COURSE PLAN

U.G. and P.G. Programs

2022-23

ODD SEMESTER

SOPHIA GIRLS' COLLEGE (AUTONOMOUS), AJMER
B. Sc. I (SEMESTER I)

ORGANIC CHEMISTRY (PAPER II) (CHE-102)

Max. Marks: 75 (50 Ext; 25 Int) **Min. Marks: 30(20 Ext; 10 Int)** **Credits:03**

COURSE PLAN

SEM I Month	UNIT/TOPIC	Concepts/facts	Teaching Pedagogy	Learning Outcomes	Questions	Marks Weightage (%)
	Unit – I **Structure and Bonding-** Hybridization, bond characteristics, Vander Waals interactions, inclusion compounds, clathrates, charge transfer complexes, resonance, hyperconjugation, aromaticity, inductive and field effects.	Structure and electronic effects in reference to organic molecules.	Presentations, Demonstration Flow Chart, Constructive teaching patterns	Predict the hybridization and structural, bonding in common organic molecules and mechanism	*Knowledge Based* - Define Hyperconjugation. - Explain the stability of 1°, 2°, 3 ° free radicals. *Understanding*	Knowledge--60 Understanding-30 Higher Order-10

	Mechanism of Organic Reactions Curved arrow notation, Types of reagents , Types of organic reactions. Energy considerations. Reactive intermediates, carbocations, carbanions, free radicals, carbenes, arynes and nitrenes (with example). Assigning formal charges.	Organic reactions- Their reactivity, selectivity and transition states.		of organic reactions. The Preparatory and chemical reactions of alkanes and cycloalkanes	*Based* - Arrange the following alkenes in the increasing order of their stabilities explain with reason $CH_2=CH_2$, $R_2C=CH_2$, $R_2C=CR_2$ -Compare the stability of cyclopropane and cyclohexane. *Higher Order Thinking Skills Based* -Justify the unequal formation of 1,2 and 1,4 products in 1,3- Butadiene at different temperatures. - Evaluate the conformations of cycloalkenes	
	Unit – II **Alkanes** Methods of preparation (with special reference to Wurtz reaction, Kolbe reaction, Corey-House reaction and decarboxylation of carboxylic acids), physical properties and chemical reactions of alkanes. Mechanism of free radical halogenation of alkanes: orientation, reactivity and selectivity.	Structure and reactivity of alkanes	Presentations, Demonstration Approach of Constructivist, etc			

	Cycloalkanes - Nomenclature, methods of preparation, chemical reactions, Baeyer's strain theory and its limitations. Ring strain in small rings (cyclopropane and cyclobutane), theory of strainless rings, cyclopropane ring: banana bonds.	Structure , stability and reactivity of cycloalkanes				
	Unit – III **Alkenes-** Nomenclature of alkenes, methods of preparation, mechanism of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. Saytzeff rule, Hoffmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes-mechanisms involved in hydrogenation, electrophilic and free radical additions, Polymerization of alkenes. Substitution at the	Structure and reactivity in context to regioselectivity in different alkenes.	Group Discussions, Diagrams, Models, visual techniques	Summarize the chemical behaviour of alkenes, dienes and alkynes.		

	allylic and vinylic positions of alkenes.					
	Alkynes- Nomenclature, structure and bonding in alkynes. Methods of preparation, chemical reactions of alkynes- hydrogenation, halogenation, hydrohalogenation, hydration, hydroboration and hydroxylation, ozonolysis of alkynes, acidity of alkynes, mechanism of electrophilic and nucleophilic addition reactions, metal-ammonia reductions, oxidation and polymerization, acidity of alkynes, characteristics of terminal alkynes.	Electrophilic addition and reactions of alkynes	Diagrams, Models, Demonstration Flow Charts			
	Diens- Nomenclature and classification of dienes: isolated, conjugated and comulated dienes. Structure of allenes and butadiene method of formation, polymerization. Chemical reactions-1,2 and 1,4 additions, Diels-Alder reaction.	Structure of dienes and thermodynamic and kinetic control of reactions	Presentations, Demonstration ,			

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M.Sc. CHEMISTRY (PREVIOUS)
SEMESTER I

ORGANIC REACTION MECHANISM I (CHEM-102)

