SEMESTER – I

MIC-1 (T) : Inorganic Chemistry Atomic Structure and Chemical Bonding and Fundamentals of organic Chemistry

Course Objective

The Objective of CBCS based four year undergraduate Programme (FYUGP) in Chemistry Hons for Semester I & II, Specially for Major & Minor course is to provide the clear conception and understanding about theory and practical course mentioned in the syllabus.

MIC-1 (T) : Inorganic Chemistry Atomic Structure and Chemical Bonding (Theory: 2 credits)		
Unit	**Topics to be covered**	**No. of Lectures**
1	**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.* Significance of quantum numbers, orbital angular momentum and quantum numbers m_l and m_s. Shapes of *s*, *p* and *d* atomic orbitals, nodal planes. Discovery of spin, spin quantum number (*s*) and magnetic spin quantum number (m_s). Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configuration, Hund's, Pauli's and Aufbau's principle.	06
2	**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 suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements. Concept of resonance and resonating structures in various inorganic and organic compounds.	06
	***Section B: Organic Chemistry-1* (30 Periods)**	
3	**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.	04
4	**Stereochemistry** Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (upto 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).	04
	TOTAL	20

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Suggested Readings :

1. Advanced Inorganic Chemistry, F.A. Cotton, G. Wilkinson.
2. Concise Inorganic Chemistry, J.D. Lee, Blackwell Science, 2001.
3. Inorganic Chemistry, J.E. Huheey, E.A. Keiter and R.I. Keiter, Pearson Education Asia, 2000.
4. Inorganic Chemistry, ELBS 2nd Edition, D.F. Shriver, P.W. Atkins and C.H. Langford. Oxford University Press 2002.
5. Principles of Inorganic Chemistry. B.R. Puri, L.R. Sharma, Jauhar S.P., S.N. Chand & Co.
6. Inorganic Chemistry, 3rd Edition (ISE) A.G. Sharpe Addison Wesley.

Reference Books:

7. □ J. D. Lee: *A new Concise Inorganic Chemistry*, E L. B. S.
8. □ F. A. Cotton & G. Wilkinson: *Basic Inorganic Chemistry*, John Wiley.
9. □ Douglas, McDaniel and Alexader: *Concepts and Models in Inorganic Chemistry*,
10. John Wiley.
11. □ James E. Huheey, *Ellen Keiter and Richard Keiter: Inorganic Chemistry: Principles*
12. *of Structure and Reactivity*, Pearson Publication.
13. □ T. W. Graham Solomon: *Organic Chemistry, John Wiley and Sons.*
14. □ Peter Sykes: *A Guide Book to Mechanism in Organic Chemistry,* Orient Longman.
15. □ E. L. Eliel: *Stereochemistry of Carbon Compounds*, Tata McGraw Hill.
16. □ I. L. Finar: *Organic Chemistry* (Vol. I & II), E. L. B. S.
17. □ R. T. Morrison & R. N. Boyd: *Organic Chemistry*, Prentice Hall.
18. □ Arun Bahl and B. S. Bahl: *Advanced Organic Chemistry,* S. Chand

MIC-1(P): Inorganic and Organic Chemistry Lab

(Practical : 1 Credit)

Practical- 1. Inorganic Chemisry Practical

a. Preparation and standardization of solutions.
b. Permangnatometry / dichromatry.
c. Acidimetry / Alkalimetry.

Practical- 2. Organic Chemisry Practical

Organic Practical : Detection of elements, separation and purification of Organic Compounds.

Suggested Readings :

1. Practical inorganic chemistry : Shikha Gulati and J. L . Sharma
2. Practical Chemistry : Dr O .P. Pandey , D.N. Bajpayi& ,Giri.
3. Quantitative Chemical analaysis: A.I. Vogel, Prentice Hall Publication.
4. Text book of practical Organic Chemistry: A.I. Vogal, Prentice Hall Publication.
5. Practical Organic Chemistry, F.G. Mann & B.C. Saunders,Orient long man.

