D.; Garg, V. C. & Gulati, A., Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).
- Athawale, V. D. &Mathur, P. Experimental Physical Chemistry New Age International: New Delhi (2001)

Course Structure& Syllabus of BSc (H) Chemistry

Applicable for Batch: 2017-2020

Subject Code	CH118	Subject Title	Analytical Clinical Biochemistry						
LTP	2 0 2	Credit	3.0	Subject Category	CC	Year	1st	Semester	II

Course Objectives: This course aims to impart the practical understanding of biochemical functions of the biomolecules including, enzymes and nucleic acids biochemistry and their qualitative and quantitative estimations. The course also covers the aspects of clinical biochemistry with reference to practical implication of altered blood and urine parameters assessment, particularly related to pathological metabolism of carbohydrates and lipids.

UNIT-I: Basic understanding of the structures, properties and functions of carbohydrates

(05 Lectures)

Review of concepts studied in the core course. Carbohydrates: Biological importance of carbohydrates, Metabolism, Cellular currency of energy (ATP), Glycolysis, Alcoholic and Lactic acid fermentations, Krebs cycle. Isolation and characterization of polysachharides.

UNIT-II :Basic understanding of the structures, properties and functions of proteins

(08 Lectures)

Proteins: Classification, biological importance; Primary and secondary and tertiary structures of proteins: α-helix and β- pleated sheets, Isolation, characterization, denaturation of proteins.

Enzymes: Nomenclature, Characteristics (mention of Ribozymes), Classification; Active site, Mechanism of enzyme action, Stereospecificity of enzymes, Coenzymes and cofactors, Enzyme inhibitors, Introduction to Biocatalysis: Importance in "Green Chemistry" and Chemical Industry.

UNIT-III :Basic understanding of the structures, properties and functions of lipids

(05 Lectures)

Lipids: Classification. Biological importance of triglycerides and phosphoglycerides and cholesterol; Lipid membrane, Liposomes and their biological functions and underlying applications. Lipoproteins. Properties, functions and biochemical functions of steroid hormones. Biochemistry of peptide hormones.

UNIT-IV :Structure of Nucleic Acid **(07 Lectures)**

Structure of DNA (Watson-Crick model) and RNA, Genetic Code, Biological roles of DNA and RNA: Replication, Transcription and Translation, Introduction to Gene therapy.

Enzymes: Nomenclature, classification, effect of pH, temperature on enzyme activity, enzyme inhibition.

UNIT-V: Biochemistry of disease: A diagnostic approach by blood/ urine analysis

(07 Lectures)

Blood: Composition and functions of blood, blood coagulation. Blood collection and preservation of samples. Anaemia, Regulation, estimation and interpretation of data for blood sugar, urea, creatinine, cholesterol and bilirubin.

Urine: Collection and preservation of samples. Formation of urine. Composition and estimation of constituents of normal and pathological urine**.**

Learning Outcomes: Students will be able to learn the biochemical functions of the biomolecules including, enzymes and nucleic acids and their biochemistry. They will develop the practical skills of determining the qualitative and quantitative estimations of biomolecules in the biological samples and will be able to grasp the knowledge of clinical biochemistry with reference to practical implication of altered blood and urine parameters assessment along with processing of blood and urine samples.

Text and Reference Books:

1. T.G. Cooper: Tool of Biochemistry.
2. Keith Wilson and John Walker: Practical Biochemistry.
3. Alan H Gowenlock: Varley's Practical Clinical Biochemistry.
4. Thomas M. Devlin: Textbook of Biochemistry.
5. Jeremy M. Berg, John L Tymoczko, Lubert Stryer: Biochemistry.
6. G. P. Talwar and M Srivastava: Textbook of Biochemistry and Human Biology.
7. A.L. Lehninger: Biochemistry.
8. O. Mikes, R.A. Chalmers: Laboratory Handbook of Chromatographic Methods.

Analytical Clinical Biochemistry Practicals

Identification and estimation of the following:

1. Carbohydrates – qualitative and quantitative.
2. Lipids – qualitative.
3. Determination of the iodine number of oil.
4. Determination of the saponification number of oil.
5. Determination of cholesterol using Liebermann- Burchard reaction.
6. Proteins – qualitative.
7. Isolation of protein.
8. Determination of protein by the Biuret reaction.
9. Determination of nucleic acids

Course Structure& Syllabus of BSc (H) Chemistry

Applicable for Batch: 2017-2020

Subject Code	MA116	Subject Title	Ordinary differential Equation and Laplace Transform						
LTP	3 1 0	Credit	3.5	Subject Category	GEC	Year	1st	Semester	II

Objective: To learn the techniques for solutions of certain differential equations and ways to transform these in to algebraic equations.

UNIT I: Introduction to Differential Equations:

Formation of differential equations. Basic definitions (linearity, order, homogeneous and non-homogeneous, explicit and implicit solution, general solution, particular solution). Existence and uniqueness theorem for linear ordinary differential equation.

UNIT II: First order ODE:

Separable equations, ODE with homogenous coefficients. Exact equations. Integrating factors. ODE with linear coefficients, Bernoulli, Ricatti and Clairaut equation; orthogonal trajectories.

UNIT III: Second and Higher order ODE:

Linear dependent and independence of functions, Wronskian and its basic properties. Solution of homogeneous andnon-homogeneous linear ODE with constant coefficients usingmethod of undetermined coefficients and inverse operator method. Equation with variable coefficients, Euler-Cauchy equations, Variation of parameters. Solution of second order differential equations by changing dependent and independent variables.

UNIT IV: Laplace Transform (LT)

Laplace of some standard functions, Existence conditions for the Laplace Transform, Shifting theorems, Laplace transform of derivatives and integrals, Inverse Laplace transform and their

properties, Convolution theorem, Initial and final value theorem, Laplace transform of periodic functions, error functions, Heaviside unit step function and Dirac delta function, Applications of Laplace transform to solve Ordinary differential equations.

Learning Outcome: The students would be well versed in modelling various physical experiments in to differential equations and providing their solutions.

Text Books:

Simmons, G. F., “Differential Equations”, McGraw-Hill, 2nd Edition.

Reference Books:

1. Tenenbaum, M. and Polard, H., “**Ordinary Differential Equations**”, Dover Publications.

2. R. K. Jain & S. R. K. Iyenger, **Advanced Engineering Mathematics**, 2nd Edition, Narosa Publishing House, New Delhi, India, 2006.

Course Structure& Syllabus of BSc (H) Chemistry

Applicable for Batch: 2017-2020

Subject Code	HS102	Subject Title	Corporate Communication & Soft Skills						
LTP	2 1 1	Credit	3.0	Subject Category	SEC	Year	1st	Semester	II

Objective: Recognize the role and importance of the language and communication skills. Know about the importance of formal communication. Equip with critical thinking, writing, listening and acquires the ability to work in a team.

Unit I: Business Communication.

Job Application Letter & Resume
Interview Skills, Impression Management: Importance & Features of Business Communication, Flow of Communication: Channels & Networks
Communication: E mails & E- Tools
Business Presentation
Business Etiquette, Telephonic Etiquette
Business Letter Writing

Unit II: Personal Skills for Corporate Communication

SWOT Analysis: Self-Assessment, Identifying Strength & Weakness
Self-Awareness, Self-Disclosure & Self-Management (Stress, Anger)
Goal Setting: Personal & Professional Goals, SMART-ER Goals
Human Perception: Understanding People, Perceptions, Attitudes
Personality (Personality Test)

Unit III: Professional Skills for Corporate Communication

Decision Making: Techniques, Six Thinking Hats
Creative Thinking, Lateral Thinking
Team Building & Leadership Skills
Time Management: Planning Organizing, Time Wasters
Conflict Resolution Skills
Negotiation Skills

Learning Outcome: By the end of course student will understand role and importance of various forms of communication skill. Students will be able to present themselves in various formal and professional situations.

TEXT BOOKS

1. Rizvi, Ashraf, Effective Technical Communication, McGraw Hill, New Delhi. 2005.

REFERENCE BOOKS

1. Steven R., The Seven Habits of Highly Effective People, 2007.
1. Dale Carnegie, **How to win Friends and influence People**, 2009.
2. Dr. Alex, **Soft Skills**: **Know Yourself & Know the World**, S. Chand Publications, 2001.
3. Gopalswamy Ramesh., T**he ACE of Soft Skills: Attitude, Communication and Etiquette for Success,** 2008.
4. B. N Ghosh, **Managing Soft skills for Personality development**, 2006.
5. Elizabeth B. Hurlock, **Personality Development**, TMH Publication. 2010.

Course Structure& Syllabus of BSc (H) Chemistry

Applicable for Batch: 2017-2020

LAB

Lab 1	Telephone Etiquette: Making an appointment, answering calls (Role Play)
Lab 2	Telephone Etiquette: Making an appointment, answering calls (Role Play)
Lab 3	Business Presentations (PPT Presentation)
Lab 4	Business Presentations (PPT Presentation)
Lab 5	Interview Skills: Mock Interview
Lab 6	Interview Skills: Mock Interview
Lab 7	Panel Discussion
Lab 8	Panel Discussion
Lab 9	Conflict & Negotiation (Situational Role Play)
Lab 10	Conflict & Negotiation (Situational Role Play)
Lab 11	Evaluation
Lab 12	Evaluation

TUTORIAL

Tutorial 1 Writing Practice **(**2 Types of Business Letters)

Tutorial 2 Writing Practice(Job Application Letter & Resume)

Tutorial 3 Personality Test

Tutorial 4 SWOT Analysis (Exercise)

Tutorial 5 Team Building (Exercise)

Tutorial 6 Time Management(Exercise)

Tutorial 7 Case Studies (Goal setting, Perception ,)

Tutorial 8 Case Studies (Decision making , Lateral thinking)

Tutorial 9 Case Studies (Leadership)

Tutorial 10 Group Discussion

Course Structure& Syllabus of BSc (H) Chemistry

Applicable for Batch: 2017-2020

Subject Code	CH-206	Subject Title	Inorganic						Chemistry-II
LTP	3 14	Credit	6	Subject Category	CC	Year	2nd	Semester	III

COURSE OUTLINE:

This course covers chemistry of s- and p-block elements with extensive understanding. This course also covers chemistry of Boranes, Silanes, oxo and peroxo acids, interhalogen compounds along with the reactivity of noble gases, theories of acids and bases and also covers the brief understanding of inorganic Polymers.

COURSE OBJECTIVE:

This is an advance course in chemistry which provides extensive understanding of the chemical properties of s- and p-block elements and comprehension of their structure-reactivity in terms of acid-base nature; Course build up an insight to understand the complex nature of higher order boranes and interhalogen compounds and their reactions.

COURSE PRE/CO- REQUISITE (IF ANY) :

The student must have basic knowledge of electrostatics and magnetostatics.

DETAILED SYLLABUS

Unit I: Chemistry of s and p block elements: 9 Hrs

Inert pair effect, Relative stability of different oxidation states, diagonal relationship and anomalous behavior of first member of each group. Allotropy and catenation, Complex formation tendency of s- and p-block elements. Hydrides and their classification: ionic, covalent and interstitial. Basic beryllium acetate and nitrate.

Unit II: Chemistry of Boranes, Silanes,oxo and peroxo acids and interhalogen compounds

10 Hrs

Study of the following compounds with emphasis on structure, bonding, preparation, properties and uses: Boric acid and borates, boron nitrides, borohydrides (diborane), silanes, Oxides and oxoacids of nitrogen, Phosphorus and chlorine. Peroxo acids of sulphur; Interhalogen compounds, polyhalide ions, pseudohalogens.

Unit III: Noble gases: 6 Hrs

Occurrence & uses, rationalization of inertness of noble gases, Clathrates; preparation and properties of XeF_2 and XeF_4, XeF_6; Nature of bonding in noble gas compounds (Valence bond treatment and MO treatment for XeF_2). Molecular shapes of noble gas compounds (VSEPR theory).

Unit IV: Acids and Bases: 7 Hrs

Brönsted-Lowry concept of acid-base reactions, solvated proton, relative strength of acids, types of acid-base reactions, leveling solvents, Lewis acid-base concept, Classification of Lewis acids, Hard and Soft Acids and Bases (HSAB) Application of HSAB principle.

Unit IV: Inorganic Polymers: 7 Hrs

Types of inorganic polymers, comparison with organic polymers, synthesis, structural aspects and applications of silicones and siloxanes. Borazines, silicates and phosphazenes, and polysulphates.

Learning Outcome:-

At the end of the course, the student will be able to:

1. Explain the concepts of Acid-Base reactivity and theorize the nature of super acids and bases
2. Gain an insight into the reactivity of various p-block compounds, their oxo- and peroxo-acids forming ability and reactions.

3. Explain the hybridization and geometry of compounds of Nobel gases and their applications
4. Classify and understand the complex structures of various boranes, silanes and Interhalogen compounds and also their implications for modern-day catalysts design and applications in medical sciences.
5. Gain an understanding of the various inorganic polymers, their chemical properties and applications in modern days.

TEXT BOOKS

1. N.N. Greenwood, and Earnshaw, Chemistry of the Elements, Butterworth Heinemann. 1997.
2. J. D. Lee, Concise Inorganic Chemistry, ELBS (1991).
3. Canham, G.R. and Overton, T., Descriptive Inorganic Chemistry, Freeman & Co.2006
4. F. A. Cotton andG. Wilkinson; Advanced Inorganic Chemistry, Wiley, VCH, 1999.