MAX. MARKS: 100 (70 EXT; 30 INT) MIN. MARKS: 40 (28 EXT;12 INT) CREDITS:06

COURSE PLAN

SEM/ Month	Unit/Topic	Concepts/facts	Teaching Pedagogy	Learning Outcomes	Questions	Marks Weightage (%)
	UNIT I **Nature of Bonding in Organic molecules** Aromaticity in benzenoid and non benzenoid compounds, Huckel's rule, energy level of π molecular orbital, annulenes,anti aromaticity, homoaromaticity.	Types of compounds in terms of aromatic behaviourism	Diagrams, Flow Charts, Presentations, Interactive quizzes	Predict structure and bonding in common organic molecules and mechanism of organic reactions.	*Knowledge Based* - What are alternant and Non-Alternant Hydrocarbons? Explain briefly. -What is aromaticity n benzoid compounds	Knowledge-25 Understanding-45 Higher Order-30

	Types of reactions and mechanisms. General methods for the determination of reaction mechanism – stereochemical evidences, kinetic evidences and isotope effects. Thermodyamic and kinetic requirements for a reaction.	Structure and Reactivity of organic compounds	3 D models, Charts, Presentations		*Understanding Based* -Compare the aromaticity of tropone and tropolone. - Elaborate the difference in the aromatic behaviour of Annulenes *Higher Order Thinking Skills Based* - Explain $ArSN^1$ with suitable examples. - Elaborate Aliphatic Substitution Reactions. -Describe Allylic halogenations	
	UNIT II **Aliphatic Nucleophilic substitution** SN^2, SN^1, mixed and SET mechanism	Aliphatic Nucleophilic substitution	Diagrams, Demonstration	Review various aliphatic and aromatic substitution reactions.		
	Aromatic Nucleophilic Substitution $ArSN^1$, $ArSN^2$, benzyne and SRN1 mechanism. Reactivity-effect of substrate structure, leaving group and attacking nucleophile. The von Richter, Sommelet-Hauser and Smiles rearrangements.	Aromatic Nucleophilic Substitution	PPT, Interactive demonstrations			

	Aliphatic Electrophilic Substitution- Bimolecular mechanism, SE1 mechanism, electrophilic substitution accompanied by double bond shifts. Effect of substrates, leaving group and the solvent polarity.	Aliphatic Electrophilic Substitution	3D Models, Presentations			
	Aromatic Electrophilic Substitution- Arenium ion mechanism, orientation and reactivity, energy profile diagrams. ortho/para ratio, ipso attack, orientation in other ring system. quantitative treatment of reactivity in substrates and electrophiles. Diazonium coupling, Vismeir reaction, Gattermann-koch reaction.	Aromatic Electrophilic Substitution	Effective model structures, Presentations			
	UNIT III **Free Radical Reactions-** Free radical reactions, types and mechanism, neighbouring group assistance. Reactivity for	Free Radical Reactions	Demonstrations , Effective interactions	Explain different types of free radical reactions		

	aliphatic and aromatic substrates at a bridgehead. Effect of solvent on reactivity. Allylic halogenations(NBS), oxidation of aldehydes to carboxylic acids, coupling of alkynes and arylation of aromatic compounds by diazonium salts, Sandmeyer reaction. Free radical rearrangement, Hunsdiecker reaction.					

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M.Sc. CHEMISTRY (PREVIOUS)
SEMESTER I

GROUP THEORY AND SPECTROSCOPY (CHEM-104)

MAX. MARKS: 100 (70 EXT; 30 INT) MIN. MARKS: 40 (28 EXT;12 INT) CREDITS:06

COURSE PLAN

SEM/ Month	Unit/Topic	Concepts/facts	Teaching Pedagogy	Learning Outcomes	Questions	Marks Weightage (%)
SEM I	**UNIT-II** **Molecular spectroscopy** Energy levels, molecular orbitals, vibrational transitions, vibration progression and geometry of the excited states, Franck-Condon Principle, electronic spectra of polyatomic molecules, Emission spectra, radiative and non-radiative decay, internal conversion, spectra of transition metal	Molecular spectra and transitions	Diagrams, Tables, Charts, PPT, Diagrams	Analyse the Molecular spectroscopy	*Knowledge Based* -What are the basic principles of ESR? -Explain the process of Decay. *Understanding Based* -Explain the Charge-transfer Spectra -Explain hyperfine constant	Knowledge-25 Understanding-45 Higher Order-30

	complexes, charge- transfer spectra.				*Higher Order Thinking Skills Based* - Define Franck-Codon Principle. -Give the Applications of ESR in biological systems.	
	UNIT - III **Electron Spin Resonance Spectroscopy** Basic principles, zero field splitting and Kramer's degeneracy, "g" value, factors affecting the "g" value Hyperfine splitting, Hyperfine coupling constant, Isotropic and anisotropic hyperfine coupling constants, application to study of free radicals, determination of oxidation state of metal and to transition metal complexes(having one unpaired electron) including biological systems.	Concept of electron spin resonance spectroscopy	3-D Models, Diagrams, Live Presentations	Assess the electron spin resonance spectroscopy.		

