



SOPHIA COLLEGE FOR WOMEN (EMPOWERED AUTONOMOUS)

Affiliated to the University of Mumbai

Programme: Science

Chemistry

S.Y.B.Sc. CHEMISTRY (Minor)

**Syllabus for the Academic Year 2025-2026 based on
the National Education Policy 2020**



SOPHIA COLLEGE FOR WOMEN (EMPOWERED AUTONOMOUS)
DEPARTMENT OF CHEMISTRY

COURSE DETAILS FOR MINOR:

	SEMESTER 3		SEMESTER 4
TITLE	General Chemistry - I		General Chemistry -II
TYPE OF COURSE - DSC	Minor		Minor
CREDITS	2		2



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Preamble:

Chemistry - a vibrant and ever growing science that encompasses every aspect of our lives. The fascinating study of matter and its applications is vital in areas like drug designing, material science, nanotechnology and most importantly, 'green chemistry', areas that are beneficial to both humanity and the environment. Bachelor's degree in Chemistry is the culmination of in-depth knowledge of Inorganic, Organic and Physical chemistry, Analytical chemistry and specialized courses such as Pharmaceutical Chemistry, spectroscopy, Nanoscience, Forensic Science, Cosmeticology, Food chemistry, Dairy Chemistry, Environmental chemistry and so on.

The learning objectives are designed to provide a focused outcome based syllabus with an agenda to structure the teaching learning experiences in a more student centric manner. This programme helps learners in building a solid foundation for higher studies in Chemistry. The hands-on experience the students gain in Practical enable them to apply theoretical knowledge acquired to solve problems in everyday life, think critically and innovatively. The syllabus is designed so that the student starts from the basic concepts of chemistry and will gradually move towards the advanced level. They are given opportunities to improve their creativity, scientific writing and communication skills through assignments and other co-curricular activities in all the semesters. The credit courses on "Positive Health in Women" and "Innovation in Natural dyeing and Entrepreneurship Skills" offered by the department further enhances their life skills and helps them evolve as entrepreneurs.

Students completing this programme will be equipped with knowledge of the concepts of Chemistry, interpret data and present their findings to both the scientific community and laymen. Completion of this programme will also enable the learners to join teaching professions, conducting research in Industry and Government run research labs



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PROGRAMME OBJECTIVES

PO 1	The students are expected to understand the basic concepts in chemistry and be aware of the recent development in the subject area.
PO 2	To inculcate critical thinking and scientific attitude in the students.
PO 3	The students should be able to apply the theoretical knowledge and practical skills acquired to solve the real world problems and environmental issues.

PROGRAMME SPECIFIC OUTCOMES

PSO 1	Core competency: The chemistry graduates are expected to gain theoretical and practical knowledge of the basic concepts in chemistry.
PSO 2	Skill development: They would acquire necessary skills and training to pursue higher studies in the field of chemistry and to be an entrepreneur.
PSO 3	Responsible citizens: The students will get trained to adopt and practice sustainable techniques for their personal growth and to address societal and environmental problems.



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Programme: Sciences CHEMISTRY MINOR	Semester – 3
Course Title: General Chemistry-I	Course Code: SCHE233MN
<u>COURSE OBJECTIVES:</u> 1. Understand and enumerate the concept of entropy, free energy functions, its variation with temperature and pressure, partial molal properties and emanate the significance of Van't Hoff Reaction Isotherm & Isochore. 2. To understand the bonding fundamentals for both ionic and covalent compounds, including electronegativities, bond distances and bond energies using MO diagrams and thermodynamic data. To predict geometries of simple molecules	
<u>COURSE OUTCOMES:</u> The learner will be able to : 1. Explain and relate the different thermodynamic parameters such as entropy, helmholtz free energy, gibbs free energy changes and its significance 2. Differentiate between ionic and covalent compounds, and explain their properties using different theories, predict and understand geometries of different covalent compounds	



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Theory Lectures per week (1 Lecture is 60 minutes)		2	
Total number of Hours in a Semester		30	
Credits		2	
Evaluation System	Semester End Examination	1 Hour	30 marks
	Continuous Assessment	--	20 marks