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SEMESTER – II

MIC-2 (T) : Inorganic Chemistry Atomic Structure, Chemical Bonding and Fundamental of organic Chemistry

Course Objective

The Objective of CBCS based four year undergraduate Programme (FYUGP) in Chemistry Hons for Semester I & II, Specially for Major & Minor course is to provide the clear conception and understanding about theory and practical course mentioned in the syllabus.

MIC-2 : Inorganic Chemistry I Atomic Structure and Chemical Bonding

(Theory: 2 credits)

Unit	Topics to be covered	No. of Lectures
1	**Atomic Structure:** What is 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 hydogenic wavefunctions (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.	04
2	**Chemical Bonding and Molecular Structure** MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for *s-s*, *s-p* and *p-p* combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1^{st} and 2^{nd} periods (including idea of *s-p* mixing) and heteronuclear diatomic molecules such as CO, NO and NO^+. Comparison of VB and MO approaches.	04
	Organic Chemistry	
3	**Aliphatic Hydrocarbons** Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure. **Alkanes:** (Upto 5 Carbons). *Preparation:* Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. *Reactions:* Free radical Substitution: Halogenation. **Alkenes:** (Upto 5 Carbons) *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 (alk. KMnO4) and trans-addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition), Hydration, Ozonolysis, oxymercuration-demercuration, Hydroboration-oxidation. **Alkynes**: (Upto 5 Carbons) *Preparation:* 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 alk. $KMnO_4$	06

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4	**Gaseous state:** Kinetic molecular model of a gas postulates and concept of an Ideal gas, Derivation of the kinetic gas equation and various gas laws; Maxwell's Distribution of Molecular velocities and its use in evaluating different types of molecular velocities – Most Probable Velocity, Average (Mean) Velocity, Root Mean Square (RMS) Velocity, and Average kinetic energy; Relationship between various molecular velocities; Law of equipartition of energy, degrees of freedom and molecular basis of heat capacities. Viscosity of gases, co-efficient of viscosity and its dependence on temperature and pressure; Collision frequency, Collision diameter and Mean free path; Relationship between mean free path (λ) and co-efficient of viscosity (η), Calculation of collision diameter (σ) from co-efficient of viscosity (η). Behaviour of real gases: Deviations form ideal gas behavior, compressibility factor Z, and its variation with pressure for different gases; Causes of deviation from ideal behaviour. Equation of states for real gases; Van der Waals equation of state, its derivation and application in explaining real gas behaviour, Virial coefficients, calculation of Boyle temperature; Isotherms of real gases and their comparison with van der Waals isotherms, continuity of states, critical state & critical constants, relation between critical constants and van der Waals constants, law of corresponding states.	06
	TOTAL	20

Suggested Readings :

1. Advanced Inorganic Chemistry, F.A. Cotton, G. Wilkinson.
2. Concise Inorganic Chemistry, J.D. Lee, Blackwell Science, 2001.
3. Inorganic Chemistry, J.E. Huheey, E.A. Keiter and R.I. Keiter, Pearson Education Asia, 2000.
4. Inorganic Chemistry, ELBS 2nd Edition, D.F. Shriver, P.W. Atkins and C.H. Langford. Oxford University Press 2002.
5. Principles of Inorganic Chemistry. B.R. Puri, L.R. Sharma, Jauhar S.P., S.N. Chand & Co.
6. Inorganic Chemistry, 3rd Edition (ISE) A.G. Sharpe Addison Wesley.

Reference Books:

7. □ J. D. Lee: *A new Concise Inorganic Chemistry*, E L. B. S.
8. □ F. A. Cotton & G. Wilkinson: *Basic Inorganic Chemistry*, John Wiley.
9. □ Douglas, McDaniel and Alexader: *Concepts and Models in Inorganic Chemistry*,
10. John Wiley.
11. □ James E. Huheey, *Ellen Keiter and Richard Keiter: Inorganic Chemistry: Principles*
12. *of Structure and Reactivity*, Pearson Publication.
13. □ T. W. Graham Solomon: *Organic Chemistry, John Wiley and Sons.*
14. □ Peter Sykes: *A Guide Book to Mechanism in Organic Chemistry,* Orient Longman.
15. □ E. L. Eliel: *Stereochemistry of Carbon Compounds*, Tata McGraw Hill.
16. □ I. L. Finar: *Organic Chemistry* (Vol. I & II), E. L. B. S.
17. □ R. T. Morrison & R. N. Boyd: *Organic Chemistry*, Prentice Hall.
18. □ Arun Bahl and B. S. Bahl: *Advanced Organic Chemistry,* S. Chand

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MIC-2(P): Physical Chemistry Lab.