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M.Sc. CHEMISTRY (FINAL)
SEMESTER III

ENVIRONMENTAL AND GREEN CHEMISTRY (CHEM-303)

MAX MARKS: 100 (70EXT; 30 INT) MIN. MARKS: 40 (28 EXT; 12 INT) CREDITS:06

COURSE PLAN

SEM/ Month	UNIT/TOPIC	Concepts/facts	Teaching Pedagogy	Learning Outcomes	Questions	Marks Weightage (%)
	Unit-II Different approaches to green synthesis : Use of green reagents, green solvents, Synthetic organic transformations under microwave, heterocyclic synthesis.	Illustrate Application of greener alternative approaches	Diagrams, Quiz, Charts, Presentation.	Illustrate application of greener alternative approaches	*Knowledge Based* -Define Green Chemistry? -Use of Green Reagents *Understanding Based* -Green Synthesis -Per Acids reagents	Knowledge-25 Understanding-45 Higher Order-30

					Higher Order Thinking Skills Based - Write down the principles of Green Chemistry	

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M.Sc. CHEMISTRY (PREVIOUS)
Practical (CHEM-305)

SEM/ Month	UNIT/TOPIC	Concepts/facts	Teaching Pedagogy	Learning Outcomes	Questions	Marks Weightage (%)
SEM III	**ORGANIC CHEMISTRY** **Qualitative Analysis** Separation and identification of the compound of mixture of three organic compounds (three solids and/or two solids and liquid) by Water, $NaHCO_3$, NaOH. Prepare derivatives, wherever possible.	Detection of organic compounds in ternary mixture		Understand the practical applications of various aspects of chemistry	*Knowledge Based* -- Practical File Work *Understanding Based* -To study the effect of addition of an electrolyte on the solubility of an organic acid. -To separate and identify the components of the given organic ternary mixture. *Higher Order Thinking Skills Based* -Viva- Voce	Knowledge--20 Understanding-40 Higher Order-40

	PHYSICAL CHEMISTRY • Determine the partial molar volume of solute and solvent in a binary mixture • Study the effect of addition of an electrolyte on the solubility of an organic acid. • Determine the composition of binary mixture containing K2Cr2O7 and KMnO4 using spectrophotometer. • Determine the heat of neutralization of hydrochloric acid by sodium hydroxide.	Use of various instruments like colorimeter, pH meter.				

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COURSE PLAN

U.G. & P.G. Programs

EVEN SEMESTER

2022-23

SOPHIA GIRLS' COLLEGE (*AUTONOMOUS*), AJMER
B. Sc. I (SEMESTER II)

ORGANIC CHEMISTRY (PAPER II) (CHE-202)

Max. Marks: 75 (50 Ext; 25 Int) **Min. Marks: 30(20 Ext; 10 Int)** **Credit: 03**

SEM II Month	UNIT/TOPIC	Concepts/facts	Teaching Pedagogy	Learning Outcomes	Questions	Marks Weightage (%)
	Unit – I Concept of isomerism. Types of isomerism. elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centres, diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization. Relative and absolute configuration. Geometric isomerism- determination of configuration of geometric isomers. E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds. Conformational isomerism- ethane, n-butane, cyclohexane,	Stereochemistry of Organic Compounds	Presentations, Visual Representaions, Interactive Discussions	Identify the stereochemistry of organic compounds. Compare the reactivity of alkyls and aryl halides.	*Knowledge Based* -Define Optical Isomerism. -What is Absolute configuration? *Understanding Based* - Give the m-directing effect of NO_2 on Benzene. -Compare the stability of Chair and boat conformations of cyclohexane *Higher Order Thinking Skills*	Knowledge--60 Understanding-30 Higher Order-10

	Qualitative treatment of stability of chair and boat conformations of cyclohexane. Newman projection and Sawhorse formulae, Fischer and flying wedge formulae. Difference between configuration and conformation.				*Based* - Discuss the relative reactivities of alkyl halides vs allyl, vinyl and aryl halides. - Explain the side chain reactions of benzene	
	Unit – II **Arenes and aromaticity** Structure of benzene: molecular formula and Kekule structure. Stability of benzene, resonance structure, MO picture. Aromaticity: Huckle rule, aromatic ions. Nomenclature of benzene derivatives. The aryl group. Aromatic nucleus and side chain. Side chain reactions of benzene derivatives. Birch reduction. Methods of formation and chemical reactions of alkylbenzenes, alkynylbenzenes and biphenyl.	Structure , stability and reactivity of Benzene and its derivatives	Quizzes, Presentations	Assess the aromaticity of arenes and electrophilic substitution reactions.		
	Aromatic electrophilic substitution- General pattern of the mechanism, role of sigma and pi- Complexes. Mechanism of nitration, halogenation,	Electrophilic substitution reaction of Aromatic Compounds	Demonstration, Diagrams, Interactive			

	sulphonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams, activating and deactivating substituents, orientation and ortho/para ratio.					
	Unit – III **Alkyl and Aryl Halides** Nomenclature and classification of alkyl halides, Methods of preparation, chemical reaction. Mechanisms of nucleophilic substitution reactions of alkyl halides, S_N2 and S_N1 reactions with energy profile diagrams. Polyhalogen compounds: chloroform, carbon tetrachloride. Methods of preparation of aryl halides, nuclear and side chain reactions. The addition elimination and the elimination-addition mechanisms of nucleophilic aromatic substitution reactions. Relative reactivities of alkyl halides vs allyl, vinyl and aryl halides. Synthesis and uses of DDT and BHC.	Preparation and reactivity of alkyl and aryl halides.	Group Discussions, Flow Chart	Compare the reactivity of alkyls and aryl halides.		

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SOPHIA GIRLS' COLLEGE (*AUTONOMOUS*), AJMER
M.Sc. CHEMISTRY (FINAL)
SEMESTER IV

GROUP-B *ORGANIC CHEMISTRY*
ORGANOMETALLICS AND DISCONNECTIONS -CHEM-401(B)

MAX. MARKS: 100 (70 EXT; 30 INT) MIN. MARKS: 40 (28 EXT; 12 INT) CREDITS: 06

COURSE PLAN

SEM/ Month	Unit/Topic	Concepts/facts	Teaching Pedagogy	Learning Outcomes	Questions	Marks Weightage (%)
SEM IV	Unit- I **Organometallic Reagents** Principles, preparations, properties and applications of the following in organic synthesis with mechanistic details. **Transition Metal organic compounds** Cu, Pd, Ni, Fe, Co, Rh, Cr and Ti Compounds.	Methods of preparations and properties of organometallic compounds of transition metal complexes	Diagrams, PPT, Charts.	Analyse organometallic reagents of transition metals.	*Knowledge Based* - Principle of Protecting Groups. - What do you understand by Regioselectivity? *Understanding Based* -Explain principle of protection of	Knowledge--25 Understanding-45 Higher Order-30

		Protection of specific organic compounds	Flow charts and tables		carboxyl compounds -How Nitro compounds can act as an acyl anion equivalent? *Higher Order Thinking Skills Based* -Differentiate between stereoselectivity and stereospecificity. -Discuss Alkene	
	Protecting Groups Principle of Protection of alcohol, amine, carbonyl and carboxyl group.					

	Unit-II **One Group C-C Disconnections** Alcohols and carbonyl compounds, regioselectivity. Alkene Synthesis, use of acetylenes and aliphatic nitro compounds in organic synthesis.	Understanding Disconnection methods and reactions in organic synthesis.	Quizzes, Diagrams, Flow Charts	Elaborate disconnection approach	Synthesis	

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GROUP-B *ORGANIC CHEMISTRY*
SEMESTER IV

HETEROCYCLIC CHEMISTRY- CHEM-401(B)

MAX MARKS: 100 (70EXT; 30 INT) **MIN. MARKS: 40 (28 EXT; 12 INT)** **CREDITS: 06**

COURSE PLAN

SEM/ Month	UNIT/TOPIC	Concepts/facts	Teaching Pedagogy	Learning Outcomes	Questions	Marks Weightage (%)
SEM IV	**Unit-I** **Nomenclature of Heterocycles** Replacement and systematic nomenclature (Hantzsch-Widman system) for monocyclic, fused and bridged heterocycles.	Structural Classification and nomenclature of heterocycles.	Diagrams, Presentations, Interactive discussions	Interpret aromatic and non- aromatic heterocycles	*Knowledge Based* -What is systematic nomenclature ?. - Give two synthesis of Oxirane. *Understanding Based* - Explain briefly the structure and reactions of Quinolizinium salts. - Discuss attractive	Knowledge-25 Understanding-45 Higher Order-30

	Aromatic Heterocycles General chemical behavior of aromatic hetrocycles, classification (structural type), criteria of aromaticity (Bond lengths, ring current and chemical shifts in ^{1}H NMR-spectra, empirical resonance energy, delocalization energy and Dewar resonance energy, dimagnetic susceptibility exaltations.) Heteroaromatic reactivity and tautomerism in aromatic heterocycles. **Non Aromatic Hetrocycles** Strain-bond angle and torsional strains and their consequences in small ring heterocycles. Conformation of six-membered heterocycles with reference to molecular geometry, barrier to ring inversion, pyramidal inversion and 1,3-diaxial interaction.	General chemical behaviours of aromatic heterocycles and non aromatic heterocycles	Diagrams, Charts, Quizzes Diagrams, charts, Quizzes		interactions through space *Higher Order Thinking Skills Based* - Illustrate torsional strain and their consequences in small ring heterocycles - Describe Meso-Ionic heterocycles.	