REFERENCE BOOKS

1. T. H. Dunning and D. E. Woon; p-Block elements-Inorganic chemistry, Magnum Publishing, 2016
2. W. N. Lipscomb; Boron Hydrides, Dover Publications.inc, 2012

SR.NO.	EXPERIMENT NAME
1	**(a) Iodo / Iodimetric Titrations** (i) Estimation of Cu (II) and $K_2Cr_2O_7$ Using sodium thiosulphate solution (Iodimetrically). (ii) Estimation of (i) arsenite and (ii) antimony in tartar-emetic iodimetrically (iii) Estimation of available chlorine in bleaching powder iodometrically.
2	Inorganic preparations of Cuprous Chloride, Cu_2Cl_2
3	Inorganic Preparation of Manganese (III) phosphate, $MnPO_4.H_2O$
4	Inorganic Preparation of Aluminium Potassium sulphate $K_2Al(SO_4)_2.12H_2O$ (Potash alum) or Chrome alum.
5	Inorganic Preparation of salicyldehyde and ethylenediamineligands based Cu-schiff base complexes.

Course Structure& Syllabus of BSc (H) Chemistry

Applicable for Batch: 2017-2020

Subject Code	CH-207	Subject Title	Organic Chemistry II						
LTP	3 1 4	Credit	6	Subject Category	CC	Year	2nd	Semester	III

COURSE OUTLINE:

This course covers reactivity, preparation and important reactions of halogenated compounds. Course also covers preparation properties and reactivity of alcohols, Phenols, Ethers and epoxide, carbonyl, carboxylic acid and sulphur containing compounds.

COURSE OBJECTIVE:

The objective of this course is to learn basics concepts of reaction mechanism and electronic flow present in the molecules which help to drive arrow pushing mechanism. This course recalls the fundamental principles of organic chemistry that include chemical bonding, nomenclature, structural isomerism, stereochemistry, chemical reactions and mechanism.

COURSE PRE/CO- REQUISITE (IF ANY): no restricted pre-requisite

DETAILED SYLLABUS

Unit I: Chemistry of Halogenated hydrocarbons **8 Hrs**

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

Aryl halides: Preparation, including preparation from diazoniumsalts. Nucleophilic aromatic substitution; S_NAr and Benzyne mechanism.

Relative reactivity of Alkyl, allyl/benzyl, vinyl and aryl halides towards nucleophilic substitution reactions.

Organometallic compounds of Mg and Li metals and use in synthesis of organic compounds.

Unit II: Alcohols, Phenols, Ethers and epoxide **9Hrs**

Alcohols: preparation, properties and relative reactivity of 1^o, 2^o, 3^oalcohols,Bouvaelt-Blanc Reduction; Preparation and properties of glycols; Oxidation by periodic acid and tetraacetate, Pinacol- Pinacolone rearrangement;

Phenols: Preparation and properties; Acidity of substituted phenols; Ring substitution reactions, Reimer-Tiemann and Kolbe's-Schmidt Reactions, Fries and Claisen rearrangements.

Ethers and Epoxides: Preparation and reactions with acids. Reactions of epoxides with alcohols, ammonia derivatives and $LiAlH_4$

Unit III: Carbonyl Compounds **8 Hrs**

Structure, reactivity and preparation; Nucleophilic additions, Nucleophilic addition-elimination reactions with ammonia derivatives with mechanism; Mechanisms of Aldolcondensation, Claisen-Schmidt condensation, Perkin and Cannizzaro reactions; Benzoin condensation, Beckmann and Benzil-Benzilic acid rearrangements and Wittig reactions. Oxidation (Baeyer Villiger) and reduction reactions (Clemmensen, Wolff-Kishner and borohydrides).Addition reactions of α, β-unsaturated carbonyl compounds: Michael additions. Active methylene compounds-Keto-enol, tautomerism.

Unit IV: Carboxylic Acids and their Derivatives **8 Hrs**

Preparation, physical properties and reactions of monocarboxylic acids, typical reactions of dicarboxylic acids, hydroxy acids and unsaturated acids, viz; succinic/phthalic, lactic, malic, tartaric, citric, maleic and fumaric acids.

Preparation and reactions of acid chlorides, anhydrides, esters and amides; Mechanism of acidic and alkaline hydrolysis of esters. Claisen condensation, Dieckmann and Reformatsky reactions, Hofmann-bromamide degradation and Curtius rearrangement

Unit V: Sulphur containing compounds **6 Hrs**

Preparation and reactions of thiols, thioethers and sulphonic acids;
Thiophene: reactions and properties.

Learning Outcome

Having successfully completed this course, the student will be able to:

1. Predict the reactivity of an organic compound from its structure.

2. Develop basic skills for the multi-step synthesis of organic compounds.

3. Justify a reasonable mechanism for a chemical reaction.

4. Identify name the functional groups and different class of organic compounds

5. Predict electronic flow and arrow pushing mechanism in a chemical reaction.

Text book [TB]:

1. Organic Chemistry, Morrison, R. T. & Boyd, R. N., Pearson Education, 7 Ed., (2010)

2. Organic Chemistry (Volume 1), Finar, I. L., Pearson Education 6 Ed., (2002)

3. March's Advanced Organic Chemistry: Reactions, Mechanisms and Structure

Reference books [RB]:

1. J. Cleyden and S. Warren, Organic Chemistry, Oxford University Press; Second edition (2012)

2. F.A. Carey & R. Sundberg, Advanced Organic Chemistry-(Part-A & B), Springer; 5th edition

3. R. B. Grossmann, The Art of Writing Reasonable Organic Reaction Mechanisms, Springer;

SR.NO.	LIST OF EXPERIMENTS
1	Functional group tests for alcohols, phenols, carbonyl and carboxylic acid group.
2	Organic preparations: Acetylation of one of the following compounds: amines (aniline, o-, m-, p-toluidines and o-, m-, p-anisidine)
3	Acetylation of Salicylic acid by any one method: a. Using conventional method b. Using green approach
4	Benzolyation of one of the following amines (aniline,β-naphthol, resorcinol, p-cresol) by Schotten-Baumann reaction.
5	Nitration of acetanilide/nitrobenzene by conventional method.
6	Preparation of Warfarin
7	Semicarbazone of any one of the following compounds: acetone, ethyl methyl Ketone, cyclohexanone, benzaldehyde.
8	Nitration of salicylic acid by green approach (using ceric ammonium nitrate.

Course Structure& Syllabus of BSc (H) Chemistry

Applicable for Batch: 2017-2020

Subject Code	CH-208	Subject Title	Physical Chemistry III						
LTP	3 1 4	Credit	6	Subject Category	CC	Year	2nd	Semester	III

COURSE OUTLINE:

This course covers the concept of phases, fundamental of electrochemistry, applications of electrochemistry, distribution Law and applications of distribution law.

COURSE OBJECTIVE:

The objective of this course is to learn basics concepts of electrolytic solutions and electrolytes. It will also give the information regarding the number of phase present in a chemical component and to know their applications in various fields.

COURSE PRE/CO- REQUISITE (IF ANY): no restricted pre-requisite

DETAILED SYLLABUS

Unit I: Phase Equilibria-I **8Hrs**

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

Three component systems, water-chloroform-acetic acid system, triangular plots.

Unit II: Phase Equilibria-II **7 Hrs**

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.

Unit III: Fundamental of Electrochemistry **8Hrs**

Quantitative aspects of Faraday's laws of electrolysis, 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.

Unit IV: Applications of Electrochemistry **9Hrs**

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 SbO/Sb_2O_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)

Unit V - Distribution Law **7 Hrs**

Nernst distribution law – its thermodynamic derivation, Modification of distribution law when solute undergoes dissociation, association and chemical combination. Applications of distribution law:

(i) Determination of degree of hydrolysis and hydrolysis constant of aniline hydrochloride.

(ii) Determination of equilibrium constant of potassium tri-iodide complex and process of extraction.

Course Structure& Syllabus of BSc (H) Chemistry

Applicable for Batch: 2017-2020

Learning Outcome

Having successfully completed this course, the student will be able to:

1. Predict the reactivity of an organic compound from its structure.

2. Develop basic skills for the multi-step synthesis of organic compounds.

3. Justify a reasonable mechanism for a chemical reaction.

4. Identify name the functional groups and different class of organic compounds

5. Predict electronic flow and arrow pushing mechanism in a chemical reaction.

Text book [TB]:

1. Essentials of Physical Chemistry By Arun Bahl, B.S Bahl, G.D.Tuli, S Chand Publishing 2014.

Reference books [RB]:

1. Atkins, P. W. & Paula, J. de *Atkin's Physical Chemistry* 8th Ed., Oxford University Press (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).

R.NO.	LIST OF EXPERIMENTS
1	Study the equilibrium of at least one of the following reactions by the distribution method: (i) $I_2(aq) + I^- \rightarrow I_3^-(aq)$ (ii) $Cu^{2+}(aq) + nNH_3 \rightarrow Cu(NH_3)_n^{2+}$
2	Perform the following potentiometric titrations (at least two): (i) Strong acid with strong base (ii) weak acid with strong base and (iii) dibasic acid with strong base
3	Potentiometric titration of Mohr's salt with potassium dichromate
4	Determination of critical solution temperature and composition of the phenol-water system and to study the effect of impurities on it.
5	Phase equilibria: Construction of the phase diagram of (i) simple eutectic and (ii) congruently melting systems, using cooling curves and ignition tube methods

Course Structure& Syllabus of BSc (H) Chemistry

Applicable for Batch: 2017-2020

Subject Code	MA206	Subject Title		COMPUTER BASED NUMERICAL AND STATISTICAL TECHNIQUES **(CBNST)**					
LTP	3 0 2	**Credit**	4	**Subject Category**	GEC	**Year**	2nd	**Semester**	III

Objective: To enable students to obtain an intuitive and working understanding of numerical methods for the basic problems of numerical analysis and gain experience in the implementation of numerical methods using a computer.

Unit I:

Errors: Approximations and Errors in Computation.

Solution of Polynomial and Transcendental Equations: Bisection method, Regula-Falsi method, Newton-Raphson method, rate of convergence.

Unit II: Interpolation

Finite differences, Newton's forward and backward interpolation formula, Central difference interpolation, Gauss's forward and backward interpolation formula, Stirling's interpolation formula, Divided differences, Lagrange, Newton's Divided difference formula.

Unit III: Numerical Differentiation and Numerical Integration

First and second order derivatives of Newton's forward & backward interpolation, Newton - Cote's Quadrature Formula: Trapezoidal, Simpson's rules, Gaussian quadrature formula.

Unit IV: Solution of Simultaneous Linear Algebraic Equations

Direct methods: Gauss elimination, Gauss Jordan method, LU Decomposition method; Iterative methods: Gauss – Jacobi iteration method, Gauss - Seidal iteration method.

Principle of Least Square and Curve Fitting: Fitting a straight line, Parabola and exponential curve.

Unit V:

Numerical Solution of Ordinary Differential Equations: Single step methods: Picard's method, Taylor series method, Euler's method, Modified Euler's method, Runge - Kutta method of fourth order (First order, Second order & Simultaneous Differential Equations), Predictor - Corrector methods: Milne's method, Adams - Bashforth method.

LEARNING OUTOCOME: Students will be able to:

- obtain an intuitive and working understanding of numerical methods.
- apply numerical methods to basic problems of numerical methods.
- use various software tools for the implementation and application of numerical methods Basics of different types of measuring instruments based on the fundamental theory of operation.
- implement frequency chart, regression analysis, linear square fit and polynomial fitting methods of problem solving.

Text Book:

1. Curtis F. Gerald and Patrick O. Wheatley, **"**Applied Numerical Analysis"**,** 7th Edition, Pearson Education Lt, 2004.

Reference Books

1. S.S. Sastry, "Introductory Methods of Numerical Analysis", 5th Edition, PHI learning Pvt. Ltd, 2012.
2. M.K Jain, S.R.K Iyengar and R.K Jain, "Numerical Methods for Scientific and Engineering Computation", 6thEdition, New age International Publishers, 2012.
3. F. B. Hildebrand, "Introduction to Numerical Analysis", 2nd Edition, McGraw-Hill Book Company Inc. 1974.
4. B. S. Grewal, "Numerical Methods in Engineering and Science", 10th Edition, Khanna Publishers, New Delhi, India, 2013.

List of Practicals:

(1) Bisection Method.	(2) Simpson's $\frac{3}{8}rd$ rule.
(3) Regula Falsi Method.	(4) Gauss Elimination Method.
(5) Newton Raphson Method.	(6) Gauss Jordan Method.
(7) Newton's Forward Interpolation Formula.	(8) Gauss - Jacobi Method.
(9) Newton's Backward Interpolation Formula.	(10)Gauss - Seidal Method
(11)Newton's Divided Difference Formula.	(12)Fitting a Straight Line and Parabola.
(13)Trapezoidal rule.	(14)Modified Euler's Method.
(15)Simpson's $\frac{1}{3}rd$ rule.	(16)Fourth Order Runge - Kutta Method.

Course Structure& Syllabus of BSc (H) Chemistry

Applicable for Batch: 2017-2020

Subject Code	CA102	**Subject Title**	**PROGRAMMING IN C**						
LTP	3 0 2	**Credit**	4	**Subject Category**	AEC	**Year**	2nd	**Semester**	III

Course Objective:

The objective of the course is to make the students to learn to make the computer programs using C language and explore various features of C.

Unit I

Problem analysis, Need for programmed languages, Introduction to algorithms, Algorithmic representations, Pseudo codes flow charts and decision tables, Structured programming and modular programming.

Unit II

Overview of C, Constant, Variables, Data, Types and size, Variable declaration, Operators and expressions, Type conversion, Conditional expression, Special operators, Precedence rules, Decision making, Looping and control structures, Data input/output, Input/output, Unformatted & formatted I/O function in C, Input functions viz. scanf(), getch(), getche(), getchar(), gets(), output functions viz. printf(), putch(), putchar(), puts().

Unit III

Arrays and String: Defining and processing an array, One dimensional arrays, Multidimensional arrays, Passing arrays to functions, Handling of character strings, Pointers: Declaration, Operations on pointers, Array of pointers, Pointers to arrays, Structure and Unions: Defining and processing a structure, User defined data types, Structure and pointers, Nested structure, Self-referential structures and unions.