When the students will finish this practical course , they will be skilled in:-

- **: determination of coefficient of viscosity of various types of liquids and also in the determination of the surface tension of the various types of liquids.**
- **: molecular weight determination by victor Meyer Method.**
- **: pH dermination of various types of buffer solutions.**

MIC-2(P) :Physical Chemistry Lab.

(Practical: 1 credit)

Practical :

Surface tension measurements using Stalagmometer

Determine the surface tension of aqueous solutions by (a) drop number, (b) drop weight method.

Viscosity measurement using Ostwald's viscometer.

1. Determination of co-efficient of viscosity of an unknown aqueous solution.
2. Study of variation of viscosity with different concentration of sugar solutions.

Molecular weight of a volatile compound

Determination of molecular weight of a volatile compound using Victor Meyer's method.

Suggested Readings :

1. Khosla, B.D.; Garg, V.C. & Gulati, A.; Senior Practical Physical Chemistry; R. Chand & Co, NewDelhi.
2. Garland, C.W.; Nibler, J.W.; Shoemaker, D.P.; Experiments in physicalChemistry, 8th Edition, McGraw-Hill, New York.
3. Yadav, J. B.; Advanced Practical Physical Chemistry, 32nd Ed; Goel Publishing House.

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SEMESTER-III

MIC-3(T) : Hydrocarbons & Chemistry in everyday life

Course outcomes:

After completion of this course, student will be able to understand:

CO1: Chemistry of hydrocarbons.

CO2: applications of Chemistry in everyday life.

MIC-3(T) : Hydrocarbons & Chemistry in everyday life (Theory: 3 credits)		
Unit	**Name of Course**	**No. of Lectures**
	Aliphatic Hydrocarbons Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.	
1	**Alkanes:** (Upto 5 Carbons): Preparation: Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. Reactions: Free radical Substitution: Halogenation.	11
2	**Alkenes:** (Upto 5 Carbons): Preparation: Elimination reaction, dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis Reactions: cis-addition (alk. $KMnO_4$) and trans-addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition), Hydration, Ozonolysis, oxymecuration-demercuration, Hydroboration-oxidation,.	11
3	**Alkynes:** (Up to 5 Carbons): Preparation: 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 alk, $KMnO_4$.	11
4	**Chemistry in everyday life:** Air Pollution, Water Pollution, Toxic Chemicals, Inorganic and Organic Chemicals in soil, Important Fertilizers Green Chemistry, essential constituents in foods, Important drugs food preservatives	12
	TOTAL	45

Suggested Readings:

1. Organic Chemistry-Graham Solomons
2. Organic Chemistry- Morrison & Boyd.

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Semester-IV
MIC-4: Physical Chemistry: Chemical Thermodynamics and its Applications (T)

Course Outcomes

After completion of the course, students will be able to understand:

CO1: various thermodynamic terms.

CO2: various enthalpies of transformations and Kirchoff's law.

CO3: entropy changes, Gibbs free energy change, spontaneous and non- spontaneous processes.

CO4: second law of thermodynamics.

