

PONDICHERY UNIVERSITY

(A CENTRAL UNIVERSITY)



B.Sc. Chemistry

(Choice Based Credit System)

Syllabus

2017-18 onwards

Pondicherry University
SCHEME FOR CHOICE BASED CREDIT SYSTEM
B.Sc., Chemistry
(With Effect from 2017-18 onwards)

COURSE	SUBJECT CODE	TITLE OF THE PAPER	Credits	Marks	Contact Hrs. / Week.	Lab Hrs. / Week
SEMESTER-I			18 Credits			
MIL – 1	LBEN//LHIN/ LMAL/LSAN/ LTAM/LTEL 111	Bengali/Hindi/Malayalam/ Sanskrit/Tamil/ Telugu	03	100	03	-
ENGLISH – 1	ENGL 112	ENGLISH – 1	03	100	03	-
DSC – 1A	UCHM 111	General Chemistry – I	04	100	04	-
DSC – 2A	UMAT 112	Mathematics – I	04	100	04	-
	UZOO 112	Zoology - I	03	75	03	-
DSC – 3A	UCHM 116	General Chemistry Practical - I	02	50	-	04
DSC – 4A	UZOO 116	Zoology Lab - I	01	25	-	02
AECC – 1	PADM 111	Public Administration	02	50	02	-
Note: Either UMAT 112 or UZOO 112 to be opted. UZOO 116 is only for UZOO 112 opted students.						
SEMESTER-II			18 Credits			
MIL – 2	LBEN//LHIN/ LMAL/LSAN/ LTAM/LTEL 121	Bengali/Hindi/Malayalam/ Sanskrit/Tamil/ Telugu	03	100	03	-
ENGLISH– 2	ENGL 122	ENGLISH – 2	03	100	03	-
DSC – 1B	UCHM 121	General Chemistry-II	04	100	04	-
DSC – 2B	UMAT 122	Mathematics – II or	04	100	04	-
	UZOO 122	Zoology - II	03	75	03	-
DSC – 3B	UCHM 126	General Chemistry Practical – II	02	50	-	04
DSC – 4B	UZOO 126	Zoology Lab - II	01	25	-	02
AECC – 2	ENVS 121	Environmental Studies	02	50	02	-
Note: Either UMAT 122 or UZOO 122 to be opted. UZOO 126 is only for UZOO 122 opted students.						
SEMESTER-III			22 Credits			
MIL – 3	LBEN//LHIN/ LMAL/LSAN/ LTAM/LTEL 231	Bengali/Hindi/Malayalam/ Sanskrit/Tamil/ Telugu	03	100	03	-
ENGLISH – 3	ENGL 232	ENGLISH – III	03	100	03	-
DSC – 1C	UCHM 231	Physical Chemistry - I	04	100	03	-

DSC – 2C	UCHM 232	Inorganic Chemistry - I	04	100	03	-
DSC – 3C	UPHY 233	Physics - I	03	75	03	-
DSC – 4C	UCHM 236	Physical and Inorganic Chemistry - Practical	02	50	-	04
DSC – 5C	UPHY 238	Physics Practical- I	01	25	-	02
SEC – 1	UCHM 234	IT Skills for Chemists	02	50	01	02
(Any One to be Selected)	UCHM 235	Basic Analytical Chemistry				
	UCHM 237	Chemical Technology and Society				
SEMESTER-IV			22 Credits			
MIL – 4	LBEN/LHIN/LMAL/LSAN/LTAM/LTEL 241	Bengali/Hindi/Malayalam/Sanskrit/Tamil/ Telugu	03	100	03	-
ENGLISH – 4	ENGL 242	ENGLISH – IV	03	100	03	-
DSC – 1D	UCHM 241	Physical Chemistry - II	04	100	03	-
DSC – 2D	UCHM 242	Organic Chemistry - I	04	100	03	-
DSC – 3D	UPHY 243	Physics - II	03	75	03	-
DSC – 4D	UCHM 246	Physical and Organic Chemistry - Practical	02	50	-	04
DSC – 5D	UPHY 248	Physics Practical- II	01	25	-	02
SEC – 2	UCHM 244	Analytical and Clinical Biochemistry	02	50	01	02
(Any One to be Selected)	UCHM 245	Chemoinformatics				
	UCHM 247	Business Skills for Chemists				
SEMESTER-V			20 Credits			
DSC – 1E	UCHM 351	Inorganic Chemistry - II	03	100	03	-
DSE – 1A DSE – 2A (Any Two to be Selected)	UCHM 352	Applications of Computers in Chemistry	04	75	04	-
		Applications of Computers in Chemistry - Practical	01	25	-	02
	UCHM 353	Analytical Methods in Chemistry	04	75	04	-
		Analytical Methods in Chemistry: Practical	01	25	-	02
	UCHM 354	Nano Chemistry	04	75	04	-
		Nano Chemistry: Practical	01	25	-	02
	UCHM 355	Green Chemistry	04	75	04	-

		Green Chemistry: Practical	01	25	-	02
	UCHM-356	Organometallics, Bioinorganic Chemistry & Polynuclear hydrocarbons	04	75	04	-
		Organometallics, Bioinorganic Chemistry & Polynuclear hydrocarbons: Practical	01	25	-	02
	UCHM-357	Research Methodology	05	100	05	02 (Tutorial)
DSC– 2E	UCHM 350	Inorganic Chemistry Practical - II	02	50	-	04
GE – 1	XXXX XXX	A course from other department	03	100	03	-
SEC – 3 (Any One to be Selected)	UCHM 358	Green Methods in Chemistry	02	50	01	02
	UCHM 359	Pharmaceutical Chemistry				
SEMESTER-VI			20 Credits			
DSC– 1F	UCHM 361	Organic Chemistry - II	03	100	03	-
DSE – 1B DSE – 2B (Any 2 DSE Courses to be selected)	UCHM 362	Analytical Chemistry	04	75	04	02
		Analytical Chemistry: Practical	01	25	-	02
	UCHM 363	Polymer Chemistry	04	75	04	02
		Polymer Chemistry: Practical	01	25	-	02
	UCHM 364	Molecular Modelling & Drug Design	04	75	04	-
		Molecular Modelling & Drug Design:Practical	01	25	-	02
	UCHM 365	Industrial Chemicals & Environment	04	75	04	-
		Industrial Chemicals & Environment: Practical	01	25	-	04
	UCHM 366	Dissertation	05	100	-	10
	DSC – 2F	UCHM 360	Organic Chemistry Practical -II	02	50	-
GE – 2	XXXX XXX	A course from other department	03	100	03	-
SEC – 4 (Any One to be Selected)	UCHM 367	Forensic Chemistry	02	50	01	02
	UCHM 368	Fuel Chemistry				

Total Number of Credits: 120

Pondicherry University
Syllabus for B. Sc., (Chemistry)
Choice Based Credit System

I Year – Semester-I

DSC – IA: UCHM 111: GENERAL CHEMISTRY – I

Objective:

4-1-0-4

- To Study Atomic Structure, Chemical Bonding and Molecular Structure
- To Study the Fundamentals of Organic Chemistry and Stereochemistry
- To Study the Gaseous state

Unit – I: Atomic Structure

Review of: Bohr's theory and its limitations, dual behaviour of matter and radiation, de Broglie's relation, Heisenberg Uncertainty principle. Hydrogen atom spectra. Need of a new approach to Atomic structure.