Unit IV

Program structure: Storage classes, Automatic, External and static variables, Data files: Opening, Closing, Creating and processing and unformatted data field.

Unit V

File Management in C: Introduction to data files, Opening & closing a file, File types, fopen, fgets, fputs, fscanf, fprintf, fclose.

Learning Outcome: A student who successfully completes the course will have the ability to

- understand the basic terminology used in computer programming.
- write, compile and debug programs in C language.
- use different data types in a computer program.
- design programs involving decision structures, loops and functions.
- use different data structures and create/update basic data files.

Text Book:

1. E. Balaguruswamy, “Programming in ANSI C”, 4th Edition, Tata McGraw-Hill, 2008.

2. Jeri R. Hanly and P. Elliot**, “**Problem Solving and Program Design in C**”,** 7thEdition, Pearson, 2013.

Reference Books:

1. Dennis Ritchie, "The C programming Language", 6th Edition, Pearson, 2015.

2. Forouzan Ceilber, "Structured programming approach using C", 3rd Edition, Thomson learning publication, 2007.

3. Yashwant Kanetkar, "Pointers in C", 3rd Edition, BPB Publication, 2003.

List of practicals:

1. Program to find area and circumference of circle.
2. Program to find the simple interest.
3. Program to convert temperature from degree centigrade to Fahrenheit.
4. Program to calculate sum of 5 subjects & find percentage.
5. Program to show swap of two no's without using third variable.
6. Program to find that entered year is leap year or not.
7. Program to find whether given no is even or odd.
8. Program to find whether given no is a prime no or not.
9. Program to display sum of series 1+1/2+1/3+…….+1/n.
10. Program to add two number using pointer.
11. Program to show sum of 10 elements of array & show the average.
12. Program to find sum of two matrices.

Course Structure& Syllabus of BSc (H) Chemistry

Applicable for Batch: 2017-2020

Subject Code	CH-216	Subject Title	INORGANIC CHEMISTRY-III						
LTP	3 1 4	Credit	6	Subject Category	CC	Year	2nd	Semester	IV

COURSE OUTLINE:

This course covers chemistry of transition elements and understanding of their coordination theories. This course also covers chemistry of actinides and lanthanides along with the brief understanding of Bioinorganic Chemistry of elements.

COURSE OBJECTIVE:

The objectives of this course isto learn basics concepts of metal-ligand interaction and their applications in medicine, pharmaceuticals, medical sciences and in allied areas.

COURSE PRE/CO- REQUISITE (IF ANY) :

The student must have basic knowledge of electrostatics and magnetostatics.

DETAILED SYLLABUS

Unit 1: Coordination Chemistry **9 Hrs**

Werner's theory, valence bond theory (inner and outer orbital complexes),. Crystal field theory, measurement of 10 Dq (Δo), CFSE in weakand strong fields, pairing energies, factors affecting the magnitude of 10 Dq (Δo, Δt).Octahedral vs. tetrahedral coordination, tetragonal distortions from octahedral geometry. Jahn-Teller theorem, square planar geometry. 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.

Unit 2: Transition Elements **9 Hrs**

General group trends with special reference to electronic configuration, colour, variablevalency, magnetic and catalytic properties and ability to form complexes. Stability of various oxidation states.Difference between the first, second and third transition series. Chemistry of Ti, V, Cr, Mn, Fe and Co in various oxidation states (excluding their metallurgy)

Unit 3: Lanthanoids **6 Hrs**

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

Unit 4: Actinoids **6 Hrs**

Electronic configuration, oxidation states, color, spectral and magnetic properties of actinides and separation of lanthanides

Unit-5 Bioinorganic Chemistry **9 Hrs**

Metal ions present in biological systems, classification of elements according to their actionin biological system. Geochemical effect on the distribution of metals. Sodium / K-pump, carbonic anhydrase and carboxypeptidase. Excess and deficiency of some trace metals.

Toxicity of metal ions (Hg, Pb, Cd and As), reasons for toxicity, Use of chelating agents inmedicine. Iron and its application in bio-systems, Haemoglobin; Storage and transfer of iron.

Learning Outcome

Students will gain an understanding of:

1. the bonding fundamentals for both ionic and covalent compounds, including electronegativities, bond distances and bond energies using MO diagrams .
2. predicting geometries of simple and complex molecules

3. the fundamentals of the chemistry of transition elements, lanthanides and actinides and important applications in bioinorganic chemistry.

4. the bonding models, structures, reactivities, and applications of coordination complexes, and organometallic chemistry .

TEXT BOOKS

1. Purcell, K.F &Kotz, J.C. Inorganic Chemistry W.B. Saunders Co, 1977.

2. Lippard, S.J. & Berg, J.M. Principles of Bioinorganic Chemistry Panima Publishing Company 1994.

REFERENCES

1. Huheey, J.E., Inorganic Chemistry, Prentice Hall, 1993.
2. Cotton, F.A. & Wilkinson, G, Advanced Inorganic Chemistry. Wiley-VCH, 1999
3. Basolo, F, and Pearson, R.C., Mechanisms of Inorganic Chemistry, John Wiley &Sons, NY, 1967.

SR.NO	EXPERIMENT NAME
1	**(a) Complexometric Titrations:**
	(i) Complexometric estimation of (i) Mg2+ (ii) Zn2+ using EDTA
	(ii) Estimation of total hardnesss of water samples
	(iii) Estimation of Ca2+ in solution by (substitution method) using Erio-chromeblack-T as indicator.
	(iv) Estimation of Ca/Mg in drugs and Biological samples
2	**(b) Argentometry**
	Estimation of Cl^- (i) By Mohr's method, (ii) By Vohlard's method, (iii) By Fajan's method.
3	**(c)** Paper Chromatographic separation of Ni (II) and Co(II); Cu(II) and Cd (II)C

Course Structure& Syllabus of BSc (H) Chemistry

Applicable for Batch: 2017-2020

Subject Code	CH-217	Subject Title	Organic Chemistry III						
LTP	3 1 4	Credit	6	Subject Category	CC	Year	2nd	Semester	IV

COURSE OUTLINE:

This course covers preparation and important reactions of nitrogen containing compounds like nitro-, amino-, nitriles, isonitrile derivatives, alkaloids and heterocyclic aromatic compounds. Course also covers polynuclear aromatic compounds and structural elucidation of terpenes and their preparation.

COURSE OBJECTIVE:

The objective of this course is to learn the various classes of heterocyclic organic compounds, their reactivities and reactions. To enable the students to employ the organic name reactions and the strategic plans for the synthesis of various heterocyclic compounds present in different natural products.

COURSE PRE/CO- REQUISITE (IF ANY): no restricted pre-requisite

DETAILED SYLLABUS

Unit-I: Nitrogen Containing Functional Groups **8 Hrs**

Preparation and important reactions of nitro- and amino-compounds, nitriles and isonitrile derivatives.

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

Diazonium Salts: Preparation and their synthetic applications.

Unit-II: Polynuclear Hydrocarbons **7 Hrs**

Reactions of naphthalene, phenanthrene and anthracene: Structure, Preparation and structure elucidation and important derivatives of naphthalene and anthracene; Polynuclear hydrocarbons.

Unit-III: Heterocyclic Compounds **9 Hrs**

Classification and nomenclature, Structure, aromaticity in 5-numbered 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), Pyrimidine, Indole, Fischer indole synthesis and Madelung synthesis.
Skraup synthesis, Friedlander's synthesis, Knorr quinoline synthesis, Doebner-Miller synthesis, Bischler-Napieralski reaction, Pictet-Spengler reaction, Pomeranz-Fritsch reaction for Quinolines and Isoquinolines.

Unit-IV: Alkaloids **8 Hrs**

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

Unit-V: Terpenes **7 Hrs**

Occurrence, classification, isoprene rule; Elucidation of structure and synthesis of Citral, Menthol and α-terpineol.

Learning Outcome

Having successfully completed this course, the student will be able to:

1. Predict the reactivity of any heterocyclic compound from its structure and explain their reaction products.
2. Develop basic skills for the multi-step synthesis of heterocyclic compounds.

3. Work-out a reasonable mechanism for a chemical reaction.

4. Identify the various classes of natural products and the total synthesis plan for various Natural products.

5. Explain the structure elucidation chemistry for different classes of natural products and their isolation process.

Text book [TB]:

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).

Reference books [RB]:

1. J. Cleyden and S. Warren, Organic Chemistry, Oxford University Press; Second edition (2012)

2. F.A. Carey & R. Sundberg, Advanced Organic Chemistry-(Part-A & B), Springer; 5th edition

3. R. B. Grossmann, The Art of Writing Reasonable Organic Reaction Mechanisms, Springer;

4. J. J. Li and E. J. Corey, Total Synthesis of Natural Products. Springer, 2012

SR.NO.	LIST OF EXPERIMENTS
1	Diels-Alder reaction between anthracene and maleic anhydride
2	Reduction: nitrobenzene to azobenzene (TLC of the mixture), m-dinitrobenzene to m-nitroaniline.
3	S-benzylisothiuranum salts of any one water soluble and one water insoluble acid: acetic acid, phenyl acetic acid, oxalic acid, benzoic acid, phthalic acid
4	Photochemical reduction of benzophenone to benzopinacol
5	Benzoin condensation of benzaldehyde (using thiamine hydrochloride)
6	Condensation of p-toluidine with benzaldehyde/salicylaldehyde/2-hydroxy-3-methoxybenzadehyde to get Schiff's base (solventless condensation).
7	**Estimation of** Phenol and aniline by bromination with potassium bromate-potassium bromide method
8	Glycine by formylation method 3. Saponification value of an oil/fat

Course Structure& Syllabus of BSc (H) Chemistry

Applicable for Batch: 2017-2020

Subject Code	CH-218	Subject Title	PHYSICAL CHEMISTRY-IV						
LTP	3 1 4	Credit	6	Subject Category	CC	Year	2nd	Semester	IV

COURSE OUTLINE:

This course covers electrochemistry of electrolytes; kinetics of chemical reactions, reactions under photolytic conditions, role of catalyst in chemical reactions also covers physical properties.

COURSE OBJECTIVE:.

The Main objective of this course is to understand the Physical Properties of matter with respect to the surrounding environment. The hands on practices through experiment are also provided to the students.

COURSE PRE/CO- REQUISITE (IF ANY) :

The student must have basic knowledge of electrostatics and magnetostatics.

Detailed Syllabus

Unit I : Electrochemistry-(II) **9 Hrs**

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, Wien effect, Debye-Falkenhagen effect, Walden's rules.

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.

Unit II: Chemical Kinetics **9 Hrs**

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.Surface chemistry: Physical adsorption, chemisorption, adsorption isotherms. nature of adsorbed state.

Unit III: Photochemistry **7 Hrs**

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

Unit IV: Catalysis **6 Hrs**

Catalysis: Types of catalyst, specificity and selectivity, mechanisms of catalyzed reactions at solid surfaces; effect of particle size and efficiency of nanoparticles as catalysts. Enzyme catalysis, Michaelis-Menten mechanism, acid-base catalysis.

Unit V: Physical Properties and Chemical Constitution **8 Hrs**

Surface Tension and Chemical Constitution, use of Parachor in elucidating structure, Viscosity and Chemical Constitution, Dunstan Rule, Molar Viscosity, Rheochor, Dipole Moment, Determination of Dipole moment, Dipole moment and molecular structure, Dipole moment and Ionic Character, Molar refraction and chemical constitution, Optical activity and chemical constitution, Magnetic properties, Paramagnetic and Diamagnetic Substances.

Learning Outcome:-

At the end of the course, the student can:

1. To understand the electrolysis process and principles involved.
2. To study the rate of reaction and effect of physical properties on it.
3. To study the photonic properties of electrons and it behavior towards light.
4. Effect of Catalyst on the reaction mechanism.
5. To study the different processes in gaseous state.

TEXT BOOKS

Essentials of Physical Chemistry ByArunBahl, B.S Bahl, G.D. Tuli, S Chand Publishing 2014.

REFERENCES BOOK:-

1. Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry 8th Ed., Oxford University Press (2006).

2. Ball, D. W. Physical Chemistry Thomson Press, India (2007).

3. Castellan, G. W. Physical Chemistry 4th Ed. Narosa (2004).

4. Laidler, K. J. Chemical Kinetics Pearson Education: New Delhi (2004).

SR.NO.	EXPERIMENT NAME
1	**To study changes in conductance in the following systems** (i) strong acid-strong base (ii) weak acid-strong base and (iii) mixture of strong acid and weak acid-strong base
2	**Study the kinetics of the following reactions.** 1. Initial rate method: Iodide-persulphate reaction 2. Integrated rate method: (a) Acid hydrolysis of methyl acetate with hydrochloric acid, volumetrically or conductometrically. (b) Iodide-persulphate reaction (c) Saponification of ethyl acetate.

Course Structure& Syllabus of BSc (H) Chemistry

Applicable for Batch: 2017-2020

Subject Code	PY217	Subject Title	Elements of Modern Physics						
LTP	3 1 4	Credit	6	Subject Category	CC	Year	2nd	Semester	IV

Course Outline:

In this course, the students will get an introductory approach on various branches of physics like quantum mechanics, atomic, molecular and nuclear physics which will establish their fundamental base for learning these subjects separately.

Course Objective:

Students will apply understanding and skill related to the principles and concepts of modern physics essential for graduate school and/or professional employment in the field

Course Pre/Co- requisite (if any) :student must be familiar with basic integration and differentiation

Detailed Syllabus

UNIT 1

Planck's quantum, Planck's constant and light as a collection of photons; Blackbody Radiation: Quantum theory of Light; Photo-electric effect and Compton scattering. De Broglie wavelength and matter waves; Davisson-Germer experiment. Wave description of particles by wave packets. Group and Phase velocities and relation between them.

