

**Dr Avtar Singh Rahi**  
Associate Professor

Month	Details		Remarks
July 2023	OC	<b>Alcohols</b> Monohydric alcohols, nomenclature, methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters. Hydrogen bonding. Acidic nature. Reactions of alcohols. Dihydric alcohols — nomenclature, methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [ $\text{Pb}(\text{OAc})_4$ and $\text{HIO}_4$ ] and pinacol-pinacolone rearrangement.	Studies are followed by Recapitulations of previous studies
August 2023	OC	<b>Phenols</b> Nomenclature, structure and bonding. Preparation of phenols, physical properties and acidic character. Comparative acidic strengths of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols — electrophilic aromatic substitution, Mechanisms of Fries rearrangement, Claisen rearrangement, Reimer-Tiemann reaction, Kolbe's reaction and Schotten and Baumann reactions.	Assessment Test
September 2023	OC	<b>Ultraviolet (UV) absorption spectroscopy</b> Absorption laws (Beer-Lambert law), molar absorptivity, presentation and analysis of UV spectra, types of electronic transitions, effect of conjugation. Concept of chromophore and auxochrome. Bathochromic, hypsochromic, hyperchromic and hypochromic shifts. UV spectra of conjugated dienes and enones, Woodward-Fieser rules, calculation of $\lambda_{\text{max}}$ of simple conjugated dienes and $\alpha, \beta$ -unsaturated ketones. Applications of UV Spectroscopy in structure elucidation of simple organic compounds.	Assignments
October 2023	OC	<b>Carboxylic Acids &amp; Acid Derivatives</b> Nomenclature of Carboxylic acids, structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparation of carboxylic acids. Reactions of carboxylic acids. Hell-Volhard-Zelinsky reaction. Reduction of carboxylic acids. Mechanism of decarboxylation. Relative stability of acid derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution. Mechanisms of esterification and hydrolysis (acidic and basic).	Assignments
November 2023	OC	<b>Epoxides</b> Synthesis of epoxides. Acid and base-catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides.	Assessment Test
Nov 2023 Dec 2023	<b>Semester-End Final Examinations</b>		

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January 2024	PC	<b>Thermodynamics</b> Second law of thermodynamics, need for the law, different statements of the law, Carnot's cycle and its efficiency, Carnot's theorem, Thermodynamics scale of temperature. Concept of entropy – entropy as a state function, entropy as a function of V & T, entropy as a function of P & T, entropy change in physical change, entropy as a criteria of spontaneity and equilibrium.	Studies are followed by Recapitulations of previous studies
	OC	<b>Infrared (IR) absorption spectroscopy</b> Molecular vibrations, Hooke's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, characteristic absorptions of various functional groups and interpretation of IR spectra of simple organic compounds. Applications of IR spectroscopy in structure elucidation of simple organic compounds.	
February 2024	PC	<b>Thermodynamics</b> Third law of thermodynamics: Nernst heat theorem, statement of concept of residual entropy, evaluation of absolute entropy from heat capacity data. Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities, G as criteria for thermodynamic equilibrium and spontaneity, its advantage over entropy change. Variation of G with P, V and T.	Assessment Test
	OC	<b>Amines</b> Structure and nomenclature of amines, physical properties. Separation of a mixture of primary, secondary and tertiary amines. Structural features affecting basicity of amines. Preparation of alkyl and aryl amines (reduction of nitro compounds, nitriles, reductive amination of aldehydic and ketonic compounds. Gabriel - phthalimide reaction, Hofmann bromamide reaction. Electrophilic aromatic substitution in aryl amines, reactions of amines with nitrous acid.	
March 2024	PC	<b>Electrochemistry</b> Electrolytic and Galvanic cells – reversible & irreversible cells, conventional representation of electrochemical cells. Calculation of thermodynamic quantities of cell reaction ( $\Delta G$ , $\Delta H$ & $K$ ).	Assignments
	OC	<b>Diazonium Salts</b> Mechanism of diazotisation, structure of benzene diazonium chloride, Replacement of diazo group by H, OH, F, Cl, Br, I, NO <sub>2</sub> and CN groups, reduction of diazonium salts to hydrazines, coupling reaction and its synthetic application.	
April 2024	PC	<b>Electrochemistry</b> Types of reversible electrodes – metal-metal ion, gas electrode, metal – insoluble salt-anion and redox electrodes. Electrode reactions, Nernst equations, derivation of cell EMF and single electrode potential. Standard Hydrogen electrode, reference electrodes, standard electrode potential, sign conventions, Concentration cells with and without transference, liquid junction potential and its measurement. Applications of EMF measurement in solubility product and potentiometric titrations using glass electrode. More stress on numerical problems.	Assignments Assessment Test