Quantum mechanics: Time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and ψ^2 , Schrödinger equation for hydrogen atom. Radial and angular parts of the hydronic wave functions (atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3p and 3d orbitals (Only graphical representation). Radial and angular nodes and their significance. Radial distribution functions and the concept of the most probable distance with special reference to 1s and 2s atomic orbitals. Significance of quantum numbers, orbital angular momentum quantum numbers m_l and m_s . Shapes of s, p and d atomic orbitals, nodal planes. Spin quantum number (s) and magnetic spin quantum number (m_s).

(12 Lectures)

Unit II: Chemical Bonding and Molecular Structure

Ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionic bonding, Lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

Covalent bonding: VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with the following examples – BeCl_2 , BF_3 , NH_3 , SF_4 , PCl_5 , SF_6 .

Concept of resonance and resonating structures in various inorganic compounds. MO Approach: Rules for the LCAO method, bonding and anti-bonding MOs and their characteristics for s-s, s-p and p-p combinations of atomic orbitals, MO treatment of homonuclear diatomic molecules of O_2 and N_2 and heteronuclear diatomic molecules such as CO, NO and NO^+ . Comparison of VB and MO approaches.

(12 Lectures)

Unit III: Fundamentals of Organic Chemistry

Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis.

Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals.

Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Benzenoids and Hückel's rule.

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

(12 Lectures)

Unit IV: Stereochemistry

Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (up to two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). Threo and erythro; D and L; cis - trans nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) and E / Z Nomenclature (for upto two C=C systems).

(12 Lectures)

Unit V: Gaseous State:

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

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

(12 Lectures)

Reference Books:

- Lee, J.D. Concise Inorganic Chemistry ELBS, 1991.
- Cotton, F.A., Wilkinson, G. & Gaus, P.L. Basic Inorganic Chemistry, 3rd Ed., Wiley.
- Douglas, B.E., McDaniel, D.H. & Alexander, J.J. Concepts and Models in Inorganic Chemistry, John Wiley & Sons.

- Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Education India, 2006.
- Graham Solomon, T.W., Fryhle, C.B. & Snyder, S.A. Organic Chemistry, John Wiley & Sons (2014).
- McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
- Sykes, P. A Guidebook to Mechanism in Organic Chemistry, Orient Longman, New Delhi (1988).
- Eliel, E.L. Stereochemistry of Carbon Compounds, Tata McGraw Hill education, 2000.
- Finar, I.L. Organic Chemistry (Vol. I & II), E.L.B.S.
- Morrison, R.T. & Boyd, R.N. Organic Chemistry, Pearson, 2010.
- Bahl, A. & Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010.
- Puri B.R., Sharma L.R. and Kalia K.C. Principles of Inorganic Chemistry, Milestone.
- Arun Bahl, Bahl, B.S. and Tuli G.D. *Essentials of Physical Chemistry*, S. Chand & Co, 2012.
- Peter Atkins and Julio de Paula, *Atkin's Physical Chemistry* 9th Ed., Oxford University Press.
- Puri B.R., Sharma L.R. and Pathania M.S. *Principles of Physical Chemistry*, Vishal Publishing Co., 2008.

DSC-3A: UCHM 116: GENERAL CHEMISTRY PRACTICAL – I

(60 Lectures)

0-1-4-2

Volumetric Analysis & Chromatography

1. Preparation of standard solutions of different Molarities and Normalities.
2. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
3. Estimation of oxalic acid by preparing standard FAS and titrating it with KMnO_4 .
4. Estimation of Fe^{2+} by preparing standard FAS and using KMnO_4 link solution.
5. Estimation of water of crystallization in Mohr's salt by titrating with KMnO_4 .
6. Estimation of Fe (II) ions by titrating it with $\text{K}_2\text{Cr}_2\text{O}_7$ using internal indicator.
7. Estimation of $\text{K}_2\text{Cr}_2\text{O}_7$ iodometrically by preparing standard $\text{K}_2\text{Cr}_2\text{O}_7$ and link $\text{Na}_2\text{S}_2\text{O}_3$.
8. Estimation of Cu (II) ions iodometrically by preparing standard CuSO_4 and link $\text{Na}_2\text{S}_2\text{O}_3$.
9. Separation of mixtures by Chromatography: Measure the R_f value in each case (combination of two compounds to be given)
10. Identify and separate the components of a given mixture of two amino acids (glycine, aspartic acid, glutamic acid, tyrosine or any other amino acid) by paper chromatography
11. Identify and separate the sugars present in the given mixture by paper chromatography.

Reference Books:

- Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012.
- Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009.
- Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G.,
Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996.
- Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman, 1960.

Scheme of Valuation: (Max marks: 50)

1. Internal Marks	-----	10 marks
2. Writing Principle and brief procedure	-----	5 marks
3. Record	-----	5 marks
4. Viva-voce	-----	5 marks
5. Experiment (based on error %)	-----	25 marks (see below)
Up to 2% error	-----	25 marks
2% to 3%	-----	20 marks
3% to 4%	-----	15 marks
4% to 5%	-----	10 marks
More than 5% error or expt. is incomplete	-----	5 marks

For calculation mistake: 2 marks to be deducted; for no calculation: 5 marks to be deducted.

I Year - Semester - II

DSC- 1B: UCHM 121: GENERAL CHEMISTRY-II

(60 Lectures)

4-1-0-4

Objective:

- To Study Chemical Energetics
- To Study the Chemical Equilibrium, Ionic Equilibria
- To Study the Hydrogen, Hydrides, and S-block elements
- To Study the Aliphatic Hydrocarbons, Aromatic Hydrocarbons

Unit I: Chemical Energetics

Review of thermodynamics and the Laws of Thermodynamics.

Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature – Kirchhoff's equation.

Third law of thermodynamics:

Statement of third law; concept of residual entropy; Nernst heat theorem; Evaluation of absolute entropy from heat capacity data.

(12 Lectures)

Unit II: Chemical Equilibrium & Ionic Equilibria:

Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between ΔG and ΔG° , Le Chatelier's principle. Relationships between K_p , K_c and K_x for reactions involving ideal gases.

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. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle.

(12 Lectures)

Unit III: Hydrogen, Hydrides, and S-block elements

Hydrogen-Isotopes, ortho- and para-hydrogens. Hydrides: ionic, covalent, metallic and interstitial hydrides, Hydrogen bonding.

Alkali metals: Introduction, halides, oxides and hydroxides, salts of oxo-acids, aqueous solution chemistry, complexes and organometallic compounds.

Alkaline Earth metals: Introduction, halides, oxides and hydroxides, salts of oxo-acids, aqueous solution chemistry, complexes and organometallic compounds.

(12 Lectures)

Unit IV: Aliphatic Hydrocarbons

Alkanes: Preparation – Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. **Reactions:** Free radical Substitution: Halogenation.

Cycloalkanes: Preparation by Dieckman condensation & Baeyer's strain theory. Conformational analysis of mono- and di-substituted cyclohexanes.