UNIT 2

Position measurement-gamma ray microscope thought experiment; Wave-particle duality, Heisenberg uncertainty principle (Uncertainty relations involving Canonical pair of variables): Derivation from Wave Packets impossibility of a particle following a trajectory; Estimating minimum energy of a confined particle using uncertainty principle; Energy-time uncertainty principle- application to virtual particles and range of an interaction.

UNIT 3

Linear superposition principle as a consequence; Matter waves and wave amplitude; Schrodinger equation for non-relativistic particles; Momentum and Energy operators; stationary states; physical interpretation of a wave function, probabilities and normalization; Probability and probability current densities in one dimension.

One dimensional infinitely rigid box- energy eigenvalues and eigenfunctions, normalization; Quantum dot as example; Quantum mechanical scattering and tunnelling in one dimension-across a step potential & rectangular potential barrier.

UNIT 4

Size and structure of atomic nucleus and its relation with atomic weight; Impossibility of an electron being in the nucleus as a consequence of the uncertainty principle. Nature of nuclear force, NZ graph, Liquid Drop model: semi-empirical mass formula and binding energy, Nuclear Shell Model and magic numbers.

Law of radioactive decay; Mean life and half-life; Alpha decay; Beta decay- energy released, spectrum and Pauli's prediction of neutrino; Gamma ray emission, energy-momentum conservation

Fission and fusion- mass deficit, relativity and generation of energy; Fission - nature of fragments and emission of neutrons. Nuclear reactor: slow neutrons interacting with Uranium 235

UNIT 5

Lasers: Einstein's A and B coefficients. Metastable states. Spontaneous and Stimulated emissions. Optical Pumping and Population Inversion. Ruby Laser and He-Ne Laser.

Learning Outcome

Having successfully completed this course, the student will be able to:

1. Outline the scientific foundation for modern physics according the Course Main Content
2. Perform quantum mechanical calculation for simple systems
3. Apply quantum mechanical principles in science and technology
4. Outline the most important experimental methods in modern physics

Text book [TB]:

1. Concepts of Modern Physics, Arthur Beiser, McGraw-Hill, 2002,
2. Introduction to Modern Physics, Rich Meyer, Kennard, Coop, Tata McGraw Hill, 2002
3. Introduction to Quantum Mechanics, David J. Griffith, Pearson Education, 2005
4. Physics for scientists and Engineers with Modern Physics, Jewett and Serway, Cengage Learning, 2010
5. Quantum Mechanics: Theory & Applications, A.K.Ghatak & S.Lokanathan, Macmillan, 2004

Reference books [RB]:

1. Modern Physics, J.R. Taylor, C.D. Zafiratos, M.A. Dubson, PHI Learning, 2004
2. Theory and Problems of Modern Physics, Schaum`s outline, R. Gautreau and W. Savin, 2nd Edn, Tata McGraw-Hill Publishing Co. Ltd.
3. Quantum Physics, Berkeley Physics, Vol.4. E.H.Wichman, Tata McGraw-Hill Co, 1971
4. Basic ideas and concepts in Nuclear Physics, K.Heyde, 3rd Edn., Institute of Physics Pub.
5. Six Ideas that Shaped Physics: Particle Behave like Waves, T.A.Moore, McGraw Hill, 2003

SR.NO.	LIST OF EXPERIMENTS
1	Measurement of Planck's constant using black body radiation and photo-detector
2	Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light
3	To determine work function of material of filament of directly heated vacuum diode.
4	To determine the Planck's constant using LEDs of at least 4 different colours
5	To determine the wavelength of H-alpha emission line of Hydrogen atom.
6	To determine the ionization potential of mercury.
7	To determine the absorption lines in the rotational spectrum of Iodine vapour.
8	To determine the value of e/m by Thomson Method.
9	To setup the Millikan oil drop apparatus and determine the charge of an electron.
10	To show the tunneling effect in tunnel diode using I-V characteristics.
11	To study the atomic spectra of a 2 electron system
12	To determine Lande's g factor using electron spin resonance spectrometer

Course Structure& Syllabus of BSc (H) Chemistry

Applicable for Batch: 2017-2020

Subject Code	CH201	Subject Title	Environmental Science						
LTP	2 0 0	Credit	2	Subject Category	AEC	Year	2nd	Semester	IV

OBJECTIVE

To impart basic knowledge about the environment and its allied problems and to develop an attitude of concern for the environment. Further the course structure will create the awareness about environmental problems among students and motivate the students to participate in environment protection and environment improvement programs. The course aims to develop skills to help the concerned individuals in identifying and solving environmental problems.

Unit 1: Basics of Environment and Natural Resources: 04 Hrs

Definition and Concept of Environment, Multidisciplinary nature of environmental studies. Scope and importance of environmental studies, Need for public awareness, Environmental concerns and people. Introduction and classification of natural resources. Energy Resources, Water Resources, Land Resources, Forest Resources, Food Resources, Mineral Resources, Case studies related to over exploitation of resources and their impacts. Role of an individual in conservation of natural resources, Sustainable lifestyles.

Unit 2: Ecosystems: 04 Hrs

Definition and concept of ecology, Structure and Function of an Ecosystem, Energy Flow in Ecosystems, Biogeochemical cycles (Nitrogen, Carbon, Phosphorus, Oxygen, Hydrological). Species interactions in ecosystems. Ecological succession and ecological pyramids. Characteristic features of grassland, pond, desert and forest ecosystems. Ecosystem services and conservation.

Unit 3: Biodiversity and its conservation: 04 Hrs

Introduction and types of biodiversity. Bio-geographic classification of India, Value and significance of biodiversity, Biodiversity at global, national and local levels, India: A mega-diversity nation, Biodiversity hotspots, Threats to Biodiversity: Poaching and man-wildlife conflicts, IUCN Red Data Book and endangered & endemic species of India. Biodiversity conservation strategies, Institutes and organizations.

Unit-4 Environmental Pollutions: 05 Hrs

Introduction and Definition. Causes, consequences and control measures of: Air pollution, Water pollution, Noise pollution, Nuclear pollution, Soil pollution, Thermal and Marine pollution. Solid waste management, Bio-medical waste management. Disasters and its mitigation strategies, Global warming, Climate change, Acid rain, Ozone depletion and Smog. Pollution case studies. Role of an individual in pollution prevention.

Unit-5 Social Issues and Environment: 04 Hrs

Sustainable Development: Concept and importance, Environmental Impact Assessment (EIA), GIS, Remote sensing. Water conservation and rain water harvesting. Resettlement and rehabilitation problems, Environmental audit, eco-labeling and eco-friendly business. Environmental Legislation in India, Population explosion and its impact on environment and human health, Value Education and environmental ethics.

Field work: 03 Hrs

- Visit to a local area to document environmental asset: river/forest/grassland/hill/mountain
- Visit to a local polluted site-Urban/Rural/Industrial/Agricultural
- Study of common flora and fauna.
- Study of a common ecosystem-pond, river, hill slopes, etc.

Course Outcome:

At the end of the course, the student will be able to:

CO1. Demonstrate depleting nature of Environmental Resources and Ecosystem concepts.

CO2. Able to identify the structure and functioning of natural ecosystems.

CO3. Establish man-wildlife harmonious relationship.

CO4. Adapt to 3R (Reuse, Recovery, Recycle).Identify the causes and control measures related to Pollutions.

CO 5. Illustrate and analyse various Case Studies related to Environmental issues and Env. Legislation.

TEXT BOOKS

1. Bharucha Erach, 2004. Textbook for Environmental Studies, University Grants Commission, New Delhi.

2. Kaushik A & Kaushik C P. 2007. Perspectives in Environmental Studies, New Age International Publ.

3. S. Deswal & A. Deswal 2015. A Basic Course in Environmental Studies. Dhanpat Rai & Co.

REFERENCES

1. Miller T.G. Jr. 2002. Environmental Science, Wadsworth Publishing Co. (TB).

2. De A.K.,1996. Environmental Chemistry, Wiley Eastern Ltd.

3. Sharma, P.D. 2005. Ecology and environment, Rastogi Publication.

Course Structure& Syllabus of BSc (H) Chemistry
Applicable for Batch: 2017-2020

Subject Code	CH-306	Subject Title	Organic Chemistry-IV						
LTP	3 1 2	Credit	5	Subject Category	CC	Year	3rd	Semester	V

Course Outline:

This course is design to provided an overview of organic chemistry. The student will understand the relationship between structure and function and molecule, major classes of reaction and synthesis of organic compound. These cover polymers, biomolecules pharmaceutical compounds.

Course Objective:

The objective of this course is to learn basics concepts of polymerization and importance of biomolecules, pharmaceutically relevant drug molecules. This course recalls the fundamental principles of organic molecules like dyes, terpenes, carbohydrates, amino acids and lipid molecules.

Course Pre/Co- requisite (if any) :

The student must have basic knowledge of organic chemistry reaction and mechanism and diversity of organic molecules.

DETAILED SYLLABUS

Unit I: Polymers **9 Hrs**

Introduction and classification of polymers; Number average molecular weight, Weight average molecular weight, Degree of polymerization, Polymerisation reactions - Addition and condensation polymerization- Mechanism of cationic, anionic and free radical addition polymerization; Ziegler-Natta catalyst polymerisation of alkenes; Preparation and applications of plastics – thermosetting (phenol-formaldehyde, Polyurethanes) and thermosoftening (PVC, polythene, Nylon-6, Nylon 6,6, Polyethylterephthalate); Rubbers- natural and synthetic: Buna-S, Buna-N, Chloroprene and Neoprene; Vulcanization; Biodegradable and conducting polymers with examples.

Unit II: Biomolecules **9 Hrs**

Carbohydrates: 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; Disaccharides – Structure elucidation of maltose, lactose and sucrose Polysaccharides –starch, and cellulose.

Nucleic Acids: Components of nucleic acids, Nucleosides and nucleotides;

Structure, synthesis and reactions of: Adenine, Guanine, Cytosine, Uracil and Thymine; Structure of polynucleotides.

Amino acids, Peptides and Proteins: Amino acids, Peptides and their classification. α-Amino Acids - Synthesis, ionic properties and reactions. Zwitterions, pKa values, isoelectric point and electrophoresis; Study of peptides:

determination of their primary structures-end group analysis, Lipids: Introduction to oils and fats; common fatty acids present in oils and fats, Hydrogenntion of fats and oils, Saponification value, acid value, iodine number. Reversion and rancidity.

Unit III: Pharmaceutical Compounds: Structure and Importance 8 Hrs

Classification, structure and therapeutic uses of antipyretics: Paracetamol (with synthesis), Analgesics: Ibuprofen (with synthesis), Antimalarials: Chloroquine (with synthesis). An elementary treatment of Antibiotics and detailed study of chloramphenicol, Medicinal values of curcumin (haldi), azadirachtin (neem), vitamin C and antacid (ranitidine).

Unit IV: Terpenes-II 6 Hrs

Occurrence, classification, isoprene rule; Elucidation of stucture and synthesis of Citral, Neraland α- terpineol.

Unit V: Dyes 7 Hrs

Classification, Colour and constitution; Mordant and Vat Dyes; Chemistry of dyeing; Synthesis and applications of: Azo dyes – Methyl Orange and Congo Red (mechanism of Diazo Coupling); Triphenyl Methane Dyes - Malachite Green, Rosaniline and Crystal Violet; Phthalein Dyes – Phenolphthalein and Fluorescein; Natural dyes –structure elucidation and synthesis of Alizarin and Indigotin.

Learning Outcome:

At the end of the course, the student will be:

1. Predict the mechanism of polymerization of monomeric units.
2. Develop basic skills for the synthesis of polymers and understanding about the biomolecules.
3. Justify a reasonable mechanism for pharmaceutically relevant molecules.
4. Identify name the functional groups and different class of organic dyes
5. Predict reactivity and synthesis of terpenes.

TEXT BOOKS

1. Organic Chemistry Morrison, R. T. & Boyd, R. N., Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Organic Chemistry Finar, I. L. (Volume 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

REFERENCE BOOKS

1. Principles of Biochemistry, Nelson, D. L. & Cox, M. M. Lehninger's Fourth Edition, W. H. Freeman.
2. L. Biochemistry, Berg, J. M., Tymoczko, J. L. &Stryer, Sixth Edition, W. H. Freeman.
3. Polymer Science Textbook of, Billmeyer, F. W. John Wiley & Sons, Inc.

Course Structure& Syllabus of BSc (H) Chemistry

Applicable for Batch: 2017-2020

S.No.	EXPERIMENT NAME	
1	Systematic analysis of extra elements in the given unknown compounds	
2	Tests for following functional groups and unsaturation	
3	Qualitative analysis of the following types of unknown organic compounds Carboxylic acids Phenols Alcohols Aldehydes Ketones Esters	
4	Synthesis of phenol-formaldehyde resin.	
5	Preparation of phenolphthalein	
6	Preparation of Schiffs base of amines.	

Course Structure& Syllabus of BSc (H) Chemistry

Applicable for Batch: 2017-2020

Subject Code	CH-307	Subject Title	PHYSICAL CHEMISTRY-V						
LTP	3 1 2	Credit	5	Subject Category	CC	Year	3rd	Semester	V

Course Outline:

This course would cover Schrödinger equation wave functions**,** Qualitative treatment of hydrogen atom and hydrogen-like ions

COURSE OBJECTIVE:

To study the aspects of Physical properties of the compound and its components

Course Pre/Co- requisite (if any) : The student must have basic knowledge of Bohrs& Thomson model of atom. Functional property of different atoms.

Detailed Syllabus

Unit I : Quantum Chemistry: Wave Mechanics 9 Hrs

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; wave functions, probability distribution functions, nodal properties, Extension to two and three dimensional boxes, separation of variables, degeneracy.

Qualitative treatment of hydrogen atom and hydrogen-like ions: setting up of Schrödinger equation in spherical polar coordinates, radial part, and 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).