MJC-4: Physical Chemistry: Chemical Thermodynamics and its Applications (Theory: 3 credits)		
Unit	**Topics to be covered**	**No. of Lectures**
1	**Basic concepts and first law of thermodynamics:** Definition of thermodynamic terms: system, surroundings, types of systems, intensive and extensive properties, state and path functions, thermodynamic processes, concept of heat and work, First law of Thermodynamics-Statements, definition of internal energy and enthalpy, Heat capacities at constant volume and constant pressure with their relationship, Joule's law, Joule-Thomson coefficient and inversion temperature, calculation of w, q, dU & dH for the expansion of ideal gases under isothermal and adiabatic conditions for reversible and irreversible processes.	12
2	**Thermochemistry:** Standard state, enthalpy of reaction, standard enthalpy of formation, Hess's law of constant heat summation and its applications, enthalpy of combustion, enthalpy of neutralization, bond dissociation energy and its calculation from thermo-chemical data, temperature dependence of enthalpy, Kirchoff's equation.	11
3	**Second law of thermodynamics:** Second law of thermodynamics, need of the law, different statements of the law, Carnot theorem, Carnot cycle and its efficiency.	11
4	**Entropy and free energy:** Concept of entropy, entropy as a function of V&T, P&T, entropy change in ideal gases and mixing of ideal gases, free energy and spontaneity, variation of Gibbs free energy (G) and Helmholtz free energy(A) with P, V and T.	11
	TOTAL	45

Suggested Readings:

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 Mc Graw Hill (2010).
7. Metz, C.R. 2000 solved problems in chemistry, Schaum Series (2006).

Semester-V

MIC-5 (P): Chemical Thermodynamics and its Applications (P)

Course Outcomes

After completion of this practical course, students will be skilled in determining:

CO1: different types of enthalpy changes.

CO2: the heat capacity of calorimeter.

MIC-5: Chemical Thermodynamics and its Applications (Practical: 3 credits)
Practical: **Chemical Thermodynamics and its Applications** 1. Determination of water equivalent of calorimeter. 2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide. 3. Determination of enthalpy of ionization of ethanoic acid. 4. Determination of heat of displacement of Cu by Zn from Cu^{2+} salt solution. 5. Determination of enthalpy of hydration of copper sulphate.

Suggested Readings:

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

SEMESTER – V

MIC-6 (T): Inorganic Chemistry: *s*-, *p*- and d-block elements (T)

Course Outcomes

After completion of the course, the students will be able to understand: -

CO1: different oxidation states of elements with their relative stability and complex forming properties.

CO2: the ring, cage and polymers of B, Si & P.

CO3: to carry out the preparation of inorganic compounds.

CO4: the important properties of transition metals such as their oxidation states, colour, magnetic and spectral, use of Latimer diagrams in identifying oxidizing, reducing and disproportionating species.

CO5: the concepts related with noble gases, their compounds, shapes, properties and applications.

***s*-, *p*- and *d*-block elements (Theory: 3 credits)**		
Unit	**Topics to be covered**	**No. of Lectures**
1	**Periodic Table and Periodicity of Elements:** The long form of periodic table, detailed discussion of the following periodic properties of the elements a) Atomic radii (covalent, metallic and van der Waals) b) Ionization enthalpy, successive ionization enthalpies, factors affecting ionization enthalpy and applications of ionization enthalpy. c) Electron gain enthalpy. d) Electronegativity: Pauling's and Mullikan, variations of electronegativity with bond order and partial charge. General electronic configuration of *s*- and *p*- block elements, inert pair effect, relative stability of different oxidation states, diagonal relationship and anomalous behaviour of first member of each group, allotropy and catenation properties.	14
2	**Compounds of *p* block elements:** Study of the following compounds with emphasis on structure, bonding, preparation, properties and uses:- Boric acid, borates, borazines, silicates, silicones, NH_3-manufacture (Haber's process), oxides, oxy- and peroxy acids of nitrogen, phosphorus and sulphur.	11
3	**Chemistry of noble gases:** Occurrence and isolation, rationalization of inertness of noble gases, shape and structure of noble gas compounds using VSEPR theory, preparation and properties of XeF_2, XeF_4 and XeF_6.	8
4	**Chemistry of d-block elements:** General electronic configuration of d-block metals and their group trends, variable oxidation states and their relative stabilities, magnetic and catalytic properties of metals, colour, complex forming ability of metals, Chemistry of Cr, Mn and Fe in various oxidation states with special reference to their following compounds: peroxo compounds of Cr, potassium dichromate, potassium permanganate..	12
	TOTAL	45