Alkenes: Preparation – Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); *cis*-alkenes (Partial catalytic hydrogenation) and *trans*-alkenes (Birch reduction). **Reactions:** *cis*-addition (alkaline KMnO_4) and *trans*-addition (bromine), addition of HX (Markownikoff's and anti-Markownikoff's addition), hydration, ozonolysis, oxymecuration-demercuration, hydroboration-oxidation.

Alkynes: Preparation of acetylene from CaC_2 and conversion into higher alkynes by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides.

Reactions: Formation of metal acetylides, addition of bromine and alkaline KMnO_4 , ozonolysis and oxidation with hot alkaline KMnO_4 .

(12 Lectures)

Unit V: Aromatic Hydrocarbons

Preparation (Case benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid.

Reactions: (Case benzene): Electrophilic substitution: nitration, halogenation and sulphonation. Friedel-Craft's reaction (alkylation and acylation) (up to 4 carbons on benzene). Side chain oxidation of alkyl benzenes (up to 4 carbons on benzene).

Activating and deactivating substituents. Orientation and ortho-para ratio. Addition reactions of benzene - Birch reduction.

(12 Lectures)

Reference Books:

- Huheey, J.E., Keiter, E.A., Keiter, R. L., Medhi, O.K. Inorganic Chemistry, Principles of Structure and Reactivity, Pearson Education 2006.
- Lee, J.D. Concise Inorganic Chemistry, John Wiley & Sons.
- Graham Solomon, T.W., Fryhle, C.B. & Snyder, S.A. Organic Chemistry, John Wiley & Sons (2014).
- McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
- Arun Bahl and Bahl, B.S. Advanced Organic Chemistry, S. Chand & Co. Ltd., 2012.
- Arun Bahl, Bahl, B.S. and Tuli G.D. Essentials of Physical Chemistry, S. Chand & Co, 2012.
- Peter Atkins and Julio de Paula, Atkin's Physical Chemistry 9th Ed., Oxford University Press.
- Puri B.R., Sharma L.R. and Pathania M.S. Principles of of Physical Chemistr, Vishal Publishing Co., 2008.
- Hari Jeevan Arnikar, Essentials of Nuclear Chemistry, Revised 4th Ed., New Age International Publishing, 1995.

DSC - 3B: UCHM 126: GENERAL CHEMISTRY PRACTICAL – II

(60 Lectures)

0-1-4-2

Physical Chemistry Experiments

1. Determination of heat capacity of calorimeter for different volumes.
2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
3. Determination of enthalpy of ionization of acetic acid.
4. Determination of integral enthalpy of solution of salts (KNO_3 , NH_4Cl).
5. Determination of enthalpy of hydration of copper sulphate.
6. Study of the solubility of benzoic acid in water and determination of ΔH .
7. Determination of molecular mass by Rast's macro method.
8. Determination of transition temperature of the given substance by thermometric method ($\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$; $\text{SrCl}_2 \cdot 6\text{H}_2\text{O}$; $\text{CH}_3\text{COONa} \cdot 3\text{H}_2\text{O}$; $\text{MnCl}_2 \cdot 4\text{H}_2\text{O}$)
9. Distribution coefficient of iodine between water and carbon tetrachloride.
10. Construction of the phase diagram of a binary system (simple eutectic) using cooling curves.
11. Determination of the critical solution temperature (CST) and composition of the phenol water system.
12. Effect of added electrolytes on the miscibility temperature of phenol-water system.

Reference Books:

1. Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012.
2. Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009.
3. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996.
4. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry. Pearson Education (2009).
5. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co., New Delhi (2011).

Scheme of Valuation: (Max marks: 50)

- | | |
|---|----------------------------|
| 1. Internal Marks | ----- 10 marks |
| 2. Writing principle, formula/graph, etc. | ----- 5 marks |
| 3. Record | ----- 5 marks |
| 4. Viva-voce | ----- 5 marks |
| 5. Experiment (based on error % with theoretical value) ----- | 25 marks (see below) |
| Up to 2% error | ----- 25 marks |
| 2% to 3% | ----- 20 marks |
| 3% to 4% | ----- 15 marks |
| 4% to 5% | ----- 10 marks |
| More than 5% error or expt. is incomplete | ----- 5 marks (grace mark) |
- For calculation mistake: 2 marks to be deduced; For no calculation: 5 marks to be deduced.

II Year – Semester - III

DSC-IC: UCHM 231: PHYSICAL CHEMISTRY – I

3-1-0-3

Objective:

- To Study the Solid State and X-ray diffraction studies.
- To Study the Chemical Kinetics
- To Study the Catalysis, Adsorption and Photochemistry.
- To Study the Dilute Solutions and Colligative Properties.
- To Study the Phase Equilibrium.

UNIT – I SOLID STATE (12 Hours)

- (a) Definition of Space lattice , Unit cell , Laws of crystallography –
- (i) Law of constancy of interfacial angles
 - (ii) Law of rationality of indices
 - (iii) Law of symmetry, symmetry elements in crystals
- (b) X-ray diffraction by crystals -- Derivation of Bragg's equation. Determination of structures of NaCl, CsCl, KCl, (Laue's method and powder method).

UNIT-II CHEMICAL KINETICS (12 Hours)

Rate and specific reaction rate; Factors influencing the rate of reaction-concentration, temperature, pressure, catalyst, solvent and light; Order and Molecularity of reactions; Derivation of rate constants-zero, first and second order (with equal and unequal concentrations) reactions; Half-life period; Pseudo order reactions; Determination of order of reactions-differential method, method of integration and method of half-life period.

Effect of temperature on reaction rate; Arrhenius equation; Activation energy and its significance; Theory of reactions-Collision theory and Transition state theory.

UNIT-III CATALYSIS, ADSORPTION AND PHOTOCHEMISTRY (12 Hours)

(a) CATALYSIS

Catalyst and catalysis: Homogeneous and heterogeneous catalysis with examples; Acid-base catalysis with examples; Enzyme catalysis-general characteristics; Auto catalysis; Derivation of Michaelis-Menten constant. Theories of catalysis-intermediate compound formation theory and adsorption theory.

(b) ADSORPTION

Adsorption-physisorption and chemisorptions; Factors influencing adsorption; Adsorption Isotherms-Freundlich, Langmuir and BET theories. Application of adsorptions.

(c) PHOTOCHEMISTRY

Difference between thermal and photochemical reactions; Laws of photochemistry-Grothus-Draper and Stark-Einstein laws; Jablonski diagram; qualitative description of fluorescence and phosphorescence; Non-radiative processes –internal conversion and inter system crossing; Quantum yield.

UNIT-IV DILUTE SOLUTIONS AND COLLIGATIVE PROPERTIES (12 Hours)

Method of expressing concentrations of solutions; dilute solutions; colligative properties; Raoult's law; relative lowering of vapour pressure; Molecular weight determination; Law of osmotic pressure; determination molecular weight by osmotic pressure; elevation of boiling point and depression of freezing point; thermodynamic derivation of the relation between molecular weight and elevation of boiling point and the relation between molecular weight and depression of freezing point.