Unit II : Quantum Chemistry: Schrödinger equation for Atomic orbitals 6 Hrs

Chemical bonding: Covalent bonding, valence bond and molecular orbital approaches, LCAO-MO treatment of H_2^+. Bonding and antibonding orbitals. Qualitative extension to H_2.

Comparison of LCAO-MO and VB treatments of H_2 (only wave functions, detailed solution not required) and their limitations. Refinements of the two approaches (Configuration Interaction for MO, ionic terms in VB).

Unit III: Molecular Spectroscopy: Molecular Rotations and Vibrations 10 Hrs

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. Vibration-rotation spectroscopy: diatomic vibrating rotator, P, Q, R branches.

Raman spectroscopy: Qualitative treatment of Rotational Raman effect; Effect of nuclear spin, Vibrational Raman spectra, Stokes and anti-Stokes lines; their intensity difference, rule of mutual exclusion.

Unit IV: Molecular Spectroscopy: Electronic Transitions and Magnetic Resonance

8 Hrs

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.

Nuclear Magnetic Resonance (NMR) spectroscopy: Principles of NMR spectroscopy, Larmor precession, chemical shift and low resolution spectra, different scales, spin-spin coupling and high resolution spectra, interpretation of PMR spectra of organic molecules.

Electron Spin Resonance (ESR) spectroscopy: Its principle, hyperfine structures, ESR of simple radicals.

Unit V: Physical properties and molecular structure **6 Hrs**

Optical activity and its measurement, dipole moment and its measurement by temperature change method, magnetic property and its measurement by Guoy balance method, Applications of optical activity, dipole moment and magnetic property for determination of structure of molecule.

Learning outcome:-

Student will be able to

1: Get idea about the wave nature of the atom and molecules
2: study the functional property of different atoms
3: study the vibrations of the molecules
4: differentiate between the transitions of atom between energy levels
5: study of Physical Properties of the compound

TEXT BOOKS

1. Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry 8th Ed., Oxford University Press (2006).

2. Laidler, K. J. Chemical Kinetics Pearson Education: New Delhi (2004).

REFERENCES

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).

SR.NO.	EXPERIMENT NAME
1	Verification of Lambert-Beer's Law
2	Determination of pK (indicator) for phenolphthalein or methyl red.
3	Study the kinetics of interaction of crystal violet with sodium hydroxide colourimetrically.
4	Analysis of the given vibration-rotation spectrum of HCl(g)
5	Record the UV spectrum of p-nitrophenol (in 1:4 ethanol:water mixture). Repeat after adding a small crystal of NaOH. Comment on the difference, if any.
6	Record the U.V. spectrum of a given compound (acetone) in cyclohexane (a) Plot transmittance versus wavelength. (b) Plot absorbance versus wavelength. (c) Calculate the energy involved in the electronic transition in different units, i.e. cm^{-1}, kJ/mol, kcal/mol&eV.
7	Study the formation of a complex between ferric and thiocyanate (or salicylate) ions.

Course Structure& Syllabus of BSc (H) Chemistry

Applicable for Batch: 2017-2020

Subject Code	CH-308	Subject Title	INORGANIC CHEMISTRY--IV						
LTP	3 1 2	Credit	5	Subject Category	CC	Year	3rd	Semester	V

COURSE OUTLINE:

This course would be a pre-requisite for the advanced level course at the M. Sc. Level. The course begins with the understanding of organometallic compounds and general principles of Metallurgy

COURSE OBJECTIVE:

The objectives of this course are to learn basics concepts involved in the chemistry of cations and anions. Study of organometallic compounds with their applications in medicine, pharmaceuticals, medical sciences and in allied areas

Course Pre/Co- requisite (if any) : The student must have basic knowledge of different methods of metallurgy, electronic and molecular structure of different compounds. Fundamental overview of periodic table is required.

Detailed Syllabus

Unit I : Theoretical principles **8 Hrs**

Theoretical principles and chemistry involved in qualitative analysis of mixture of cations and anions including interfering and insoluble. Basic principles involved in analysis of cations and anions and 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.

Unit II : General Principles of Metallurgy **7 Hrs**

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. Methods of purification of metals: Electrolytic Kroll process, Mond's process, Zone refining

Unit III: Organometallic Compounds-I **8 Hrs**

Definition and classification of organometallic compounds on the basis of bond type. Concept of hapticity of organic ligands. Metal carbonyls: 18 electron rule, electron count of mononuclear, polynuclear and substituted metal carbonyls of 3d series. Zeise's salt: Preparation and structure, evidences of synergic effect and comparison of synergic effect with that in carbonyls

Unit IV: Organometallic Compounds-II **9 Hrs**

Ferrocene: Preparation and reactions (acetylation, alkylation, metallation, Mannich Condensation). Structure and aromaticity. Comparison of aromaticity and reactivity with that of benzene Role of triethylaluminium in polymerisation of ethene (Ziegler –Natta Catalyst). Species present in ether solution of Grignard reagent and their structures, Schlenk equilibrium.

Unit V: Catalysis by Organometallic Compounds 7 Hrs

Study of the following industrial processes and their mechanism: 1.Alkene hydrogenation (Wilkinsons Catalyst)2. Hydroformylation (Co salts)3.Wacker Process 4.Synthetic gasoline (Fischer Tropsch reaction)5.Synthesis gas by metal carbonyl complexes

Learning Outcome

Students will gain an understanding of:

1. principles and chemistry involved in qualitative analysis of mixture of cations and anions and the role of interfering ions.
2. Introduction of different metallurgical processes used for different industries
3. detailed study of different types of organometallic compounds
4. Organometallic compounds and their biological importance.

5. Different catalytic processes initiated by organometallic compounds.

TEXT BOOKS

1. N.N. Greenwood, and Earnshaw, Chemistry of the Elements, Butterworth Heinemann. 1997.
2. J. D. Lee, Concise Inorganic Chemistry, ELBS 1991.
3. Canham, G.R. and Overton, T., Descriptive Inorganic Chemistry, Freeman & Co.2006.
4. F. A. Cotton andG. Wilkinson; Advanced Inorganic Chemistry, Wiley, VCH, 1999.
5. Svehla, G. Vogel's Qualitative Inorganic Analysis, 7th Edition, Prentice Hall, 1996-03-0
6. Powell, P. Principles of Organometallic Chemistry, Chapman and Hall, 1988.

REFERENCE BOOKS

1. T. H. Dunning and D. E. Woon; p-Block elements-Inorganic chemistry, Magnum Publishing, 2016
2. W. N. Lipscomb; Boron Hydrides, Dover Publications.inc, 2012
3. Spessard, Gary O., &Gary L. Miessler. Organometallic Chemistry. Upper Saddle River, NJ: Prentice-Hall, 1996.

SR.NO.	EXPERIMENT NAME
1	Using H_2S /PTC/ Thioacetamide or any other reagent. Identification of cations and simple anions in a mixture of salts containing not more than six ions (Three cations and three anions) interfering anions using semimicro scheme of analysis. If combination of cations or anions is given in the mixture, insoluble should be avoided. Spot tests should be carried out for final identifications wherever feasible. Cation : Pb^{2+},Bi^{3+}, Cu^{2+}, Cd^{2+}, As^{3+}, Sb^{3+}, Sn^{2+} or Sn^{4+}, Fe^{2+} or Fe^{3+}, Al^{3+}, Cr^{3+},Co^{2+}, Ni^{2+}, Zn^{2+}, Mn^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, Mg^{2+}, NH_4^+, K^+
2	Using H_2S /PTC/ Thioacetamide or any other reagent. Identification of cations and simple anions in a mixture of salts containing not more than six ions (Three cations and three anions) interfering anions using semi micro scheme of analysis. If combination of cations or anions is given in the mixture, insoluble should be avoided. Spot tests should be carried out for final identifications wherever feasible. Anion : CO_3^{2-}, SO_3^{2-}, S2-, NO_2^-, CH_3COO^-, NO_3^-, Cl^-, Br^-, I^-, SO_4^{2-}, PO_4^{3-}, BO_3^{3-}, F^-, $C_2O_4^{2-}$
3	Controlled synthesis of two copper oxalate hydrate complexes: kinetic vs thermodynamic factors.
4	Preparation of acetylacetanato complexes of Cu^{2+}/Fe^{3+}. Find the λmax of the complex.
5	Synthesis of ammine complexes of Ni(II)

Course Structure& Syllabus of BSc (H) Chemistry

Applicable for Batch: 2017-2020

Subject Code	CH-346	Subject Title	GREEN METHODS IN CHEMISTRY						
LTP	3 0 0	Credit	3	Subject Category	DSE	Year	3rd	Semester	V

Course Outline:

This course would includes application of twelve principles of green chemistry

Course objective:-

To impart basic knowledge and designing skills with reference to green chemistry.

2. To teach alternate eco-friendly techniques for chemical reactions

3. To understand the green & renewable raw materials and clean synthesis processes.

4. To recognize the sustainable bio-approaches in catalytic processes and industrial operations.

5. To figure out the nature friendly techniques in routine chemical procedures..

Course Pre/Co- requisite (if any) : The student must have basic knowledge of methodology and reaction mechanism for various conventional preparation.

Detailed Syllabus

Unit – 1 Introduction to Green Chemistry **6 Hrs**

Emergence of green chemistry, Twelve principle of green chemistry, Use of alternative feedstock (biofuels), Use of innocuous reagents, Use of alternative solvents, Design of safer chemicals, Designing alternative reaction methodology, Minimizing energy consumption.

Unit – 2 Alternative Reaction Conditions **9 Hrs**

Ionic liquids: “Designer” solvents for green chemistry, Supported liquid-phase systems in transition metal catalysis, Organic chemistry in water: green and fast formation, mechanisms, and minimization of chlorinated micropollutants (Dioxins) formed in technical incineration processes

Unit – 3 Green Reagents **7 Hrs**

The four-component reaction and other multicomponent reactions of the isocyanides, Carbohydrates as renewable raw materials: A major challenge of green chemistry, Photo-initiated synthesis: A useful perspective in green chemistry, Dimethyl carbonate as a green reagent

Unit-4 : Green Catalysis and Biocatalysis **9 Hrs**

Green Chemistry: Catalysis and Waste Minimization, Seamless Chemistry for Sustainability Enantioselective Metal Catalyzed Oxidation Processes, Zeolite Catalysts for Cleaner Technologies, Acid and Superacid Solid Materials as Noncontaminant Alternative Catalysts in Refining, The Oxidation of Isobutane to Methacrylic Acid: An Alternative Technology for MMA Production, Biocatalysis for Industrial Green Chemistry

Unit -5 : Case Studies **8 Hrs**

A green synthesis of ibuprofen which creates less waste and fewer byproducts (Atom economy),

Surfactants for Carbon Dioxide – replacing smog producing and ozone depleting solvents with CO_2 for precision cleaning and dry cleaning of garments, Environmentally safe antifoulant, CO_2 as an environmentally friendly blowing agent for the polystyrene foam sheet packaging market, Using a catalyst to improve the delignifying (bleaching) activity of hydrogen peroxide, A new generation of environmentally advanced preservative: getting the chromium and arsenic out of pressure treated wood, Rightfit pigment: synthetic azopigments to replace toxic organic and inorganic pigments, Development of a fully recyclable carpet: cradle to cradle carpeting.

Learning outcome:

1. The student will be able to develop proficiency in fundamental principles of green chemistry.
2. Scholar become well versed with nature harmonious chemical reaction techniques.
3. The learner will be proficient to adopt cleaner raw material & synthesis approaches in chemistry.
4. The student comprehends the environment friendly catalysis methods in chemical processes.
5. The scholar will be well acquainted with routine chemical processes harmonious with nature.

TEXT BOOKS-

1. V.K. Ahluwalia & M.R. Kidwai: New Trends in Green Chemistry, Anamalaya Publishers (2005).
2. Mishra, A. (2005) Environmental Studies. Selective and Scientific Books, New Age publishers.

REFERENCE BOOKS

1. "Methods and Reagents for Green Chemistry – An Introduction" edited by PietroTundo, Alvise Perosa and Fulvio Zecchini, published by John Wiley and Sons Inc. in 2007.
2. Cann, M. C. & Thomas, P. Real world cases in Green Chemistry, American Chemical Society (2008).

Course Structure& Syllabus of BSc (H) Chemistry

Applicable for Batch: 2017-2020

Subject Code	CH-347	Subject Title	POLYMER CHEMISTRY					
LTP	3 00	Credit	3	Subject Category	DSE	Year	3rd	Semester	V

COURSE OUTLINE:

This course would be a pre-requisite for the advanced level course at the M. Sc. Level. The course begins with the topics related to basic terminologies and classification system used in Polymer science. In the second unit, the kinetics and morphological description of polymers are included which is followed by the description of physical models for the structure-property relationships of the polymers in the third unit. Fourth and fifth units are about the characteristics and applications of various commodity polymers and studies of various engineering and specialty polymers and their application in materials design.

COURSE OBJECTIVE:

- To develop among students basic concepts regarding polymers
- To make them understand of the kinetics, process of polymerization for various kinds of polymers and their applications
- The course imparts a considerate learning on the Structure-Properties relations of polymers and to develop an insight towards interpretations of physical parameters through applying thermodynamics of polymer mixtures.
- To make them well versed with various kind of specialty and engineering polymers

COURSE PRE/CO- REQUISITE (IF ANY):

The student must have basic knowledge of polymer reactions, polymer product such as thermoplastic thermosetting elstromers extra.

DETAILED SYLLABUS

Unit 1: Introduction, Basic terms and Functionality of Polymeric Materials 7 Hrs

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

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

Unit 2: Kinetics of Polymerization and Crystallization of Polymers 9 Hrs

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.

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

Unit 3 Structure Property relationships of Polymers 9 Hrs

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

Solubility parameters for solutions of polymer mixtures, Thermodynamics of polymer solutions; Enthalpy and free energy change of mixing of polymers solutions, Free volume and Glass transition temperature (Tg) determination and factors affecting Tg.