	<p><b>Aldehydes and Ketones</b></p> <p>Nomenclature and structure of the carbonyl group. Synthesis of aldehydes and ketones with particular reference to the synthesis of aldehydes from acid chlorides, advantage of oxidation of alcohols with chromium trioxide (Sarett reagent) pyridinium chlorochromate (PCC) and pyridinium dichromate.</p> <p><b>OC</b> Physical properties, Comparison of reactivities of aldehydes and ketones. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on benzoin, aldol, Perkin and Knoevenagel condensations. Condensation with ammonia and its derivatives. Wittig reaction. Mannich reaction. Oxidation of aldehydes, Baeyer–Villiger oxidation of ketones, Cannizzaro reaction. MPV, Clemmensen, Wolff-Kishner, LiAlH<sub>4</sub> and NaBH<sub>4</sub> reductions.</p>	
<p><b>May 2024</b> <b>June 2024</b></p>	<p><b>Semester-End Final Examinations</b></p>	

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July 2023	IC	<b>Metal- Ligand Bonding in Transition Metal complexes</b> Limitations of valence bond theory, an elementary idea of crystal field theory, crystal field splitting in octahedral, tetrahedral and square planer complexes, factors affecting the crystal field parameters.	Studies are followed by Recapitulations of previous studies
	OC	<b>NMR Spectroscopy</b> Principle of nuclear magnetic resonance, the PMR spectrum, number of signals, peak areas, equivalent and nonequivalent protons positions of signals and chemical shift, shielding and deshielding of protons, proton counting, splitting of signal s and coupling constants, magnetic equivalence of protons. Discussion of PMR spectra of the molecule s: ethyl bromide, n-propyl bromide, isopropyl bromide, 1,1-dibromoethane, ethanol, acetaldehyde, ethyl acetate, toluene, benzaldehyde and acetophenone..Simple problems on PMR spectroscopy for structure determination of organic compounds.	
August 2023	IC	<b>Thermodynamics and Kinetic Aspects of metal complexes</b> A brief outline of thermodynamic stability of metal complexes and factors affecting the stability, Irving William Series, substitution reactions of square planer complexes of Pt[II], Trans effect.	Assessment Test
	OC	<b>Carbohydrates</b> Classification and nomenclature of Monosaccharides, mechanism of osazone format ion, interconversion of glucose and fructose, chain lengthening and chain shortening of aldoses. Configuration of monosaccharides. Erythro and threo diastereomers. Conversion of glucose into mannose. Formation of glycos ides, Determination of ring size of glucose and fructose. Open chain and cyclic structure of D(+)-glucose & D(-) fructose. Mechanism of mutarotation.	
September 2023	IC	<b>Magnetic properties of Transition metal complexes</b> Types of magnetic materials, magnetic susceptibility, method of determining magnetic susceptibility, spin only formula, L-S coupling, correlation of $\mu_s$ and $\mu_{eff}$ values, orbital contribution to magnetic moments, application of magnetic moment data for 3d metal complexes.	Assignments
	OC	<b>Carbohydrates</b> Structures of ribose and deoxyribose. An introduction to disaccharides (maltose, sucrose and lactose) and polysaccharides (starch and cellulose) without involving structure determination.	
October 2023	IC	<b>Electronic spectra of Transition metal complexes</b> Selection rules for d-d transition, spectroscopic ground states, spectrochemical series, Orgel energy level diagram for d1 and d9 states, discussion of electronic spectrum of $[Ti(H_2O)_6]^{+3}$ complex ion.	Assignments
	OC	<b>Organometallic Compounds</b> Organomagnesium compounds: the Grignard reagents-formation, structure and chemical reactions. Organozinc compounds: formation and chemical reactions.	