UNIT-V PHASE EQUILIBRIUM (12 Hours)

Definition of Phase, Component and Degrees of Freedom; Derivation of Gibb's phase rule; Phase equilibria of one component systems – H_2O , CO_2 and sulphur systems; Two component systems – Solid-Liquid equilibria- simple eutectic Bi-Cd and Pb-Ag systems; desilverisation of lead; Solid solutions-compound formation with congruent melting point (Mg-Zn) and incongruent melting point ($NaCl-H_2O$ and $CuSO_4-H_2O$) systems.

Liquid-liquid mixtures-ideal liquid mixtures; Raoult's and Hendry's law; non-ideal solutions; partially miscible liquids-phenol-water; trimethylamine-water and nicotin-water systems. Lower and upper consolute temperature. Effect of impurity on consolute temperature.

Azeotropes- $HCl-H_2O$ and ethanol-water systems.

Nernst distribution law-thermodynamic derivations and applications.

Text Books

1. S.H. Maron and J.B. Lando, *Fundamentals of Physical Chemistry*, Macmillan limited, New York, 1966.
2. B.R. Puri, L.R. Sharma and M.S. Pathania, *Principles of Physical Chemistry*, 46th Edition, Vishal Publishing Company, New Delhi, 2013.
3. Gurdeep Raj, *Advanced Physical Chemistry*, 35th Edition, Goel Publishing House, Meerut, 2009.
4. P.W. Atkins, *Physical Chemistry*, 7th edition, Oxford university press, 2001.
5. S.K. Dogra and S. Dogra, *Physical Chemistry Through Problems*, New age international, 4th edition 1996.

Reference Books

1. Gilbert. W. Castellan, *Physical Chemistry*, Narosa publishing house, third edition 1985.
2. Irving M. Klotz and Robert M. Rosenberg, *Chemical Thermodynamics*, John Wiley and sons, Inc. 1994.
3. J. Rajaram and J.C. Kuriacose, *Thermodynamics*, Shoban Lal Nagin Chand and CO. 1986.
4. K. L. Kapoor, *A Textbook of Physical chemistry*, (volume-2 and 3) Macmillan, India Ltd, 1994.
5. K. Laidler, *Chemical Kinetics*, 3rd Edition, Pearson Education, New Delhi, 2004.
6. K.K. Sharma and L.K. Sharma, *A Textbook of Physical Chemistry*, 5th Edition, Vikas Publishing House, New Delhi, 2012.
7. K.L. Kapoor, *Physical Chemistry Vol. 3&5*, Macmillan Publishers, Noida, 2004.
8. G.K. Vemula Palli, *Physical Chemistry*, Prentice Hall of India, New Delhi, 1997.

II Year – Semester - III

DSC-2C: UCHM 232: INORGANIC CHEMISTRY-I

3-1-0-3

Objective:

- To Study Nuclear Chemistry
- To Study the Principles of Qualitative Inorganic Analysis
- To Study the Theories of Acids, Bases & Non-aqueous solvents
- To Study the P-Block Elements

UNIT – I: NUCLEAR CHEMISTRY

(12 Hrs)

Nuclear forces- atomic mass unit- packing fraction – mass defect and binding energy of the nucleus. Stability of nuclei. Nuclear models- the liquid drop model. Nuclear reactions- nuclear fission- fission of uranium- nuclear reactors- types- importance of thorium in India's nuclear energy production. Nuclear fusion. Radio activity- natural radio activity- rate of radio activity disintegration – half life period- transmutation of elements- group displacement law- radio active decay series. Isotopes-separation of isotopes - applications of isotopes in analytical chemistry, medicine, and in reaction mechanism. Carbon dating. Neutron activation analysis. (12 Hrs)

UNIT-II: PRINCIPLES OF QUALITATIVE INORGANIC ANALYSIS (12 Hrs)

(a) Principles of solubility – solubility product – factors affecting solubility – temperature, solvent, common ion effect, effect of complex formation – Separation of metal ions based on solubility differences – sulphide separations. Applications of solubility product principle in qualitative and quantitative analysis. Standard semi micro procedure of identifying common anions and cations in a mixture containing two salts. Spot tests for common cations. Interfering radicals – reason for their interference and method of their removal.

(b) Techniques of separation and purification of mixtures -gravity and suction filtration – centrifugation- drying techniques-melting point and boiling point determinations.

UNIT-III: ACIDS, BASES & NON-AQUEOUS SOLVENTS (12 Hrs)

(a) Acids and Bases-Bronsted acids and bases: Lewis acids and bases: definitions, strengths, representative Lewis acids, heterogeneous acid-base reactions.

Hard & soft acids & bases (HSAB) : Classification, Pearson's HSAB concept, acid base strength & hardness and softness.

(b) Physical properties of a solvent, Types of solvents and their general characteristics. Reactions in non-aqueous solvents with reference to liquid NH_3 and liquid SO_2 , THF and Dioxan.

UNIT-IV: P-BLOCK ELEMENTS –I (Boron, Carbon and Nitrogen group) (12 Hrs)

(a) General characteristics of Boron group elements - Diagonal relationship between B and Si. Hydrides of Boron – preparation, properties and structure of Diborane. Boron Nitride, Borazine, Sodium Borohydride and Lithium Aluminium hydride, Boric acid

(b) General characteristics of carbon group elements – Allotropy of carbon, structure of Diamond and Graphite, catenation, fullerenes. Fluorochlorocarbons, silicates and carbides.

c) General characteristics of Nitrogen group elements. Allotropy of phosphorus, oxides (N_2O , NO_2 , N_2O_3 , N_2O_5 , P_2O_3 , P_2O_5) and Acids of Nitrogen (HNO_2 , HNO_3) & Phosphorus (H_3PO_3 , H_3PO_4 , $\text{H}_4\text{P}_2\text{O}_7$). Preparation and Structure and uses of Hydrazine, Hydrazoic acid and Hydroxylamine.

UNIT-IV: P-BLOCK ELEMENTS –II (Oxygen, Halogens and noble gases group)

(12 Hrs)

(a) General characteristics of Oxygen group. Allotropy of sulphur - oxides, halides, oxyhalides of sulphur. Oxyacids (H_2SO_4 , H_2SO_3 , $\text{H}_2\text{S}_2\text{O}_7$) of sulphur. Persulphuric acids, Dithionic and Thiosulphuric acid (structure, preparation and properties).

(b) General characteristics of halogen group elements, Oxides and oxoacids of halogens, Relative strength of oxo acids of the halogens, inter halogen compounds, Pseudo halogens, Electro positive character of iodine.

c) Chemistry of noble gases:- Position in the periodic table. Occurrence- isolation and separation of noble gases from atmosphere. Physical properties of noble gases, fluorides- oxyfluorides and oxides of xenon (preparation, properties and structure). Applications of noble gases.