Unit 4 Properties (Physical, thermal, Flow & Mechanical) of selected Synthetic Polymers

8 Hrs

Brief introduction to preparation, structure, properties and application of the following polymers: polyolefins, polystyrene and styrene copolymers, poly(vinyl chloride) and related polymers, poly(vinyl acetate) and related polymers, acrylic polymers, fluoro polymers, Phenol formaldehyde resins (Bakelite, Novalac),

Unit 5 Some Selected Engineering Polymers, Properties and their Modern Applications

6 Hrs

Polycarbonates, Polamides compounds (PAI, Aramids), Thermoplastic polyurethanes (TPUs), Silicone polymers;

Biocompatible polymers: Polylactide-co-glycolides

Conducting Polymers, [polyacetylene, polyaniline, polyIndoles

Learning Outcome:-

At the end of this course –

The student will be able to:

1. isolate the key design features of a product which relate directly to the material(s) used in its construction
2. indicate how the properties of polymeric materials can be exploited by a product designer
3. describe the role of rubber-toughening in improving the mechanical properties of polymers
4. estimate the number, weight and average molecular masses of polymer samples given the degree of polymerization and mass fraction of chains present.

TEXT BOOKS

- Text Book of Polymer Science, F.W. Billmeyer: John Wiley.
- Polymer Science & Technology, P. Ghosh: Tata Mcgraw-Hill.•

REFERENCE BOOKS

- Polymer Chemistry, Seymour's Marcel Dekker, Inc.
- Principles of Polymerization G. Odian:, John Wiley.
- Organic Chemistry R.W. Lenz: of Synthetic High Polymers.

Course Structure& Syllabus of BSc (H) Chemistry

Applicable for Batch: 2017-2020

Subject Code	CH-348	Subject Title	FUEL CHEMISTRY						
LTP	3 0 0	Credit	3	Subject Category	DSE	Year	3rd	Semester	V

COURSE OUTLINE:

This course will cover fuel, Petroleum and petrol products: it incudes topics related to industrial chemistry.

COURSE OBJECTIVE:

To develop understanding among students regarding chemical composition and properties. To make familiar with various sources and isolation procedures of petroleum To provide understanding of the development and advancements of alternating fuels and advance battery material. To impart knowledge of various processes for synthetic fuels, characterization and related mechanism.

COURSE PRE/CO- REQUISITE (IF ANY) :

The student must have basic knowledge of calorific value refining of petroleum product and knowledge of solid liquid and gaseous fuel.

DETAILED SYLLABUS

Unit 1 **8 Hrs**

Review of energy sources (renewable and non-renewable) – classification of fuels and their calorific value. Coal: Uses of Coal (fuel and non-fuel) 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 based chemicals, requisites of a good metallurgical coke, coal gasification (Hydro gasification and catalytic gasification) coal liquefaction.

Unit 2 8 Hrs

Petroleum and petrol chemical industry: Composition of crude petroleum. Refining and different types of petroleum products and their applications, fuels derived from biomass, fuel from waste, synthetic fuels (gaseous and liquids), clear fuels, petro chemicals: vinyl acetate , propylene oxide , isoprene , butadiene, toluene. Petro chemicals: vinyl acetate, propylene oxide, isoprene, butadiene, toluene.

Unit 3 8 Hrs

Fractional distillation (principle and process) , cracking (Thermal and catalytic cracking)

Reforming petroleum and non-petroleum fuels (LPG, CNG, LNG). 2 Bio-fuels- Biogas, Bio-ethanol, Bio- diesel.

Unit-4 **8 Hrs**

Lubricants: Classification of lubricants ,Theories of Lubrication conducting) Lubricating oils (conducting and non-solid and semi-solid lubricants. Properties of lubricants (viscosity index, cloud point , pore point) and their determination. Synthetic lubricants.

UNIT-5 **7 Hrs**

Batteries: Primary and secondary batteries, battery components and their role Characteristics of Battery. Working of following batteries: Pb acid, Li-Battery, Solid state electrolyte battery. Fuel cells, Solar cell and polymer cell.

Learning Outcome:

At the end of this course –

The student will be able to

1 understand the conventional and advance fuel.

2 understand the various manufacturing process and design methodology of the chemical steps.

3 grasp the idea of advanced materials used in nonconventional fuels and fuel cells.

TEXT BOOKS: Synthetic Fuels by Ronald F. Probstein, R. Edwin Hicks.

Published January 31st 2006 by Dover Publications 5th Edition

REFERENCE BOOKS

1. Industrial chemistry , E.Stochi : Vol-1,Ellis Horwood Ltd.UK

2. Engineering chemistry, P.C.Jain ,M.Jain: Dhanpat Rai & sons , Delhi.

3. Industrial Chemistry ,B.K.Sharma: Goel Publishing house , Meerut.

Experiment List

1. To determine the heat of neutralization of NaOH AND HCl :
2. Determination of Aniline point.
3. To determine flash point of an oil by Pensky and Martin apparatus.
4. To determine fire point of an oil by Pensky and Martin apparatus.
5. Determination of Iodine value of an oil.
6. Determination of viscosity of heavy oil by means of Redwood viscometer.
7. Determination of Saponification of an oil.
8. To determine percentage moisture, volatile, fixed carbon and ash contents in a given coal sample by proximate analysis.
9. Determination of heat of neutralization of hydrochloric acid with sodium hydroxide.
10. Determination of Acid value (Acidity) of an oil.
11. Determination of saponification value of oil.

Course Structure& Syllabus of BSc (H) Chemistry

Applicable for Batch: 2017-2020

Subject Code	CH-349	Subject Title	ANALYTICAL METHODS IN CHEMISTRY						
LTP	3 0 0	Credit	3	Subject Category	DSE	Year	3rd	Semester	V

COURSE OUTLINE:

This course covers thermal methods of analysis fundamental laws of spectroscopy and selection rules, Techniques of atomization and sample introduction; the lab will include chromatographic techniques.

COURSE OBJECTIVE:

- To develop understanding among students regarding various analytical techniques
- To make familiar with various instrumentation techniques.

To make them well versed in interpretation of analytical data.

COURSE PRE/CO- REQUISITE (IF ANY) : The student must understanding of spectroscopy.

DETAILED SYLLABUS

Unit 1: Qualitative and quantitative aspects of analysis 6 Hrs

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

Unit 2: Practical Methods in UV-VIS and IR spectroscopy 9 Hrs

UV-VIS spectroscopy for quantitative analysis: Determination of composition of metal complexes and stability constant using Job's method of continuous variation and mole ratio method. UV-VIS spectrophotometry in Clinical chemistry (selected examples) Sampling methods in FT-IR, FT-IR spectral analysis in Pharmaceutical and Petroleum Industries; significance of fingerprint informations, ATR-FTIR analysis for fibers and composite materials, basics of characterization methods of polymers (fibers and composites) through FT-IR and Surface analysis

Unit 3: Qualitative and quantitative aspects of chromatographic separation method 12 Hrs

Principle, Process of elution through a column, Band broadening and Tailing, Column efficiency, Number of plates, Plate height and Column resolution, experimental development methods of chromatographs. Gas Chromatography (GC): Carrier gases, different type of injection systems, columns, stationary phases and detectors. High Performance Liquid Chromatography (HPLC): Basics of Instrumentation-pumps and columns. Mobile phases, isocratic and gradient elution systems, stationary phases, normal phase and reverse phase chromatography, detectors. Analytical methods and applications of GC, HPLC and GLC

Chiral chromatographic techniques using chiral columns (GC and HPLC) and optical rotation methods for enantiomeric excess determination. Basic instrumentation, methods and applications of Ion-Exchange chromatography, Gel permeation chromatography. Role of computers in instrumental methods of analysis.

Unit 4: Solvent Extraction of Metals and organic compounds 5 Hrs

Qualitative and quantitative aspects of solvent extraction: Batch and counter-current extraction methods; extraction of metal ions from aqueous solution, extraction of organic species from the aqueous and non-aqueous media. Crystallization methods for industrially important organic compounds.

Unit5: Introduction to Advanced Electrochemistry Methods 7 Hrs

Potentiostatic and galvanostatic methods including chronoamperometry, coulometry, cyclic voltammetry, spectro-electrochemistry.

Learning Outcome:-

At the end of the course, the student will be able to:

1. Perform data sampling, identification of patterns through estimation of analytical errors and precision, statistical test of data and confidence intervals.
2. Explain the principles of the origin of spectroscopy, selection rules in UV-Vis and IR-spectrometry, instrumentation and various domains of applications.
3. Interpret UV-VIS spectra in Clinical chemistry (selected examples) and sampling methods in FT-IR, FT-IR spectral analysis in Pharmaceutical and Petroleum Industries.
4. Conceive the significance of fingerprint informations, ATR-FTIR analysis for fibers and composite materials, basics of characterization methods of polymers (fibers and composites) through FT-IR and Surface analysis
5. Develop insight of the practical methods for performing thermogravimetric analysis, potentiometric and conductometric titrations and their graph analysis.
6. Gain practical understanding of solvent extraction; implications in metallic and organic compound extractions. Students will develop a basic knowledge of various chromatographic techniques and corresponding stationary phases and mobile phases.

TEXT BOOKS

1. A Text book of Quantitative Chemical Analysis (Rev. by GH Jeffery and others), Vogel, Arthur I: A, 6th Ed. The English Language Book Society of Longman, (2009).
2. Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age, International Publisher, 2009.

REFERENCE BOOKS

1. Christian, Gary D; Analytical Chemistry, 6th Ed. John Wiley & Sons, New York, 2004.
2. Harris, Daniel C: Exploring Chemical Analysis, Ed. New York, W.H. Freeman, 2001.
3. Skoog, D.A. Holler F.J. and Nieman, T.A. Principles of Instrumental Analysis, Thomson Asia Pvt. Ltd. Singapore.
4. Mikes, O. & Chalmes, R.A. Laboratory Hand Book of Chromatographic & Allied Methods, Elles Harwood Ltd. London.
5. Ditts, R.V. Analytical Chemistry – Methods of separation.
6. Willard, Hobert H. et al.: Instrumental Methods of Analysis, 7th Ed. Wardsworth Publishing Company, Belmont, California, USA, 1988.
7. Modern Electrochemistry 2A - Fundamentals of Electrodics Paperback, John O`M Bockris (Author), Springer (2018)

Course Structure& Syllabus of BSc (H) Chemistry

Applicable for Batch: 2017-2020

S.No.	EXPERIMENT NAME	
1	**Chromatography**	(a) <u>Separation of mixtures</u> (i) Paper chromatographic separation of Fe^{3+}, Al^{3+}, and Cr^{3+}. (ii) Separation and identification of the monosaccharides present in the given mixture (glucose & fructose) by paper chromatography. Reporting the R_f values (b) Separate a mixture of Sudan yellow and Sudan Red by TLC technique and identify them on the basis of their R_f values. (c) Chromatographic separation of the active ingredients of plants, flowers and juices by TLC
2	**Solvent Extractions**	(i) 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) Solvent extraction of zisconium with amberliti LA-1, separation from a mixture of irons and gallium.
3	**Analysis of soil**	(i) Determination of pH of soil. (ii) Total soluble salt (iii)Estimation of calcium, magnesium, phosphate, nitrate
4	**Ion exchange**	(i) Determination of exchange capacity of cation exchange resins and anion exchange resins. (ii) Separation of metal ions from their binary mixture. (iii) Separation of amino acids from organic acids by ion exchange chromatography.
5	**PH metry**	Determine the pH of the given aerated drinks fruit juices, shampoos and soaps.
6	**Photo metry**	Determination of Na, Ca, Li in cola drinks and fruit juices using fame photometric techniques.

Course Structure& Syllabus of BSc (H) Chemistry

Applicable for Batch: 2017-2020

Subject Code	CH-326	Subject Title	Organic Chemistry -V						
LTP	3 1 2	Credit	5	Subject Category	CC	Year	3rd	Semester	VI

COURSE OUTLINE:

This course covers elucidation of molecular structures and spectroscopy of molecular compound.

COURSE OBJECTIVE:

The objective of this course is to learn basics techniques for the identification and characterization of organic compounds. In this unit students will learn characterization of organic compounds in multistep synthesis and step by step synthesis. This course recalls the fundamental principles of spectroscopy.

COURSE PRE/CO- REQUISITE (IF ANY):

The student must have basic knowledge of UV, IR, NMR mass spectroscopy of organic compounds.

DETAILED SYLLABUS

Unit I: UV Spectroscopy of Organic Compounds 8 Hrs

UV Spectroscopy: Types of electronic transitions, λ-max, Chromophores and Auxochromes, Bathochromic and Hypsochromic shifts, Intensity of absorption; Application of Woodward Rules for calculation of λ-max for the following systems: α,β unsaturated aldehydes, ketones, carboxylic acids and esters; Conjugated dienes: alicyclic, homoannular and heteroannular; Application of Woodward Rules for calculation of λ-max for extended conjugated systems (aldehydes, ketones and dienes); distinction between cis- and trans-isomers

Unit II: IR Spectroscopy of Organic Compounds: 8 Hrs

Fundamental and non-fundamental molecular vibrations; IR absorption positions of O, N and S containing functional groups.Effect of H- bonding, conjugation, resonance and ring size on IR absorptions; Fingerprint region and its significance; application in functional group analysis.

Unit III: NMR Spectroscopy of Organic Compounds:8 Hrs

Basic principles of Proton Magnetic Resonance, chemical shift and factors influencing it; Spin – Spin coupling and coupling constant; Anisotropic effects in alkene, alkyne, aldehydes and aromatics, Interpetation of NMR spectra of simple compounds

Unit IV: Mass Spectroscopy of Organic Compounds: 7 Hrs

Types of ionization techniques, basic principles of EI. Fragmentation processes and structural analysis. ESI, GC/MS, LC/MS and MS/MS techniques, fragmentation pattern of small molecules and Mc Lafferty rearrangement.