UNIT 1 (1 Credit)	1.1	Chemical Thermodynamics – II (8L) 1.1.1 Recapitulation: Second law of thermodynamics 1.1.2 Free Energy Functions: Helmholtz Free Energy, Gibbs Free Energy, Variation of Gibbs Free Energy with pressure and temperature, Gibbs-Helmholtz Equation. (Numericals expected) 1.1.3 Thermodynamics of open systems: Partial molal properties, Chemical potential and its variation with pressure and temperature, Gibbs- Duhem equation. 1.1.4 Van't Hoff Reaction Isotherm and Van't Hoff Reaction Isochore. (Numericals expected)	15 Hours
	1.2	Electrochemistry – I (7L) 1.2.1 Electrochemical Cells: Galvanic cells, Electrochemical conventions, Reversible and Irreversible cells. 1.2.2 Types of electrodes, Standard electrode potential, Electrochemical series, Nernst Equations: Derivation and its applications. (Numericals expected). 1.2.3 Calomel electrode, Glass electrode and Salt bridge – Principle, construction and working. 1.2.4 pH determination using Glass electrode and Quinhydrone electrode (Numericals expected)	



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UNIT 2 (1 Credit)	2.1	Non-Directional Bonding (3L) 2.1.1 Ionic Bond: Introduction, conditions for the formation of an ionic bond. 2.1.2 Ionic crystals: definitions-crystal lattice, lattice points, unit cell, lattice parameters, types of ionic crystals 2.1.3 Lattice Energy: Born-Lande equation, Kapustinski equation, Born-Haber Cycle and its application (Numericals expected)	15 Hours
	2.2	Directional bonding (5L) 2.2.1 Covalent Bonding: Valence Bond Theory- introduction and basic tenets 2.2.2 Formation of H ₂ : Interaction between two hydrogen atoms and the potential energy diagram of the resultant system, corrections applied to the system of two hydrogen atoms 2.2.3 Hybridization and types of hybrid orbitals- <i>sp</i> , <i>sp</i> ² , <i>sp</i> ³ , <i>sp</i> ³ <i>d</i> , <i>sp</i> ³ <i>d</i> ² 2.2.4 Equivalent and Non-Equivalent hybrid orbital 2.2.5 Limitations of VBT	
	2.3	Molecular Orbital Theory(4L) 2.3.1 Introduction to MOT, definitions- bonding, anti-bonding and non-bonding molecular orbitals 2.3.2 LCAO- MO approach to homonuclear diatomic molecules H ₂ to Ne ₂ (calculation of bond order and magnetic property) 2.3.3 Bond Order and magnetic property of species of O ₂ : O ₂ ⁺ , O ₂ ²⁻ 2.3.4 LCAO- MO approach to heteronuclear diatomic molecules- HCl, NO, CO (calculation of bond order and magnetic property)	
	2.4	Acid- Base Theory (3L) 2.4.1 Arrhenius, Lowry- Bronsted, Lewis, Usanovich concept, Solvent – Solute concept of acids and bases 2.4.2 Concept of K _a and pK _a to understand acid strength (numericals expected) 2.4.3 Hard and Soft acids and bases. Applications of HSAB	



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PRACTICAL Course Title: General Chemistry-I Practical	Course Code: SCHE233MNP
<u>COURSE OBJECTIVE:</u>	
<ol style="list-style-type: none"> 1. To prove various laws and equations using different instrumental methods. 2. use potentiometry for analysis of various compounds and to construct an electrochemical cell 	
<u>COURSE OUTCOMES:</u>	
The learner will be able to :	
<ol style="list-style-type: none"> 1. analyze various compounds by using classical and instrumental methods of analysis 2. able to prove or verify laws/equations through simple experiments and calculate rate and order of the reaction for known chemical systems 	

Lectures per week (1 Lecture is 120 minutes)		2	
Total number of Hours in a Semester		60	
Credits		2	
Evaluation System	Semester End Examination	3 Hours	50 marks
	Internal Assessment	--	



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	1	To interpret the order of the reaction graphically for the given experimental data and calculate the specific reaction rate.	60 hours
	2	To investigate the reaction between $K_2S_2O_8$ and KI with equal concentration of reactants.	
	3	To determine the rate constant for the alkaline hydrolysis of ethyl acetate conductometrically	
	4	To titrate a strong acid against a strong base conductometrically	
	5	To determine the standard EMF and the standard free energy of the Daniel cell potentiometrically.	
	6	To conduct a pH titration of a weak acid against a strong base and to find out its dissociation constant.	
	7	To estimate the amount of zinc ions in solution complexometrically	
	8	To determine the amount of magnesium ions in the given solution complexometrically	



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ASSESSMENT DETAILS:

1. Continuous Assessment (CA): Any one activity / assignment / test of 20 marks
2. Summative Assessment (SA): Theory exam of 30 marks – One hour duration
3. Summative Assessment (SA): Practical exam of 50 marks – Three hours duration

REFERENCES:

SCHE233MN General Chemistry-I

- Physical Chemistry by G.M. Barrow. Tata McGraw-Hill (2007)
- Physical Chemistry by G.W. Castellan. Narosa 4th Edition (2004)
- General Chemistry by Kotz J.C., Treichel P.M. & Townsend. Cengage Learning India Pvt. Ltd., New Delhi (2009)
- Concise inorganic chemistry, J D Lee, Blackwell Science Ltd, fifth edition.
- Principles of structure and reactivity, James Huheey, Addison Wesley publishing company, fourth edition

SCHE233MNP General Chemistry-I Practical

- Senior Practical Physical Chemistry by B.D. Khosla, V.C. Garg & A. Gulati. R. Chanda and Co., New Delhi (2011)
- Experiments in Physical Chemistry by C.W. Garland, J.W. Nibler & D.P. Shoemaker. McGraw-Hill New York 8th Edition (2003)
- Experimental Physical Chemistry by Halpern A.M. & G.C. McBane. W.H. Freeman and Co., New York (2003)
- Experimental Physical Chemistry by V.D. Athawale and P. Mathur. New Age International, New Delhi (2001)
- Practical Physical Chemistry by Vishwanathan B. and Raghavan P.S.. Viva Books (2017)
- Systematic experimental physical chemistry by Rajbhoj S.W. and Chondhekar T.K. Anjali Publication (2013)
- Physical Chemistry – A Lab Manual by Sinha S.K. Narosa Publication (2014)
- Vogel's Textbook of Quantitative Chemical Analysis. Pearson Publication
- Vogel, A.I., Tatchell, A.R., Furnis B.S. Hanaford, A.J.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.
- Ahluwalia, V.K. & Aggrawal, R. *Comprehensive Practical Organic Chemistry*, University Press
- Vogel's qualitative inorganic analysis, G. Svehla, Orient Longman, sixth edition
- Semi-micro qualitative analysis, Velcher and Hahn, East West Press
- A textbook of quantitative inorganic analysis, Arthur I. Vogel, Longman, 3rd edition
- A. I. Vogel's *Quantitative Chemical Analysis*, Mendham, Pearson, 6th Edition



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Programme: Sciences CHEMISTRY MINOR	Semester – 4
Course Title: General Chemistry-II	Course Code: SCHE244MN
<u>COURSE OBJECTIVES:</u> 1. To understand methods of preparation, reactions and applications of hydrocarbons, stability of cycloalkanes, To understand the regioselectivity and mechanism of some selected reactions. 2. To learn the importance of classical and instrumental methods of analysis.	
<u>COURSE OUTCOMES:</u> The learner will be able to : 1. Write various preparative methods and predict the mechanisms of hydrocarbon and predict the stability of cycloalkanes. Predict the product for given reactions and identify and arrange the given compounds as per acidity and basicity 2. Identify and classify the sources of error, calculate accuracy and precision of a method from the given data, and apply significant figures rules accurately	

Theory Lectures per week (1 Lecture is 60 minutes)	2		
Total number of Hours in a Semester	30		
Credits	2		
Evaluation System	Semester End Examination	1 Hour	30 marks
	Internal Assessment	--	20 marks



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UNIT 1 (1 Credit)	1.1	<p>Alkanes (5L)</p> <p>1.1.1 Introduction to Alkanes and Cycloalkanes. The Chemistry of Petroleum Refining, Shapes of Alkanes Conformational Analysis of Butane. The Relative Stabilities of Cycloalkanes: Ring Strain. Conformations of Cyclohexane: The Chair and the Boat</p> <p>1.1.2 Physical Properties of Alkanes and Cycloalkanes, Synthesis of Alkanes and Cycloalkanes- Hydrogenation of Alkenes and Alkynes. Chemical Reactivity of Alkanes</p> <p>1.1.3 Applications: The Chemistry of Pheromones, Muscle Action, Nanoscale Motors and Molecular Switches.</p>	15 hours
	1.2	<p>Alkenes and alkynes- Introduction (5L)</p> <p>1.2.1 Relative Stabilities of Alkenes, Cycloalkenes Synthesis of Alkenes via Elimination Reactions, (mechanism) - Dehydrohalogenation of Alkyl Halides, Acid-Catalyzed Dehydration of Alcohols, Carbocation Stability, and Molecular Rearrangements</p> <p>1.2.2 The Acidity of Terminal Alkynes, Synthesis of Alkynes by Elimination Reactions, Replacement of the Acetylenic Hydrogen Atom of Terminal Alkynes Alkylation of Alkynide Anions and Reactivity</p> <p>1.2.3 The Chemistry of Hydrogenation in the Food Industry. The Function of the Catalyst, Hydrogenation of Alkynes</p>	
	1.3	<p>Alkenes and Alkynes Reactions (5L)</p> <p>1.3.1 Addition Reactions of Alkenes.</p> <p>1.3.2 Electrophilic Addition of Hydrogen Halides to Alkenes: Mechanism and Markovnikov's Rule Stereochemistry of the Ionic Addition to an Alkene Addition of Sulfuric Acid to Alkenes Addition of Water to Alkenes: Acid-Catalyzed Hydration</p> <p>1.3.3 Alcohols from Alkenes through Oxymercuration–Demercuration: Markovnikov Addition Alcohols from Alkenes through Hydroboration–Oxidation: Anti-Markovnikov Syn Hydration I</p>	