Reference Books:

1. Cotton, F.A., Wilkinson, G. & Gaus, P.L. Basic Inorganic Chemistry, 3rd Ed., Wiley.
2. Douglas, B.E., McDaniel, D.H. & Alexander, J.J. Concepts and Models in Inorganic Chemistry, John Wiley & Sons.
3. Puri B.R., Sharma L.R. and Kalia K.C. Principles of Inorganic Chemistry, Milestone

4. Huheey, J.E., Keiter, E.A., Keiter, R. L., Medhi, O.K. Inorganic Chemistry, Principles of Structure and Reactivity, Pearson Education 2006.
5. Lee, J.D. Concise Inorganic Chemistry, John Wiley & Sons.
6. HariJeevanArnikar, Essentials of Nuclear Chemistry, Revised 4th Ed., New Age International Publishing, 1995.
7. Rodgers, G.E. Inorganic & Solid State Chemistry, Cengage Learning India Ltd., 2008. Miessler, G. L. & Donald, A. Tarr. Inorganic Chemistry 4th Ed., Pearson, 2010.
8. Atkin, P. Shriver & Atkins' Inorganic Chemistry 5th Ed. Oxford University Press (2010).

DSC-4C: UCHM 236: PHYSICAL AND INORGANIC CHEMISTRY PRACTICAL

(60 Lectures)

0-1-4-2

A. Physical Chemistry

Surface tension and Viscosity measurements (use of organic solvents excluded).

1. Determination of the surface tension of the given liquid or dilute solution using a stalagmometer.
2. Determination of the viscosity of the given liquid or dilute solution using an Ostwald's viscometer.
3. Determination of m.pt of the given compound using water bath (m.pt.< 100° C)

B. Inorganic Chemistry

Systematic semi-micro qualitative analysis of mixtures - not more than four ionic species (two anions and two cations, excluding insoluble salts) out of which one anion being an interfering radical:

Cations: Lead, antimony, arsenic, tin, bismuth, cadmium, copper, aluminium, chromium, iron, manganese, zinc, nickel, cobalt, calcium, strontium, barium, magnesium, potassium and ammonium.

Anions: Carbonate, sulphide, chloride, bromide, iodide, sulphate, nitrate, phosphate, borate, oxalate, acetate and fluoride.

(using H₂S or other methods. Spot tests should be carried out wherever feasible).

(Combination of mixtures forming insoluble salts should be avoided)

Reference Books:

Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012.

J. Mendham, R.C. Denney, J. D. Barnes, M.J.K. Thomas, Vogel's Quantitative Chemical Analysis, Pearson, 2009.

Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011)

Scheme of Valuation: (Max marks: 50)

- | | | |
|--|-------|----------|
| 1. Internal Marks | ----- | 10 marks |
| 2. Record (containing both A & B) | ----- | 10 marks |
| 3. Any one Physical Chemistry Experiment | ----- | 5 marks |
| 4. Inorganic Qualitative Analysis | ----- | 25 marks |

II – Year – Semester - III

SEC-1: UCHM234: IT SKILLS FOR CHEMISTS

(30 Lectures)

1-1-0-2

Objectives:

- To introduce the basics of computers.
- To learn C language and its applications in solving problems in Chemistry.

Unit-I

Introduction: Basic computer organization, processor and memory – main memory, secondary storage devices and storage hierarchy. Software – relationship between hardware and software – types of software. Planning the computer program – algorithm and flowcharts. Basics of operating systems.

Unit-II

Computer languages – machine language, assembly language, assembler, compiler, interpreter and programming languages - C language – introduction, C compiler, operating systems and preprocessor directives - variables, constants, operators, input and output functions.

Unit-III

Control structures – conditional, looping, goto, break, switch and continue statements, functions, arrays and pointers.

Unit-IV

Applications in Chemistry-I – calculation of the radius of the first Bohr orbit for an electron, calculation of half-life time for an integral order reaction, calculation of molarity, molality and normality of a solution, calculation of pressure of ideal or Vanderwaal's gas, Calculation of electronegativity of an element using Pauling's relation.

Unit-V

Applications in Chemistry-II - Calculation of empirical formulae of hydro carbon, calculation of reduced mass of a few diatomic molecules, determination of the wave numbers of spectral lines of hydrogen atom, calculation of work of expansion in adiabatic process, calculation of pH, solubility product and bond energy using Born - Lande equation, calculation of standard deviation and correlation coefficient.

PRACTICALS (FOR INTERNAL ASSESSMENT ONLY):

Learning activities and evaluation of skills in using the following:

- Computer software and data logging equipment in chemistry.
- Portable ICT devices for modelling and simulation
- Worksheet, spreadsheet, database templates and graph drawing software
- Web-based resources: for interacting with appropriate teaching and learning chemistry
- Learning chemistry materials on CD-ROMs, websites and interactive multi-media display boards

Students will perform four to five experiments based on topics that are covered in the Units IV and V.

SCHEME OF EXAMINATION:

External Theory Examination	-----	40 marks (to be conducted by University with time duration of 2 Hrs.)
Internal Practical Assessment	-----	10 marks (to be provided by the teacher as CIA, based on the performance of students in acquiring the skills)

Reference Books:

1. K.V. Raman, Computers in Chemistry, 8th Edition, Tata McGraw Hill, 2005.
2. Venugopal and Prasad, Programming with C, 11th Edition, 1971.
3. Balaguruswamy, Programming in C, 2nd Edition, 1989.

II – Year – Semester - III

SEC-1: UCHM235: BASIC ANALYTICAL CHEMISTRY

(30 Lectures)

1-1-0-2

UNIT-I

(10 Hrs)

(A) Laboratory Glassware:

- Types, maintenance and cleaning.
- Calibration of burette, pipette and standard flask; practice of inter-calibration.
- Laboratory first aids.

(B) Stoichiometry and concentration systems:

Stoichiometry – Mole and equivalent concepts – Stoichiometric calculations - concentration systems – Molarity – Normality – p-functions – percent concentration – ppm and ppb - calculations involving various types of concentration systems.

UNIT-II

(10 Hrs)

Principles of Titrimetric (Volumetric) Analysis:

- Definition of the terms primary standard and secondary standard solutions — Equivalence point and end point of titrations, — Types of titrations — Calculations involving volumetric titrations.
- Acid - Base Titrations : Derivation of titration curves for strong acid Vs strong base and weak acid Vs strong base titrations — Theory of acid-base indicators.
- Redox Titrations : Nernst equation — Theory of redox indicators — Types of redox indicators.
- Complex Formation Titrations: Chelating agents – EDTA- Theory of metallochromic indicators – Titrations involving EDTA – Types of EDTA titrations.
- Precipitation Titrations: Argentometric titrations – indicators for titrations involving silver nitrate.

UNIT-III

(10 Hrs)

Statistical Evaluation of Analytical Data :

Mean, median and mode – Accuracy and precision – ways of expressing accuracy and precision and their calculation – Errors – types – determinate, indeterminate and gross errors – minimization of errors – methods of reporting data – significant figures and problems involving significant figures – Statistical treatment of indeterminate errors – confidence limits – criteria for rejection of outliers – Q-test graphing – the least squares principle – linear regression of data.

PRACTICALS (FOR INTERNAL ASSESSMENT ONLY):

1. Calibration of pipette, burette and standard flask
2. Inter-calibration of pipette and standard flask
3. Preparation of primary and secondary standard solutions.
4. Illustration of rejection of outlying data.
5. Illustration of drawing linear regression line (line of best fit).