Unit V: Application of Spectroscopic Technique in Characterization of Organic Compounds 8 Hrs

Interpretation of spectroscopic (NMR, IR and mass) data as applied to organic compounds. Problems incorporating spectroscopic data. Application of spectroscopic technique in step by step and multistep synthesis

Learning Outcome

At the end of the course, the student will be able to:

1. To understand the role of NMR spectroscopy in the structural elucidation of organic compounds.

2. Develop the basic skills for characterization of multi-step synthesis of organic compounds.

3. Predict the active nuclei in the nuclear magnetic resonance spectroscopy.

4. Identify the functional groups in organic compounds by IR spectroscopy

5. Predict the structure of simple organic compounds by UV, IR, NMR, and mass spectroscopy.

TEXT BOOKS

1. Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Kemp, W. *Organic Spectroscopy*, Palgrave.
3. Kalsi, P. S. *Textbook of Organic Chemistry* (1st Ed.), New Age International (P) Ltd.Pub.

Robert M. Silverstein, Francis X. Webster, David J. Kiemle, David L. Bryce *Spectrometric Identification of Organic Compounds*, 8th Edition published by Wiley.

REFERENCE BOOKS

1. J. Cleyden and S. Warren, Organic Chemistry, Oxford University Press; Second edition (2012)
2. Robert M. Silverstein, Francis X. Webster, David J. Kiemle, David L. Bryce Spectrometric Identification of Organic Compounds, 8th Edition published by Wiley..

S.No.	EXPERIMENT (Synthesis and isolation of the product by column chromatography)	
1	Preparation of Benzyl alcohol from benzaldehyde.	
2	Esterification of carboxylic acid.	
3	Williamson synthesis of ether	
4	Synthesis of oxime from ketones	
5	Oxidation of alcohol to ketone	
6	Oxidation of aldehyde to carboxylic acid	
7	Hydrolysis of triglyceride	
8	Preparation of bio Diesel by trans esterification reaction.	
9	Iodination of α-Naphthol	
10	Multistep synthesis	

Course Structure& Syllabus of BSc (H) Chemistry

Applicable for Batch: 2017-2020

Subject Code	CH-327	Subject Title	Inorganic Chemistry -V						
LTP	3 1 2	Credit	5	Subject Category	CC	Year	3rd	Semester	VI

COURSE OUTLINE:

This course highlights the applications in industry. The course covers different sources of energy and its correlation with environment and metallurgical processes.

COURSE OBJECTIVE:.

The objectives of this course are to learn basics concepts involved in inorganic chemicals and industrial gases. To study of energy and environment with introduction of biocatalysts and their importance in green chemistry as well as in chemical industries to understand their role in environment.

COURSE PRE/CO- REQUISITE (IF ANY) :

The student must have prior and basic knowledge of catalysts, energy sources causes of pollution.

DETAILED SYLLABUS

Unit I: Industrial Gases 8 Hrs

Industrial Gases: Large scale production, uses, storage and hazards in handling of the following gases: oxygen, nitrogen, argon, neon, helium, hydrogen, acetylene, carbon monoxide, chlorine, fluorine, sulphur dioxide and phosgene.

Unit II: Inorganic Chemicals 7 Hrs

Inorganic Chemicals: Manufacture, application, analysis and hazards in handling the following chemicals: hydrochloric acid, nitric acid, sulphuric acid, caustic soda, common salt, borax, bleaching powder, sodium thiosulphate, hydrogen peroxide, potash alum, chrome alum, potassium dichromate and potassium permanganate.

Unit III: Energy &Environment 9 Hrs

Sources of energy: Coal, petrol and natural gas. Nuclear Fusion / Fission, Solar energy, Hydrogen, geothermal, Tidal and Hydel, etc. Nuclear Pollution: Disposal of nuclear waste, nuclear disasterand its management.

Unit IV: **Biocatalysts 6 Hrs**

Introduction to biocatalysis: Importance in “Green Chemistry” and Chemical Industry.

Unit V: Industrial Metallurgy 9 Hrs

Preparation of metals (ferrous and nonferrous) and ultrapure metals for semiconductor technology.

Learning Outcome

Students will gain an understanding of:

1. Industrial gases, their production and hazardous effects.
2. Introduction of different types of inorganic chemicals and their uses for domestic as well as in industrial purposes.
3. Detailed study of different sources of energy and its correlation with environment.

4. Role of biocatalysts with special reference to green chemistry.

5. Different metallurgical processes used for metals.

TEXT BOOKS

1. N.N. Greenwood, and Earnshaw, Chemistry of the Elements, Butterworth Heinemann. 1997.

2. E. Stocchi: Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK.

3. R.M. Felder, R.W. Rousseau: Elementary Principles of Chemical Processes, Wiley Publishers, New Delhi.•

4. J. A. Kent: Riegel's Handbook of Industrial Chemistry, CBS Publishers, New Delhi.•

5. S. S. Dara: A Textbook of Engineering Chemistry, S. Chand & Company Ltd. New Delhi.•

6. K. De, Environmental Chemistry: New Age International Pvt., Ltd, New Delhi.

REFERENCE BOOKS

1 .S. M. Khopkar, Environmental Pollution Analysis: Wiley Eastern Ltd, New Delhi.

2. S.E. Manahan, Environmental Chemistry, CRC Press(2005).•

3. G.T. Miller, Environmental Science 11th edition. Brooks/ Cole (2006).

4. A. Mishra, Environmental Studies. Selective and Scientific Books, New Delhi (2005).

SR.NO.	EXPERIMENT NAME
1	Determination of dissolved oxygen in water.
2	Percentage of available chlorine in bleaching powder
3	Measurement of chloride, sulphate and salinity of water samples by simple titration method (AgNO3and potassium chromate).
4	Determination of Chemical Oxygen Demand (COD)
5	Determination of Biological Oxygen Demand (BOD)
6	Study of some of the common bio-indicators of pollution.
7	Preparation of borax/ boric acid.

Course Structure& Syllabus of BSc (H) Chemistry

Applicable for Batch: 2017-2020

Subject Code	CH-356	Subject Title	BUSINESS SKILLS FOR CHEMISTS AND IPR						
LTP	3 0 0	Credit	3	Subject Category	DSE	Year	3rd	Semester	VI

Course Outline:

The course gives an idea of the Chemical Industry: opportunities and Challenges Business Plans and Business Model Innovation this will also help student to learn about supply chain management.

Course Objective:

The key objective of this course is to familiarize students with a range of essential mathematical tools for solving the advanced problems in theoretical physics.

COURSE PRE/CO- REQUISITE (IF ANY) :

The student should have Data Analysis and knowledge with Excel.

DETAILED SYLLABUS

Unit I: Business Plans and Business Model Innovation 7Hrs

Key business concepts: Business plans, market need and project management. The value of Business models and Business model innovation; Tools.

Unit II: Indian Chemical Industry: opportunities and Challenges 8 Hrs

Segments of Indian Chemical Industry and Percent Economic size. Demand drivers and recent investments. Concept theme of Sustainable Natural Resource Management, Impact of Green Chemistry and Modern Design of the Chemical Enterprise and challenges.

Unit III: Supply chain management 9 Hrs

Basics of: The Supply chain management; finance need, Information systems, Manufacturing and Process operations in the Chemical Industry.

Factors governing Supply chain resources and long term challenges.

Unit IV: Introduction to Intellectual Property and Patents 7Hrs

Different Types of IP, Importance of protecting IP; Basics of Copyrights and Trade Marks;

Patents: WIPO, PCT system, Traditional Knowledge, Patents and Healthcare – balancing promoting innovation with public health, Software patents and their importance for India.

International Agreements: Word Trade Organization (WTO), Trade Related Intellectual Property Rights (TRIPS) agreement, General Agreement on Trade related Services (GATS), Budapest Treaty and Paris Convention. IP Infringement issue and enforcement; Various laws in India Licensing and technology transfer.

Unit V: Marketing and Data Analysis 8 Hrs

Introduction to marketing analytics, Organization Data Analysis & Visualization with Excel.

Learning outcome:-

At the end of the course, the student can:

1: develop understanding of Green chemistry and Sustainable resource management related policies and challenges to realize new business models

2: workout on the documentations related to IPR and trade secrets and budgeting

3: perform data analysis using spreadsheets and data visualization for the finance need of an organization

4: able to understand the structure plan of a new business model and able to evaluate the robustness of business model towards trends and uncertainties

TEXT BOOKS

. 1. Martha J. Boss (Editor), Brad Boss (Editor), Cybil Boss (Editor), Dennis W. Day (Editor), Handbook of Chemical Regulations: Benchmarking, Implementation, and Engineering Concepts, CRC PRESS (2016)

REFERENCES

1. P. Ganguli, Intellectual Property Rights: Unleashing the Knowledge Economy, Tata

McGraw-Hill (2001).

2. JayashreeWatal, Intellectual property rights in the WTO and developing countries, Oxford University Press, Oxford (2003)

Course Structure& Syllabus of BSc (H) Chemistry

Applicable for Batch: 2017-2020

Subject Code	CH-357	Subject Title	PESTICIDE CHEMISTRY						
LTP	3 00	Credit	3	Subject Category	DSE	Year	3rd	Semester	VI

Course Outline:

This course covers Synthetic Pesticide Analysis of Pesticides in food materials Toxicological and environmental impact of pesticides on human being and aquatic animals.

Course Objective:

The objective of this course is to learn basics concepts of Pesticides and its importance. This course recalls the basic fundamentals of synthetic and natural pesticides. They will also learn analysis of pesticides in food materials, in soil, water and in air. Student also gain knowledge regarding regulations on the use of pesticides. The course includes a definite and concise module on Perfumery industry; the major raw materials and concept of sensorial perception of fragrance.

Course Pre/Co- requisite (if any) :

The student must have gone through CH-106 and CH-116

DETAILED SYLLABUS

Unit 1: Introduction of Pesticides **7 Hrs**

General introduction to pesticides. Importance of pesticides, Classification of pesticides based on origin (natural and synthetic).
Benefits and adverse effects of pesticides, changing concepts of pesticides, structure activity relationship.

Unit 2:Natural Pesticides **8 Hrs**

Occurrence and isolation, General properties, Structural determination, naturally occurring pesticides-rotenone and pyrethroids obtained from pyrethrin flowers, nicotine obtained from tobacco leaves.

Unit 3: Synthetic Pesticide **9 Hrs**

Preparation and properties of following synthetic pesticides
1. Organochlorine pesticides: Example-dichlorodiphenyltrichloro ethane (DDT or 1,1,1-trichloro-2,2-bis-p-chlorophenyl ethane).
2. Organophosphorous pesticides: Example- Parathion, Paraoxon
3. Organocarbamates and
4. Synthetic Pyrethroids.

Unit 4: Analysis of Pesticides in food materials **8 Hrs**

Identification of pesticides in food material, in vegetables, in rice and wheat and in soil.

Unit 5: Toxicological and environmental impact of pesticides **7 Hrs**

Properties or characteristics of pesticides, Regulations on the use of pesticides,

Learning Outcome:

At the end of this course –
The student will be able to
1 To develop understanding among students regarding various natural and synthetic pesticides.
2. To make familiar with various environmental impact and toxicology on human being and aquatic animals.
3 To make them well versed in interpretation of pesticides by analytical methods.

TEXT BOOKS

1. Chemistry of Pesticides by N. K. Roy published by CBS publishers and distributors Pvt. Ltd.
2. Manures Fertilizers and Pesticides by A. Rakshit
3. Chemistry of Pesticides by N. N. Melnikov, R. L. Busbey, et al.

REFERENCE BOOKS

1. Pesticide Formulation and Adjuvant Technology Hardcover – by Chester L. Foy (Author), David W. Pritchard (Author)
2. Chemistry of Pesticides by Karl HeizBüchel

Course Structure& Syllabus of BSc (H) Chemistry

Applicable for Batch: 2017-2020

Subject Code	CH-358	Subject Title	MEDICINAL AND PHARMACEUTICAL CHEMISTRY						
LTP	3 00	Credit	3	Subject Category	DSE	Year	3rd	Semester	VI

Course Outline:

This course covers generic drugs and the use basic principle of drugs action on human system.

COURSE OBJECTIVE:

The subject is designed to impart knowledge about the classification of pharmaceutical drugs and basic principles of medicinal chemistry of drug action.Course deals with the synthetic methods of industrial drugs preparation of selected classes.Course is also useful for industrial applications

COURSE PRE/CO- REQUISITE (IF ANY) :

The student must have gone through CH-116 and CH-216

Detailed Syllabus

Unit I: Basic Principles of Drugs Action **9 Hrs**

Physiochemical aspects of Drug action- Stereochemical aspects of drug action (Optical, geometric and bio-isosterism of drug molecules with biological action), conformational isomerism, solubility and partition coefficient, chemical bonding. Drug-receptor interactions, receptor-effector theories, types of receptors and their actions including transduction mechanism and G- proteins. Principles of drug design (Theoretical aspects)

Unit II: Medicinal chemistry of NSAIDs and Synthetic Antibiotics **7 Hrs**

Classification, structure and therapeutic uses of NSAIDs: Ibuprofen (with synthesis), Etoricoxib (with synthesis). Classification, structure and therapeutic uses of Antibiotics: Antimalarials (Amodiaquine (with synthesis) and Artemesinin. Antibacterial and antifungal agents; (Fluoroquinolones, Fluconazole, Sulphamethoxazol, Trimethoprim, Metronidazole).

Unit III: Medicinal chemistry of CNS and CVS Drugs **8 Hrs**

Classification, Medicinal Chemistry and Synthesis of the representative drugs of the following classes: Central Nervous System agents (Phenobarbital, Diazepam, Imipramine), Cardiovascular (Atenolol, clonidine), HIV-AIDS related drugs (AZT- Zidovudine), Antiviral agents (Acyclovir).