<b>November 2023</b>	<b>IC</b>	Revision/ Recapitulations of studies	Assessment Test
	<b>OC</b>	<b>Organometallic Compounds</b> Organolithium compounds: formation and chemical reactions.	
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January 2024	IC	<b>Acids and Bases</b> Arrhenius, Bronsted-lowry, Lux-flood, solvent system and Lewis concept of acids and bases, relative strength of acids and bases, levelling solvents, hard and soft acids and bases(HSAB), Applications of HSAB principle.	Studies are followed by Recapitulations of previous studies
	OC	<b>Organic Synthesis via Enolates</b> Acidity of alpha-hydrogens, alkylation of diethyl malonate and ethyl acetoacetate. Synthesis of ethyl acetoacetate: the Claisen condensation. Keto-enol tautomerism of ethyl acetoacetate.	
February 2024	IC	<b>Organometallic chemistry</b> Definition, classification and nomenclature of organometallic compounds, preparation, properties and bonding of alkyls of Li, Al, Hg and Sn, concept of hapticity of organic ligand, Structure and bonding in metal-ethylenic complexes, Structure of Ferrocene, classification in metal carbonyls, preparation, properties and bonding in mononuclear carbonyls.	Assessment Test
	OC	<b>Heterocyclic Compounds</b> Introduction: Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine. Methods of synthesis and chemical reactions with particular emphasis on the mechanism of electrophilic substitution. Mechanism of nucleophilic substitution reactions in pyridine derivatives. Comparison of basicity of pyridine, piperidine and pyrrole.	
March 2024	IC	<b>Bio inorganic chemistry</b> Metal ions present in biological system, classification on the basis of action (essential, non essential, trace, toxic), Metalloporphyrins with special reference to haemoglobin and myoglobin. Biological role of Na <sup>+</sup> , K <sup>+</sup> , Ca <sup>2+</sup> , Mg <sup>2+</sup> , Fe <sup>2+</sup> ions, Cooperative effect, Bohr effect.	Assignments
	OC	<b>Heterocyclic Compounds</b> Introduction to condensed five and six- membered heterocycles. Preparation and reactions of indole, quinoline and isoquinoline with special reference to Fisher indole synthesis, Skraup synthesis and Bischler-Napieralski synthesis. Mechanism of electrophilic substitution reactions of, quinoline and isoquinoline.	
April 2024	IC	<b>Silicones and Phosphazenes</b> Nomenclature, classification, preparation and uses of silicones, elastomers, polysiloxane copolymers, poly phosphazenes and bonding in triphosphazene.	Assignments Assessment Test
	OC	<b>Amino Acids, Peptides &amp; Proteins</b> Classification, of amino acids. Acid-base behavior, isoelectric point and electrophoresis. Preparation of alpha-amino acids. Structure and nomenclature of peptides and proteins. Classification of proteins. Peptide structure determination, end group analysis, selective hydrolysis of peptides. Classical peptide synthesis, solid-phase peptide synthesis. Structures of peptides and proteins :Primary & Secondary structure.	

	<p><b>Synthetic Polymers</b>  Addition or chain-growth polymerization. Free radical vinyl polymerization, ionic vinyl polymerization, Ziegler –Natta polymerization and vinyl polymers. Condensation or step growth polymerization. Polyesters, polyamides, phenol formaldehyde resins. Natural and synthetic rubbers.</p>	
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