SCHEME OF EXAMINATION:

External Theory Examination	-----	40 marks (to be conducted by University with time duration of 2 Hrs.)
Internal Practical Assessment	-----	10 marks (to be provided by the teacher as CIA, based on the performance of students in acquiring the above skills)

Reference Books:

- R. Gopalan and others, Elements of Analytical Chemistry, Sultan chand & Co.
- Dr. Alka Gupta, Analytical Chemistry, Pragati Prakashan
- Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. Instrumental Methods of Analysis. 7th Ed. Wadsworth Publishing Co. Ltd., Belmont, California, USA, 1988.
- Skoog, D.A.; West, D.M. & Holler, F.J. Fundamentals of Analytical Chemistry 6th Ed., Saunders College Publishing, Fort Worth (1992).
- Harris, D. C. Quantitative Chemical Analysis, W. H. Freeman.
- Dean, J. A. Analytical Chemistry Notebook, McGraw Hill.
- Day, R. A. & Underwood, A. L. Quantitative Analysis, Prentice Hall of India.
- Vogel, A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Prentice Hall.

II – Year – Semester - III

SEC-1:UCHM237: CHEMICAL TECHNOLOGY & SOCIETY

(30 Lectures)

1-1-0-2

Chemical Technology:

Basic principles of distillation, solvent extraction, solid-liquid leaching and liquid-liquid extraction, separation by absorption and adsorption. An introduction into the scope of different types of equipment needed in chemical technology, including reactors, distillation columns, extruders, pumps, mills, emulgators. Scaling up operations in chemical industry. Introduction to clean technology.

Chemistry in Nanotechnology Breakthroughs, Chemistry in Computing, Chemistry in Transportation, and Chemistry in the Space Age.

Policies to Enable Innovations in Technology – updating primary chemicals management law to adapt to scientific advancements and to promote that “chemical products are safe for intended use”, while also encouraging innovation.

Society:

Exploration of societal and technological issues from a chemical perspective. Chemical and scientific literacy as a means to better understand topics like air and water (and the trace materials found in them that are referred to as pollutants); energy from natural sources (i.e. solar and renewable forms), from fossil fuels and from nuclear fission; materials like plastics and polymers and their natural analogues, proteins and nucleic acids, and molecular reactivity and interconversions from simple examples like combustion to complex instances like genetic engineering and the manufacture of drugs.

The innovative products of chemistry lead to cutting edge advancements - applied technology in medical devices, aerospace, computing, cars, fuels etc. - technological advancements that drive innovation, create jobs and enhance safety in our everyday lives.

Communicating costs and benefits of the chemical industry and chemical technology to society – Risk communication.

PRACTICALS (FOR INTERNAL ASSESSMENT ONLY):

1. Determination of Total Suspended Particulates (TSPs) in ambient air.
2. Medicinal compounds extraction using solvent extraction, solid-liquid leaching and liquid-liquid extraction.
3. Adulteration checking in food items.

SCHEME OF EXAMINATION:

External Theory Examination	-----	40 marks (to be conducted by University with time duration of 2 Hrs.)
Internal Practical Assessment	-----	10 marks (to be provided by the teacher as CIA, based on the performance of students in acquiring the above skills)

References:

- John W. Hill, Terry W. McCreary & Doris K. Kolb, Chemistry for changing times 13th Ed.
- <https://www.acs.org/content/acs/en/education.html>

II Year - Semester - IV

DSC-1D- UCHM 241: Physical Chemistry-II

(60 Lectures)

3-1-0-3

Objective:

- To Study the Electrochemistry
- To Study the Elementary Quantum Mechanics
- To Study the molecular spectroscopic methods: microwave, IR, Raman and electronic spectroscopy.
- To Study the physical properties and molecular structure.

UNIT-I ELECTROCHEMISTRY-I

(12 Hours)

Electrical transport-conduction in metals and in electrolyte solutions; specific conductance; equivalent conductance; measurement of equivalent conductance; variation of equivalent conductance with dilution; migration of ions and Kohlrausch law; Ostwald dilution law-uses and limitations; Debye-Huckel-Onsager equation for strong electrolytes (derivation not required).

Transport number; determination by Hittorf method and moving boundary method; determination of degree of dissociation; determination of K_a of acids; determination of solubility product of sparingly soluble salts; conductometric titrations.

UNIT-II ELECTROCHEMISTRY-II

(12 Hours)

Types of reversible electrodes- Gas-metal ion, metal-metal ion, metal-insoluble salt and redox electrodes. Electrode reactions; Nernst equation; derivation of cell E.M.F and single electrode potential; sign conventions; electrochemical series and its significance.

Reversible and irreversible cells; conventional representation of electrochemical cells; E.M.F of cell and its measurements; computation of cell E.M.F.; calculation of thermodynamic quantities of cell reactions (ΔG , ΔH and ΔK); concentration cells with and without transport; liquid junction potential; applications of concentration cells.

Definition of pH and pK_a ; determination of pH by using hydrogen, quinhydrone and glass electrodes by potentiometric method; potentiometric titrations.

Buffers; mechanism of buffer action; Hendersen-Hazel equation; hydrolysis of salts.

UNIT-III ELEMENTARY QUANTUM MECHANICS (12 Hours)

Black body radiation; Plank's radiation law; photoelectric effect; Compton effect; De Broglie hypothesis; Heisenberg's uncertainty principle; Sinusoidal wave equation; Radial and angular wave functions; Probability distribution curves; Hamiltonian operator; Schrodinger wave equation and its significance; physical interpretation of wave function; postulates of quantum mechanics; particle in one dimensional box.

UNIT-IV MOLECULAR SPECTROSCOPY-I (12 Hours)

(a) MICROWAVE SPECTROSCOPY

Electromagnetic radiation; Regions of the spectrum; Diatomic molecules; selection rules; energy levels of rigid rotor (semi-classical principles); spectral intensity; distribution using population distribution (Maxwell-Boltzmann distribution); determination of bond length; isotope effect.

(b) INFRARED SPECTROSCOPY

Infrared spectrum; selection rules; energy levels of simple harmonic oscillator; pure vibrational spectrum; intensity; force constant and its determination; qualitative relation between force constant and bond energy; effect of anharmonic motion and isotope on the infrared frequency; vibrational frequencies of different functional groups.

UNIT-V MOLECULAR SPECTROSCOPY-II (12 Hours)

(a) RAMAN SPECTROSCOPY

Concept of polarisability; selection rules; pure rotational and pure vibrational Raman spectra of diatomic molecules; classical theory of rotational and vibrational Raman spectroscopy, complementarities of Raman and IR spectroscopy, mutual exclusion principle, polarized and depolarized Raman lines.

(b) ELECTRONIC SPECTROSCOPY

Concept of potential energy curves for bonding and antibonding molecular orbitals; qualitative description of selection rules; Frank-Condon principle; predissociation; qualitative description of σ , π and n molecular orbitals and their energy levels; types of electronic transitions.

(c) PHYSICAL PROPERTIES AND MOLECULAR STRUCTURE

Optical activity and polarization (Clausius-Mossotti equation); dipole moment; induced dipole moment; measurement of dipole moment – temperature and refractivity methods;

dipole moment and structure of molecules. Magnetic properties-paramagnetism, diamagnetism and ferromagnetism.