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		Hydroboration: Synthesis of Alkylboranes, Oxidation and Hydrolysis of Alkyl Boranes, Oxidative Cleavage of Alkenes. Addition of Hydrogen Halides to Alkynes Electrophilic Addition of Bromine and Chlorine to Alkynes	
UNIT 2 Basics in Analytical Chemistry (1 Credit)	2.1	Language of Analytical Chemistry: (Important terms and their significance in Analytical Chemistry): Analysis, determination, measurement, techniques, methods, procedures, protocols, sensitivity, selectivity, robustness, ruggedness and scale of operation.	15 hours
	2.2	Classical and non-classical methods of analysis: Their types and importance. Errors: Errors in analysis and its classification, Minimization of errors. Normal distribution curve.	
	2.3	Precision and accuracy: Methods for their expression:- Absolute error, relative error, mean, mode, median, range, deviation, relative average deviation, standard deviation, relative standard deviation, variance and coefficient of variance (Numericals expected)	
	2.4	Significant figures and computation: Significant figures, Significance of zero in the computation of analytical data, Rules of computation.	
	2.5	Calibration of glasswares: Calibration of burette, pipette and standard flask.	



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PRACTICAL COURSE Course Title: General Chemistry Practical	Course Code: SCHE244MNP
<u>COURSE OBJECTIVES:</u> 1. Qualitatively analyze the given mono functional organic compounds using microtechniques. 2. Analysis of given organic compounds based on functional group specific reactions	
<u>COURSE OUTCOMES:</u> 1. Identify the given monofunctional organic compounds 2. Estimate the amount of organic compound present in the given sample using suitable method	
Lectures per week (1 Lecture is 120 minutes)	2
Total number of Hours in a Semester	60
Credits	2

Evaluation System	Semester End Examination	3 Hours	50 marks
	Internal Assessment	--	



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	1	To determine the concentration of Cu (II) in the given solution by colorimetry	60 hours
	2	To determine the percentage of optically active substance in a given solution (glucose/sucrose) by polarimetry.	
	3	To determine the dissolved oxygen in the given sample.	
	4	To determine the percentage of composition of calcium oxide/magnesium oxide in the given dolomite sample complexometrically.	
	5	Systematic Qualitative analysis of organic compounds with mono functional groups (acids, phenols, alcohols/ketone, amides, nitro, amines, esters, hydrocarbons) minimum 5 compounds	
	6	Preparation of m-dinitrobenzene from nitrobenzene	



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REFERENCES:

SCHE244MN General Chemistry-II

- Analytical Chemistry by G. L. David Krupadanam, D.Vijaya Prasad and others. University Press.
- Modern Analytical Chemistry by David Harvey. Mc Graw-Hill International Edition.
- Analytical Chemistry by D. Kealey and P.J. Haines.

SCHE244MNP General Chemistry-II

- Senior Practical Physical Chemistry by B.D. Khosla, V.C. Garg & A. Gulati. R. Chanda and Co., New Delhi (2011)
- Experiments in Physical Chemistry by C.W. Garland, J.W. Nibler & D.P. Shoemaker. McGraw-Hill New York 8th Edition (2003)
- Experimental Physical Chemistry by Halpern A.M. & G.C. McBane. W.H. Freeman and Co., New York (2003)
- Experimental Physical Chemistry by V.D. Athawale and P. Mathur. New Age International, New Delhi (2001)
- Practical Physical Chemistry by Vishwanathan B. and Raghavan P.S.. Viva Books (2017)
- Systematic experimental physical chemistry by Rajbhoj S.W. and Chondhekar T.K. Anjali Publication (2013)
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- Vogel's qualitative inorganic analysis, G. Svehla, Orient Longman, sixth edition
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