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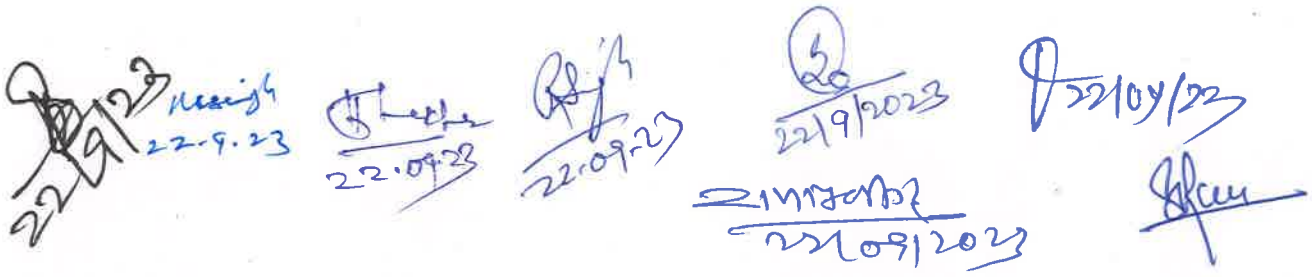
Readings:

1. Lee, J. D., Concise Inorganic Chemistry, 5th Ed., Wiley India (2008).
2. Housecroft, C. E.; Constable, E. C. Chemistry-An Introduction to Organic, Inorganic and Physical Chemistry, 4th Ed., Pearson Education (2010).
3. Atkins, P.; Overton, T.; Rouke, J.; Weller, M.; Armstrong, F.; Hagerman, M., Shriver Atkins's Inorganic Chemistry, 6th Ed., Oxford University Press India (2015).
4. Miessler, G.; Tarr, D. A., Inorganic Chemistry, 3rd Ed., Pearson Education India (2008).
5. Huheey, J. E.; Keiter, E. A.; Keiter, R. L.; Medhi, O. K., Inorganic Chemistry: Principles of Structures and Reactivity, 4th Ed., Pearson Education India (2006).
6. Cotton, F. A.; Wilkinson, G.; Gaus, P. L., Basic Inorganic Chemistry, 3rd Ed., Wiley India (2007).
7. Puri, B. R.; Sharma, L. R.; Kalia, K. C., Principles of Inorganic Chemistry, 33rd Ed., Vishal Publishing (2017).



Semester-VI

MIC-7 (P): Qualitative Analysis of Inorganic Salt Mixture Containing Four Radicals (P)

Course Outcomes

After the end of this practical course students will be skilled in: -

CO1: identification of basic radicals from known and unknown salts.

CO2: identification of acid radicals from known and unknown salts.

Qualitative Analysis of inorganic salt mixture containing Four Radicals. **(Practical 3 credits)**
1. Identification of known cations (basic radicals) and anions (acid radicals) from the supplied salt.
2. Identification of cation (basic radicals) and anions (acid radicals) from unknown salt.
3. Identification of cation (basic radicals) and anions (acid radicals) from binary mixture of inorganic salts.

SuggestedReadings:

1. Raj, G., Advanced Practical Inorganic Chemistry, Krishna Prakashan, Meerut (2013).
2. Mendham, J.; Denney, R. C., Barnes, J. D.; Thomas, M.; Sivasankar, B., Vogel's Quantitative Chemical Analysis, 6th Ed., Pearson Education India (2009).

Semester-VI

MIC-8 (T): Organic Chemistry: Compounds with Oxygen Containing Functional Groups (T)

CourseOutcomes

After the completion of the course, students will be able to understand:

CO1: preparation, properties and reactions of compounds with oxygen containing functional groups.

CO2: to draw plausible mechanisms for reactions involving these functional groups.

CO3: the knowledge of various named organic reactions associated with these functional groups.

CO4: chemistry of epoxides.

CO5: the detection of *O*-containing functional groups like alcohols, phenols, carbonyl and carboxylic acid groups.

CO6: the preparation of various organic compounds by functional group transformations and other common organic reactions.

CO7: the green practices in Organic syntheses.