Text Books

1. Principles of Physical Chemistry - B.R. Puri and Sharma - Shobanlal Nagin Chand & Co.,
2. P.L. Soni, O.P. Dharmarha and U.N. Dash, Textbook of Physical Chemistry, 23rd Edition, Sultan Chand & Sons, New Delhi, 2011.
3. Physical Chemistry - Negi and Anand – Eastern Wiley Pvt.Ltd..
4. Physical Chemistry - Kundu and Jain - S. Chand & Co.
5. Physical Chemistry - K.L Kapoor - Macmillan - 4 volumes
6. Elements of Physical Chemistry - Glasstone and Lewis - Macmillan.
7. C.N. Banwell and E.M. McCash, Fundamentals of Molecular Spectroscopy, 4th Edition, McGraw–Hill Publishing Company Limited, New Delhi, 2002.
8. Gurudeep R. Chatwal and Sham K. Anand, Spectroscopy: Atomic and Molecular, 5th Edition, Himalaya Publishing House, New Delhi, 2013.

Reference Books:

1. Text book of Physical Chemistry - S. Glasstone- Macmillan (India) Ltd.
2. S. Glasstone, *An Introduction to Electrochemistry*, East-West Press Pvt. Ltd., New Delhi, 2007.
3. Fundamentals of Physical Chemistry - Maron and Landor - Colier - Macmillan.
4. Physical Chemistry - G.W. Castellan - Narosa publishing house.
5. Physical Chemistry - Walter J. Moore - Orient Longman.
6. Elements of Analytical Chemistry - R. Gopalan, P.S. Subramanian, K. Rengarajan - S. Chand and sons (1997).
7. Principles of Instrumental Methods of Analysis - D.A Skoog and Saunders - College publications - III edition (1985).
8. Instrumental Methods of Chemical Analysis – B.K. Sharma - Goel Publications.

II Year - Semester - IV

DSC-2D: UCHM 242: Organic Chemistry – I

(60 Lectures)

4-1-0-4

Objective:

- To Study about the Alkyl and Aryl Halides
- To Study about the Alcohols and Phenols
- To Study about the Carbonyl Compounds
- To Study about the Organic Compounds of Nitrogen
- To Study about the Heterocyclics

Unit-I: Alkyl and Aryl Halides

(12Hrs)

Alkyl halides: Preparation from alkenes and alcohols. Reactions - hydrolysis, nitrite & nitro formation, nitrile and isonitrile formation, Williamson's synthesis, Elimination vs Substitution

Aryl halides: Preparation of chloro-, bromo- and iodo-benzenes from phenol, Sandmeyer and Gattermann reactions. Reactions of aryl halides: Aromatic nucleophilic substitution (replacement by -OH group and effect of nitro substituent. Benzyne mechanism: $K(Na)NH_2/NH_3$).

Reactivity and relative strength of Carbon-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides.

Unit-II: Alcohols and Phenols

(12 Hrs)

Alcohols: Preparation of primary, secondary and tertiary alcohols using Grignard reagent, ester hydrolysis, reduction of aldehydes, ketones, carboxylic acids and esters. Reactions with sodium, HX (Lucas Test), esterification, oxidation (with PCC, alk. $KMnO_4$, acidic dichromate, Con. HNO_3). Oxidation of diols - Pinacol-Pinacolone rearrangement.

Phenols: Preparation by cumene hydroperoxide method, from diazonium salts. Reactions - Electrophilic substitution - nitration, halogenations and sulphonation. Reier-Tiemann reaction, Gattermann-Koch reaction, Houben- Hoesch condensation, Schotten Baumann reaction. Acidic character of phenol, comparative strength of alcohol and phenol.

Unit-III: Carbonyl Compounds

(12 Hrs)

Structural significance of the carbonyl function and nomenclature.

Aldehydes and ketones: Formaldehyde, acetaldehyde, acetone and benzaldehyde - preparation from acid chlorides & from nitriles. Reactions: reaction with HCN, ROH, $NaHSO_3$, amino derivatives. Iodoform test, aldol condensation, Cannizzaro's reaction, Wittig reaction, Benzoin condensation, Clemmensen Reduction and Wolff Kishner reduction. Meerwein-Ponndorf-Verley reduction.

Carboxylic acids & their derivatives: Preparation of formic, acetic and benzoic acids. Reactions: Hell-Volhard-Zelinsky reaction, synthetic applications of diethyl malonate &

ethyl acetoacetate. Preparation of acid chlorides, anhydrides, esters and amides from acids and their interconversion. Reactions: comparative study of the nucleophilicity of acyl derivatives. Reformatsky Reaction, Perkin condensation.

Unit-IV: Organic Compounds of Nitrogen

(12 Hrs)

Nitro compounds: Preparation of nitroalkanes and nitroarenes. Reduction of nitrobenzene under various conditions, nitro-acinitro tautomerism.

Amines (aliphatic and aromatic): Classification, preparation from alkyl halides, Gabriel-Phthalimide synthesis, Hofmann bromamide reaction. Hofmann and Saytzeff elimination, Carbylamine test, Hinsberg test, with HNO₂, Schotten-Baumann reaction, Electrophilic substitution in aniline: nitration, bromination and sulphonation.

Diazonium salts: Preparation from aromatic amines. Conversion to benzene, phenol and azodyes.

Unit-V: Heterocyclics

(12 Hrs)

Molecular Orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine. Methods of synthesis and chemical reactions with emphasis on the mechanism of electrophilic substitution reaction, mechanism of nucleophilic substitution reactions in pyridine derivatives. Comparison of basicity of pyridine, piperidine and pyrrole. Introduction to condensed five- and six-membered heterocyclics. Preparation and reaction of indole, quinoline and isoquinoline with special reference to Bisler-Napieralski synthesis. Mechanism of electrophilic substitution reactions of indole, quinoline and isoquinoline.

Reference Books:

- Kotz, J.C., Treichel, P.M. & Townsend, J.R. General Chemistry, Cengage Learning India Pvt. Ltd.: New Delhi (2009).
- Petrucci, R.H. General Chemistry, 5th Ed., Macmillan Publishing Co.: New York (1985).
- Morrison, R. T. & 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), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Nelson, D. L. & Cox, M. M. Lehninger's Principles of Biochemistry 7th Ed., W. H. Freeman.
- Berg, J.M., Tymoczko, J.L. & Stryer, L. Biochemistry, W.H. Freeman, 2002.
- R.T. Morrison & R.N. Boyd: Organic Chemistry, Prentice Hall.
- Peter Sykes: A Guide Book to Mechanism in Organic Chemistry, Orient Longman.
- ArunBahl and B. S. Bahl: Advanced Organic Chemistry, S. Chand.

DSC- 4D: UCHM 246: PHYSICAL & ORGANIC CHEMISTRY PRACTICAL

(60 Lectures)

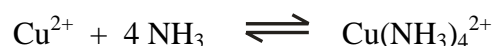
0-1-4-2

A. PHYSICAL CHEMISTRY

1. Determination of rate constant of acid catalysed hydrolysis of esters at room temperature.
2. Kinetics of persulphate oxidation.
3. Determination of standard potential of Zn^{2+}/Zn ; Cu^{2+}/Cu ; Ag^+/Ag electrodes
4. Determination of the equilibrium constant for the equilibrium



(or)



using amyl alcohol as solvent and methyl red as indicator.