Unit IV: Fermentation technology for Important Pharmaceutics **8 Hrs**

Fermentation: Aerobic and anaerobic fermentation. Production of (i) Acetic Acid and citric acid, (ii) Antibiotics; Penicillin, Cephalosporin, and Gentamycin (iii) Lysine, Glutamic acid, Vitamin B2, Vitamin B12 and Ascorbic acid.

Unit V: Medicinally Important Drugs from Plants & Marine **7 Hrs**

Pharmaceutics and Medicinal chemistry of Anticancerous and Antioxidants from natural products (selected examples; curcumins, Resveratrol, Taxol, Vincristine, Azadirachtin etc.); Flavonoids and Polyphenols (selected examples).

Learning outcome:-

At completion of this course it is expected that students will be able to understand-

• Rationality in Drugs Design and Drug-Target specific interactions and inhibitions.

• Tools (basics) of medicinal chemistry in drug research.

• Design of chemical schemes for the industrial methods of drugs synthesis of various classes.

• Fermentation technology process for various complex drugs for which synthesis is not viable.

• Fundamental medicinal chemistry of advanced natural products, basis of their anticancer and anti-inflammatory (diabetes) preparations from active principles.

TEXT BOOKS

Medicinal and Pharmaceutical Chemistry, H. Singh and V. K. Kapoor, Vallabh Prakashan,

Delhi.

Medicinal Chemistry, AshutoshKar, New Age Publication (2018)

REFERENCES

Foye's Principles of Medicinal Chemistry by Lemke T.L., Williams D.A., Roche V.F. and Zito S.W., 7th Ed. (2012). Lippincott Williams and Wilkins, Philadelphia.

Synthesis of Essential Drugs by Vardanyan R.S. and Hruby V.J., Elsevier, Philadelphia.

Contemporary Drug Synthesis by Jie Jack Li (Author), Douglas S. Johnson (Author), Drago R. Sliskovic (Author), Bruce D. Roth (Author), Wiley-Interscience; 1st edition (June 25, 2004)

Course Structure& Syllabus of BSc (H) Chemistry

Applicable for Batch: 2017-2020

Subject Code	CH-359	Subject Title	CHEMISTRY OF COSMETICS AND PERFUMES						
LTP	3 00	Credit	3	Subject Category	DSE	Year	3rd	Semester	VI

Course Outline:

The course includes study of potential chemical use in Cosmetics: Hair & Care Cosmetics. This also covers Raw materials in cosmetics: Various oils, fats and waxes.

Course Objective:

The course is designed to impart knowledge about the various principal ingredients used in cosmetics preparations for Skin and Hair care products, their basic chemistry and principles of physiological actions. The course also gives details and explanation for the use of different surfactants and other additives in cosmetics. The course includes a definite and concise module on Perfumery industry; the major raw materials and concept of sensorial perception of fragrance. A general description of various legislations and Regulatory statutory bodies along with Market trends is included in the course.

Course Pre/Co- requisite (if any) :

The student must have gone through CH-116 and CH-217

DETAILED SYLLABUS

Unit 1 Introduction to Cosmetics: Hair & Care Cosmetics 7 Hrs

Raw materials in cosmetics: Various oils, fats and waxes; powders, emulsifiers, thickeners and gums. Major ingredients and their uses in the formulations of Shampoos (including hair growth/strength enhancers), Hair oils (hair strength enhancers) and hair dyes. Major ingredients and their uses in the formulations of Face and Talcum powders.

Unit 2 Skin care cosmetics and Physiological Actions 9Hrs

Major ingredients and their uses in the formulations of various creams (cold creams, face creams, whitening creams, gels and lotions).Natural products (selected) extracts used in cream formulations, (Wheat germ and wheat germ oil, Rose hydrosols, Shea butter, Evening primrose oil, Borage , Hemp seed oils, Jojoba and Avocado kernels), chemical compositions, physiological actions and identification.

Unit 3: Minerals and additives in cosmetics and Sun screens 8 Hrs

Study of mineral ingredients. Kaolin, Bentonite, Talc, Fuller's earth, Tannins, Calamine, Bismuth-oxychloride. Dyes and pigments used in lipsticks, nail polish and foundations.
Speciality products- Sun protection formula (SPFs)

Unit-4 Basics of Perfumery 8 Hrs

Raw materials in Perfumery; 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. Alcoholic and Non-Alcoholic multifunctional perfumery.

Unit-5 Cosmetics Regulation and Market 7 Hrs

Legislation and regulations for perfumes and cosmetics; Cosmetic Product notification Portal, Cosmetic ingredient Review (CIR), Artwork and Labeling (FPLA).Safety testing and toxicology. Cosmetic Product Development Sequence and Logic. Market Trends in Cosmetics and Hair dyeing agents. Efficacy Testing and Clinical Trials

Learning outcome:-

On successful learning through this course it is expected that students will be able to understand-

• Chemistry of various ingredients used in Hair products, Skin creams, Lotions and gels

• Chemistry and specific roles of various additives and surfactants used in different cosmetic preparations

• Basic technology involved in the extraction of rewarded natural products and their applications in skin care cosmetics

• Legislations and Regulatory issues pertaining to cosmetic products and current Market trends.

TEXT BOOKS

1. Handbook of Cosmetic Science and Technology 3rd Edition by André O. Barel, Marc Paye, Howard I. Maibach. Informa Healthcare, CRC Press, New York (2009).

REFERENCE BOOKS

1. Introduction to Cosmetic Formulation and Technology 1st Kindle Edition, by Gabriella Baki (Author), Kenneth S. Alexander (Author), Wiley (2015).
2. Handbook of Cosmetic Science and Technology 4th Edition by André O. Barel, Marc Paye, Howard I. Maibach. Informa Healthcare, CRC Press, New York (2009).
3. Formulas, Ingredients and Production of Cosmetics Technology of Skin- and Hair-Care Products in Japan, Iwata, Hiroshi, Shimada, Kunio, Springer (2012)

Course Structure& Syllabus of BSc (H) Chemistry

Applicable for Batch: 2017-2020

Subject Code	CH-366	Subject Title	Green Chemistry						
LTP	3 00	Credit	3	Subject Category	DSE	Year	3rd	Semester	VI

Objective:

Course aims to impart the basic principles of green and sustainable chemistry. Scholars must be able to do and understand stoichiometric calculations and relate them to green process metrics. They learn alternative solvent media and energy sources for chemical processes. They learn about renewable feedstocks for the chemical industry, present and under development. They review the principles of catalysis, photochemistry and other interesting processes from the viewpoint of green chemistry. They perform laboratory experiments in which they apply some of the concepts previously learnt (stoichiometry, green metrics etc.) and they put into practice some of the principles of green chemistry.

Course Outcome:

At the end of the course, the student will be able to:

CO1. Demonstrate the fundamental concepts of green chemistry.

CO2. Able to depict the basic principles of green chemistry and clean synthesis approaches.

CO3. Understands the green products synthesis and bio-production techniques.

CO4. Identify renewable and sustainable methods in chemical processes.

CO 5. Illustrate and analyse various green technologies for future of sustainable chemistry.

Unit 1: Introduction to Green Chemistry **4 Hours**

Introduction, Definition & Concepts of Green Chemistry. Need for Green Chemistry. Goals of Green Chemistry. Limitations in the pursuit of the goals of Green Chemistry.

Unit 2: Principles of Green Chemistry and Green Chemical synthesis **10 Hours**

Twelve principles of Green Chemistry with their explanations and examples; Designing a Green Synthesis using these principles; Waste: Production, Problems, Prevention; prevention/ minimization of hazardous/ toxic products; designing safer chemicals, Organic Solvents: Environmentally Benign Solutions (Focus on Water and Ionic Liquids; fluorous solvents and supercritical CO_2), Some Examples of green synthesis/ reactions.

Unit 3: Green products and green processes **10 Hours**

Green solvents, solventless processes, immobilized solvents and ionic liquids; energy requirements for reactions - use of microwaves, ultrasonic energy; selection of starting materials; avoidance of unnecessary derivatization – careful use of blocking/protecting groups; Catalysis and Green Chemistry: Introduction, Basics of Organometallic Chemistry & Catalysis, use of catalytic reagents (wherever possible) in preference to stoichiometric reagents; bio-transformations and bio-production approaches. Designing of biodegradable products; prevention of chemical accidents

Unit-4 Renewable and Sustainable approaches in Green Chemistry **06 Hours**

Renewable Resources: What's Available? Renewable Resources: Chemicals from Biomass. Sustainable Polymers: The Case of Polylactide. Sustainable Polymers: Using CO_2 and other feedstocks. Bio-degradation approaches in green chemistry. Bio-fuels generation through green approaches.

Unit-5: Future Trends in Green Chemistry **06 Hours**

Oxidation reagents and catalysts; Biomimetic, multifunctional reagents; Combinatorial green chemistry; Proliferation of solventless reactions; oncovalent derivatization; Green chemistry in sustainable development. Alternative energy sources in chemistry, Green Chemistry and Public Policy.

TEXT BOOKS

1. V.K. Ahluwalia & M.R. Kidwai: New Trends in Green Chemistry, Anamalaya Publishers (2005).
2. P.T. Anastas & J.K. Warner: Oxford Green Chemistry- Theory and Practical, University Press (1998).
3. M. Lancaster, "Green Chemistry. An Introductory Text", 2nd Ed., RSC Publishing, 2010.
4. J. Clark, D. Macquarrie, "Handbook of Green Chemistry & Technology", Blackwell Science, 2002.

REFERENCES

1. P. Tundo, A. Perosa, F. Zecchini (Eds.), " Methods and Reagents for Green Chemistry. An introduction", Wiley-Interscience, 2007.
2. A.S. Matlack: Introduction to Green Chemistry, Marcel Dekker (2001).
3. M.C. Cann & M.E. Connely: Real-World cases in Green Chemistry, American
4. Chemical Society, Washington (2000).

Course Structure& Syllabus of BSc (H) Chemistry

Applicable for Batch: 2017-2020

Subject Code	CH-367	Subject Title	Forensic Chemistry						
LTP	3 00	Credit	3	Subject Category	DSE	Year	3rd	Semester	VI

COURSE OUTLINE:

This course covers basics of forensic concepts and Analysis the crime evidences on the basis of various advanced instrumental methods

COURSE OBJECTIVE:.

The course is designed to impart knowledge on the concepts of forensic science, chemistry of various biological and non-biological samples obtained at the crime scene and their sampling methods. The course also gives details of the advanced instrumental methods employed in the detection of various biological samples and interpretation of results.

The course renders the description of various advanced Biometric data and DNA fingerprinting assays.

Course Pre/Co- requisite (if any) :

The student must have basic knowledge of CH-118 and CH-116

Detailed Syllabus

Unit -1 Fundamental Concepts of Forensic Science 7 Hrs

Forensic Science: Definition, History & Development, Scope, Ethics in Forensic Science

Physical Evidence: Nature, Types, Search methods, Collection, Preservation, Packing & Forwarding of Physical & Trace evidence for forensic analyses, Chain of Custody Crime Scene: Nature, Types, Preservation of Scene of Crime Criminal Investigations: Unnatural deaths, Criminal assaults, Sexual offences, Poisoning, Vehicular accidents

Unit -2 Instrumentation methods used in Forensic Chemistry 11 Hrs

Microscopy: Polarizing, Comparison, Stereoscopic, Fluorescent and Electron Microscopes

Spectrophotometry: UV, Visible, IR, Raman, Atomic absorption, Emission ,Neutron Activation Analysis ,X – rays and x-ray based techniques such as XRD, XRF ,Mass Spectroscopy Chromatographic Techniques: TLC, GLC, HPLC,HPTLC Hyphenated Techniques: GC-MS, LC-MS, IR-MS and ICP-MS ,Electrophoresis: High and Low voltage electrophoresis, Immuno electrophoresis Immunoassays: Principle, Types ,Techniques and applications

Unit -3 Detection and Identification of biological fluids 8 Hrs

Determination of Species of Origin ,Blood Group Systems ,Techniques of Determination of Blood groups of Blood Stains, Detection of Seminal and other body fluids and their Blood Grouping, Red cells Enzymes, Serum Proteins of forensic significance ,Disputed Paternity & Maternity

DNA: Structure, DNA as genetic marker, DNA Extraction and Profiling Techniques

DNA Phenotyping and RNA Profiling & their applications

Unit -4 Biometric Systems of Identification and its relevance 7 Hrs

Fingerprints: Characteristics, Types, Classification;

Biometric computerization of Fingerprints, AFIS, Track Marks: Foot Prints, Shoe Prints,Tire Marks, Their Preservation & Casting, Comparison, Skid marks. Gait pattern and Voice Analysis: Introduction, Significance, Structure of Human Voice apparatus, Voice spectrography, Voice analysis, Legal aspects and limitations

Unit -5 Forensic Analysis of some materials **6 Hrs**

Hair & Fibers: Nature, Types, Structure and Examination , Pollens and Diatoms: Their application in Forensic investigation , Dust & Soil: Nature, Types, Forensic Examination , Paint, Lacquer & Varnishes: Nature, composition and forensic examination Glass: Composition, Types, Fractures, Examination , Cement, Mortar and Concrete: General Composition, Forensic Analysis

Learning outcome:

1: Understand the basics of forensic concepts, types of criminal assaults and crime scene investigation
2: Understand the chemistry of biological fluids, genetics and other non-biological materials at the crime scene
3: Analyze the crime evidences on the basis of various advanced instrumental methods and interpretations
4: Develop an insight of the integrated approaches using biometric tests and DNA/RNA profiling.

Text Books:

1. Basic Principles of Forensic Chemistry, Javed I. Khan, 1st Ed., Springer, (2011)
2. Forensic Chemistry by Max Houck, ElsevierIst edition

Reference Books:

1. Introduction to Forensic Chemistry, Kelly M. Elkins,1st Edition, CRC Press, (2018).