Compounds with Oxygen Containing Functional Groups (Theory: 3 credits)		
Unit	**Topics to be covered**	**No. of Lectures**
1	**Alcohols, Phenols, Ethers and Epoxides** **Alcohols:** Classification and nomenclature. Preparation of 1^{o}, $2^{o}$and 3^{o}alcohols using substitution reaction, addition reactions, Grignard reagent. **Reactions:** With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. $KMnO_4$, acidic dichromate, conc. HNO_3). Oppeneauer oxidation. **Phenols:** Classification, nomenclature and properties **Preparation:** Cumene hydroperoxide method, from diazonium salts. **Reactions:** Electrophilic substitution: Nitration, halogenation and sulphonation. Kolbe's–Schmidt Reaction, Reimer-Tiemann Reaction, Gattermann-Koch Reaction, Schotten–Baumann Reaction. **Ethers and epoxides (aliphatic and aromatic):** Classification, nomenclature, preparation and properties. **Reactions:** Cleavage of ethers with HI. Syntheses of epoxides, Acid and base–catalyzed ring opening of epoxides.	17
2	**Aldehydes and ketones (aliphatic and aromatic):** Structure, reactivity and preparation; nucleophilic additions, Nucleophilic addition-elimination reactions with ammonia derivatives and their mechanisms; mechanisms of Aldol and Benzoin condensation, Knoevenagel condensations, Claisen-Schmidt, Perkin, Cannizzaro and Wittig reactions, haloform reaction and Baeyer Villiger oxidation, oxidations and reductions (Clemmensen, Wolff-Kishner, $LiAlH_4$, $NaBH_4$, MPV and PDC).	10

	Addition reactions of unsaturated carbonyl compounds: Michael addition.	
3	**Carboxylic Acids and their Derivatives:** Preparation, physical properties and reactions of monocarboxylic 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.	09
4	**Carbohydrates** Classification and general properties of carbohydrates, Glucose and Fructose (open chain and cyclic structure), Mutarotation, ascending and descending in monosaccharides.	09
	TOTAL	45

Suggested Readings:

1. Greeves, N.; Clayden, J.; Warren, S., Organic Chemistry, 2nd Ed., Oxford University, Press India (2014).
2. Sykes, P., A Guide book to Mechanism in Organic Chemistry, 6th Ed., Pearson Education India (2003)
3. Ghosh, S. K., Advanced General Organic Chemistry, Part-I & Part-II, 3rd Ed., New Central Book Agency (2010).
4. Bhal, B. S.; Bhal, A., A Textbook of Organic Chemistry, 22nd Ed., S. Chand and Company (2016).
5. Sengupta, S., Basic Stereochemistry of Organic Molecules, 2ndEd., Oxford University Press India (2018).
6. Finar, I. L. Organic Chemistry (Volume1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

Semester-VII

MIC-9 (P): Organic Chemistry: Identification of Oxygen Containing Functional Groups (P)

Course Outcomes:

When the students will finish this practical course, they will be skilled in: -

CO1: acetylation and benzoylation of various functional groups present in organic compounds.

CO2: oxime formation, hydrazone formation, semi-carbazone formation, iodoform test and in the bromination of phenols.

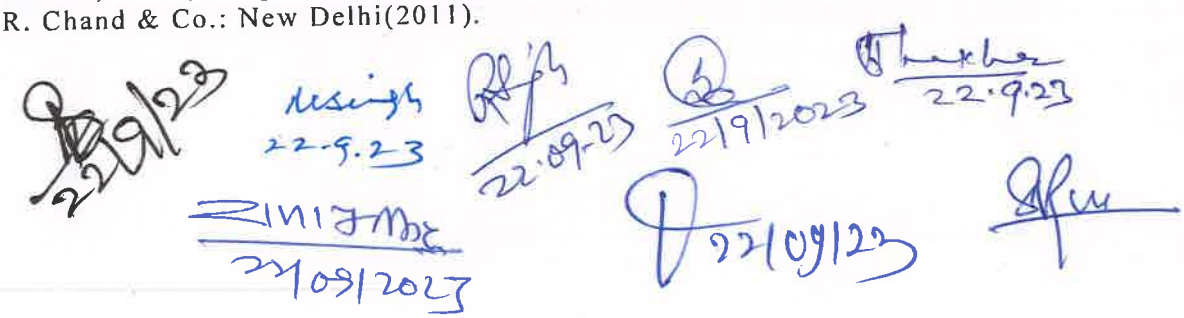
CO3: oxidation of alcohols and reduction of nitro compounds.