5. Determination of pH using quinhydrone electrode
6. Determination of solubility and solubility product using e.m.f measurement.
7. Estimation of chromate in a solution by spectrophotometry – Verification of Beer-Lambert's Law.

B. ORGANIC CHEMISTRY:

Separation of any one of the following mixtures:

Naphthalene & Benzoic acid

Benzoic acid & Glucose

Naphthalene & Glucose

Reference Books:

1. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).
2. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. and Smith, P.W.G., Vogel's Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996.
3. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman, 1960.
4. Manual of Biochemistry Workshop, 2012, Department of Chemistry, University of Delhi.

Scheme of Valuation: (Max marks: 50)

1. Internal Marks	-----	10 marks
2. Record (containing both A & B)	-----	10 marks
3. Physical Chemistry Experiment	-----	20 marks
4. Organic Separation	-----	10 marks

III – Year – Semester -IV

SEC-2:UCHM244: ANALYTICAL AND CLINICAL BIOCHEMISTRY

(30 Lectures)

1-1-0-2

UNIT-I

(10 Hrs)

Biological Chemistry-I:

Elementary treatment of digestion and absorption of carbohydrates, proteins and fats:

Carbohydrates: Biological importance of carbohydrates, Metabolism, Cellular currency of energy (ATP), Glycolysis, Alcoholic and Lactic acid fermentations, Krebs cycle.

Proteins: Aminoacids, peptides and proteins: classification of proteins: Digestion and absorption of proteins, Formation of Urea, Transamination, Deamination, Plasma Protein, Lipotropic factors.

Lipids: Definition, Classification, Importance, General Lipid Metabolism, Digestion and Absorption of Fat, Oxidation of Fatty acids, Ketosis, Lipoprotein metabolism classification of lipoprotein, Biological importance of triglycerides and phosphoglycerides and cholesterol.

UNIT-2

(10 Hrs)

Biological Chemistry-II:

Enzymes: Elementary treatment of enzymes, cofactors, prosthetic groups and theory of enzyme action. Nomenclature, classification, effect of pH, temperature on enzyme activity, enzyme inhibition.

Hormones: Introduction, General Mechanism of actions - Physiological functions of adrenaline, thyroxin, oxytocin, insulin and sex hormones.

Micronutrients and their biological role in human systems. Iron Metabolism - General consideration of Importance of sodium, potassium, calcium, magnesium, chloride and fluoride - Vitamins: General consideration, clinical importance. Definition of Health, WHO standard - Balanced diet.

UNIT-3

Biochemical Analysis:

(10 Hrs)

Principle of estimation and diagnostic approach by blood and urine analysis:

Blood: Composition, grouping and Rh factor - collection and preservation of samples. Anaemia, Regulation, estimation and interpretation of data for blood sugar, urea, creatinine, cholesterol and bilirubin. significance of HDL and LDL - Important lipid profile tests.

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

Normal and abnormal values of clinical chemistry in relation to human diseases – General consideration and interpretations.

PRACTICALS / FIELD VISIT (FOR INTERNAL ASSESSMENT ONLY):

Students to be taken in small groups to a nearby hospital or clinical laboratory in order to gain a first-hand practical knowledge of the tests they study in this paper and submit a report.

SCHEME OF EXAMINATION:

External Theory Examination	-----	40 marks (to be conducted by University with time duration of 2 Hrs.)
Internal Practical Assessment	-----	10 marks (to be provided by the teacher as CIA, based on the above report submitted by the student)

Reference Books:

- T.G. Cooper: Tool of Biochemistry.
- Keith Wilson and John Walker: Practical Biochemistry.
- Alan H Gowenlock: Varley's Practical Clinical Biochemistry.
- Thomas M. Devlin: Textbook of Biochemistry.
- Berg, J.M., Tymoczko, J.L. & Stryer, L. Biochemistry, W.H. Freeman, 2002.
- Talwar, G.P. & Srivastava, M. Textbook of Biochemistry and Human Biology, 3rd Ed. PHI Learning.
- Nelson, D. L. & Cox, M. M. Lehninger's Principles of Biochemistry 7th Ed.,
W. H. Freeman.
- Mikes, O. Laboratory Hand Book of Chromatographic & Allied Methods, Elles Harwood Series on Analytical Chemistry, John Wiley & Sons, 1979.

II – Year – Semester – IV

SEC-2:UCHM245: CHEMOINFORMATICS

(30 Lectures)

1-1-0-2

Introduction to Chemo informatics: History and evolution of chemoinformatics, Use of chemoinformatics, Prospects of chemoinformatics, Molecular Modelling and Structure elucidation.

Representation of molecules and chemical reactions: Nomenclature, Different types of notations, SMILES coding, Matrix representations, Structure of Molfiles and Sdfiles, Libraries and toolkits, Different electronic effects, Reaction classification.

Searching chemical structures: 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.

Applications: 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, 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.

PRACTICALS (FOR INTERNAL ASSESSMENT ONLY):

1. SMILES coding, Matrix representations, Structure of Molfiles and Sdfiles for simple organic molecules
2. 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 of simple molecules.
3. Prediction of NMR, IR and Mass spectra of simple compounds
4. Ligand-Based and Structure-Based Drug design: Understanding medicinal properties of commercially available drugs.

SCHEME OF EXAMINATION:

External Theory Examination	-----	40 marks (to be conducted by University with time duration of 2 Hrs.)
Internal Practical Assessment	-----	10 marks (to be provided by the teacher as CIA, based on the performance of students in acquiring the above skills)

Hands-on Exercises Reference Books:

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

II – Year – Semester - IV

SEC-2:UCHM247: BUSINESS SKILLS FOR CHEMISTS

(30 Lectures)

1-1-0-2

Chemical knowledge/ skills: Safe handling of chemical materials, Skills with chemical instrumentation.

Generic skills: Planning and design of experiments, Report writing skills, Oral presentation skills, Information retrieval skills

Problem solving skills: Team working skills, Time management and organisational skills, Independent learning ability required for continuing professional development

Business Basics:

Key business concepts: Business plans, market need, project management and routes to market.

Chemistry in Industry

Current challenges and opportunities for the chemistry-using industries, role of chemistry in India and global economies.

Making money: Financial aspects of business with case studies

Intellectual property: Concept of intellectual property, patents.

PRACTICALS / CASE STUDY (FOR INTERNAL ASSESSMENT ONLY):

1. SWOT analysis of any chemical industry
2. Finance Case Study for a industry
3. How to Set up a Site Visit: Taking suitable example
4. How to prepare a Business Plan: Taking suitable example

(Department of Chemistry can take help of BBA/MBA dept for this course)

SCHEME OF EXAMINATION:

External Theory Examination	-----	40 marks (to be conducted by University with time duration of 2 Hrs.)
Internal Practical Assessment	-----	10 marks (to be provided by the teacher as CIA, based on the performance of students in any one of the above listed activities)

Reference:

- www.rsc.org
- <http://www.rsc.org/learn-chemistry/resources/business-skills-for-chemists>
- <http://www.rsc.org/learn-chemistry/resources/business-skills-and-commercial-awareness-for-chemists>
- <http://www.rsc.org/learn-chemistry/resources/business-skills-for-chemists/Tutors/ITBC/downloads.php>