	Stereo-electronic effects- anomeric and related effects. Attractive interactions- hydrogen bonding and intramolecular nucleophilic-electrophilic interactions.					
	Unit-II **Heterocyclic Synthesis** Principlesof heterocyclic synthesis involving cyclization reaction and cycloaddition reactions.	Reactions and synthesis of small ring and six membered heterocycles.	Flow charts , Guessing the synthesis(Interactive Sessions)	Elaborate the synthesis of various types of heterocyclic compounds.		
	Small Ring Heterocycles Three - membered and four - membered heterocyles - synthesis and reactions of aziridines, oxiranes, azetidines, oxetanes.		Demonstration, Charts			

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	Heterocyclic Systems containing P- Heterocyclic ring containing phosphorus: Introduction, nomenclature, synthesis and characteristics of 5-and 6 membered ring systems-phosphorinanes, phospholanes and phospholes.		Charts, Diagrams			
	Six Membered Heterocycles with one Heteroatom Synthesis and reaction of quinolizinium and benzopyrilium salts, coumarins and chromones.		Charts, Presentations			
	Unit-III **Benzo Fused Five-membered Heterocyles** Synthesis and reactions including medicinal applications of benzopyrroles, benzofurans and benzothiophenes. Meso-Ionic heterocycles.	Applications and reactions of benzo fused heterocycles	Flow charts, Diagrammatic Questionnaire	Illustrate benzo fused five-membered and six-membered heterocycles.		

	Six-Membered heterocycles with Two or More Heteroatoms Synthesis and reactions of tetrazines and thiazines	Characteristics of Six-Membered heterocycles with Two or More Heteroatoms	Flipped classrooms, Diagrams			

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M.Sc. CHEMISTRY (PREVIOUS)
Practicals (CHEM-205)

SEM/ Month	UNIT/TOPIC	Concepts/facts	Teaching Pedagogy	Learning Outcomes	Questions	Marks Weightage (%)
SEM II	**INORGANIC PREPARATIONS** Separation and determination of two metal ions Cu-Ni, Ni-Mg, Cu-Fe, Cu-Ba etc. involving volumetric and gravimetric methods.	Methods of separation and determination of two metal ions	Demonstration of the exercise	Understand the practical applications of various aspects of chemistry	*Knowledge Based* - Practical File Work *Understanding Based* - Mechanism of various Chemical reactions. -To evaluate	Knowledge--20 Understanding-40 Higher Order-40

					Gravimetric analysis *Higher Order Thinking Skills Based* - Viva Voce	

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SOPHIA GIRLS' COLLEGE (*AUTONOMOUS*), AJMER
M.Sc. CHEMISTRY (FINAL)
PRACTICALS (CHEM-405) (FOR GROUP –A,B,C)

SEM/ Month	UNIT/TOPIC	Concepts/facts	Teaching Pedagogy	Learning Outcomes	Questions	Marks Weightage (%)
SEM IV	**PHYSICAL CHEMISTRY** • Determination of pKa of indicator (e.g.Phenolphthalein). • Determination of stoichiometry and stability constant of inorganic (e.g.ferric-salicyclic acid) organic (e.g. amine and iodine) complexes. • Characterization of complexes by electronic and IR spectral data. • To obtain solubility curve for a ternary system of liquids, water-acetic acid, acid-chloroform system. • To estimate oxalic acid by carrying out suitable conductometric titration in the following solutions. i. A solution of pure Oxalic acid. ii. A solution of Oxalic acid	Instrumentation	Demonstration of the Exercise Exercises with the use of different Apparatus, instruments like pH meter, conductivity meter	Understand the practical applications of various aspects of chemistry	*Knowledge Based* -- Practical File Work *Understanding Based* - Characterization of Complexes -To obtain solubility curve *Higher Order Thinking Skills Based* -Viva- Voce	Knowledge--20 Understanding-40 Higher Order-40

	and HCl. A solution of Oxalic acid and CH_3COOH				

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