CO4: Aldol Condensation by conventional and green methods.

Compounds with Oxygen Containing Functional Groups (Practical: 2 credits)
(a) Acetylation of salicylic acid. (b) Benzolyation of aniline. (c) Preparation of Oximes and 2,4-dinitrophenylhydrazones of aldehydes and ketones (d) Bromination of Phenol.

Suggested Readings:

1. Agarwal, O. P., Advanced Practical Organic Chemistry, Krishna Prakashan, Meerut (2014).
2. Ahluwalia, V. K.; Aggarwal, R., Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, Universities Press (2000).
3. Furniss, B. S.; Hannafold, A. J.; Smith, P. W. G.; Tatchell, A. R., Vogel's Textbook of Practical Organic Chemistry, 5th Ed., Pearson Education India (2003).
4. Clarke, H. T., A Handbook of Organic Analysis: Qualitative and Quantitative, 4th Ed., CBS Publishers India (2007).
5. 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.
6. Mann, F.G. & Saunders, B. C. Practical Organic Chemistry Orient-Longman, 1960.
7. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi(2011).



Semester-VII

MIC-9 (T): Colligative Properties of Dilute Solutions, Chemical Kinetics and Photochemistry (T)

Course Outcomes

After completion of the course, students will be able to understand:-

CO1: Colligative properties of dilute solutions and determination of these properties.

CO2: Abnormal colligative properties and molar mass.

CO3: Azeotropes, maximum and minimum boiling azeotropic mixture.

CO4: Kinetics of simple and complex reactions.

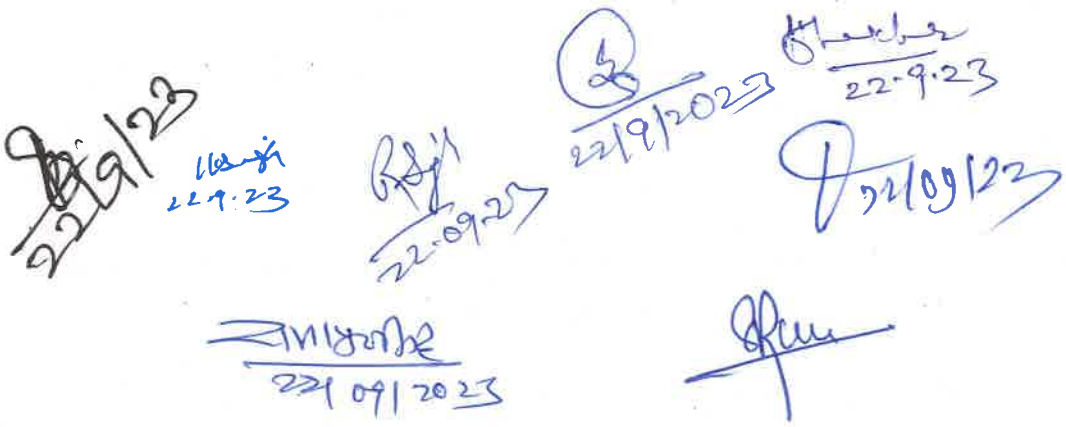
CO5: Jablonski diagram and laws of photochemistry.

Colligative Properties of Dilute Solutions, Chemical Kinetics and Photochemistry (Theory: 2 credits)		
Unit	**Topics to be covered**	**No. of Lectures**
1.	**Colligative Properties of Dilute Solutions:** Colligative properties of solutions, Henry's law, Raoult's law (thermodynamic derivation), ideal and non-ideal solutions, azeotropes, thermodynamic derivation and experimental determination of relative lowering in vapour pressure, elevation in boiling point, depression in freezing point and osmotic pressure, abnormal colligative properties due to association and dissociation of solutes in solutions, van't Hoff's factor, abnormal molar mass, applications of colligative properties in determining molar mass of solutes, degree of dissociation and association.	8
2.	**Kinetics of Elementary Reactions:** Rate laws of first, second, third and zero order reactions, methods of determination of order of reactions, temperature dependance of reaction rate, Arrhenius equation, Activation energy, **Catalysis:** Theory and applications.	8
3.	**Kinetics of Complex Reactions:** Steady state approximation, integrated rate expression (first order only) for the 1. Opposing reactions 2. Parallel reactions and 3. Consecutive reactions.	7
4.	**Photochemistry:** Introduction, consequences of light absorption, Lambert-Beer's law, laws of photochemistry, Grotthus-Draper law, Stark-Einstein law of photochemical equivalence, quantum yield, photochemical reactions ($H_2 + Cl_2$, $H_2 + Br_2$, decomposition of HI), photochemical rate laws.	7
	TOTAL	30

Suggested Readings:

1. Physical Chemistry: P.W. Atkins (ELBS)
2. Comprehensive Physical Chemistry: Hemant Snehi
3. Theoretical Physical Chemistry: Gladstone
4. Physical Chemistry: G.M. Barrow.
5. Modern Electrochemistry: JOM Bakris and A.K.N. Reddy

6. Text Books of Polymer Science: F.W. Billmayer Jr.
7. Advanced Physical Chemistry: Gurdeep Raj



Semester-VIII

MIC-10: Physical Chemistry: Phase Equilibria, Conductance and Electrochemical Cells (T)

Course Outcomes

After completion of the course, students will be able to understand: -

CO1: the degree of ionization, pH and salt hydrolysis.
CO2: the different types of Buffer solutions.
CO3: the concepts of solubility product.
CO4: the conductivity, specific conductivity, equivalent conductivity and molar conductivity, application of conductance measurement in determining various physical parameters.
CO5: the standard electrode potential of half cells and calculate the EMF of a cell using Nernst equation.
CO6: EMF measurements in determining various parameters like free energy, enthalpy, entropy, equilibrium constants, etc.
CO7: the concentration cells with and without transference.
CO8: the principle of potentiometric titrations.

MIC-10: Physical Chemistry: Ionic Equilibria, Conductance and Electrochemical Cells (Theory: 4 credits)		
Unit	**Topics to be covered**	**No. of Lectures**
1	**Phase Equilibria:** Phases, components and degrees of freedom of systems, criteria of phase equilibria, Gibbs Phase Rule and its thermodynamic derivation, phase diagram of one component system (water/sulphur).	15
2	**Conductance:** Conductance, specific conductance (conductivity), equivalent and molar conductance, their variation with dilution for weak and strong electrolytes, Kohlrausch law of independent migration of ions, transference number.	15
3	**Electrochemical cells:** Electrode and electrode potential, reference electrodes (Standard hydrogen electrode and Calomel electrode), standard electrode potential, type of electrodes, galvanic cells, electrochemical series and its significance, Nernst equation and its importance, types of electrochemical cells – chemical cells and concentration cells, concept of EMF of a galvanic cell, measurement of EMF of a cell, construction and working of a Galvanic cell.	15
4	**Applications of EMF measurements** Determination of equilibrium constant, ΔG, ΔS and ΔH of cell reactions, calculation of solubility product of a sparingly soluble salt, the valency of ions.	15
	TOTAL	60

Suggested Readings:

1. Atkins, P. W.; de Paula, J.; Keeler, J., Physical Chemistry, 11th Ed., Oxford University Press India (2018).
2. Bahl, A.; Bahl, B. S.; Tuli, G. D., Essentials of Physical Chemistry, S.

Chand and Company (2014).
3. Negi, A. S.; Anand, S. C., Physical Chemistry, New Age International Publishers (2007).
4. Puri, B. R.; Sharma, L. R.; Pathania, M. S., Principles of Physical Chemistry, 47th Ed., Vishal Publishing (2017).
5. Silbey, R. J.; Alberty, R. A.; Bawendi, M. G., Physical Chemistry, 4th Ed., Wiley India (2006).
6. Rakshit, P. C., Physical Chemistry, Revised Ed. Sarat Book House (2014).
7. Kapoor, K. L., A Textbook of Physical Chemistry: States of Matter and Ions in Solution, Vol. I, 6th Ed., McGraw Hill Education India (2019).