

UNIVERSITY OF MADRAS
B.Sc. DEGREE PROGRAMME IN CHEMISTRY
 SYLLABUS WITH EFFECT FROM 2023-2024

Title of the Course	GENERAL CHEMISTRY -III						
Paper No.	Core V(CC5)						
Category	Core	Year	II	Credits	5	Course Code	224C3A
		Semester	III				
Instructional hours per week	Lecture	Tutorial	Lab Practice		Total		
	4	1	-		5		
Prerequisites	General Chemistry – I and II						
Objectives of the course	This course aims to provide a comprehensive knowledge on <ul style="list-style-type: none"> • the physical properties of gases, liquids, solids and X-ray diffraction of solids. • fundamentals of nuclear chemistry and nuclear waste management. • applications of nuclear energy • basic chemistry of halo-organic compounds, phenol and other aromatic alcohols. • preparation and properties of phenols and alcohols. 						
Course Outline	UNIT I Gaseous state Kinetic molecular model of a gas: postulates and derivation from the kinetic gas equation; The Maxwell –Boltzmann distribution of speed of molecules-average, root mean square and most probable velocity and average kinetic energy, law of equipartition of energy, degrees of freedom and molecular basis of heat capacities. Collision frequency; collision diameter; mean free path and viscosity of gases. Real gases: Deviations from ideal gas behavior, (Andrew’s and Amagat’s plots); compressibility factor, Z, and its variation with pressure for different gases. equations of states for real gases-van der Waal’s equation; Virial equation; Boyle temperature; Numerical problems based on equations of states for real gases, isotherms of real gases–critical phenomena–isotherms of CO ₂ - continuity of state–Van der Waal’s equation and the critical state; law of corresponding states-liquefaction of gases.						

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Unit-II

Liquid and Solid State

Properties of Liquids- Surface tension, viscosity and their applications.

Crystalline and amorphous – differences - geometry, isotropy and anisotropy, melting point; isomorphism, polymorphism.

Crystals –size and shape; laws of crystallography; symmetry elements – plane,

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	<p>Centre and axis; Miller indices, unit cells and space lattices; classification of crystal systems; Bravais lattices; X – ray diffraction – Bragg’s equation</p> <p>Packing in atomic solids – simple cubic, body centered cubic, face centered and hexagonal close packing; Co-ordination number in typical structures - NaCl, CsCl, ZnS, TiO₂;</p> <p>Defects in solids - stoichiometric and nonstoichiometric defects.</p>
	<p>UNIT-III</p> <p>Nuclear Chemistry</p> <p>Natural radioactivity - α, β and γ rays; half-life period; Fajan–Soddy group displacement law; Geiger–Nattal rule; isotopes, isobars, isotones, mirror nuclei, isodiaphers; nuclear isomerism; radioactive decay series; magic numbers; units – Curie, Rutherford, Roentgen; nuclear stability - neutron- proton ratio; binding energy; packing fraction; mass defect. Simple calculations involving mass defect and B.E., decay constant and $t_{1/2}$ and radioactive series.</p> <p>Isotopes – uses – tracers – determination of age of rocks by radiocarbon dating. (Problems to be worked out)</p> <p>Nuclear energy; nuclear fission and fusion – major nuclear reactors in India; radiation hazards, disposal of radioactive waste and safety measures.</p>
	<p>UNIT-IV</p> <p>Halogen derivatives, Aliphatic halogen derivatives</p> <p>Nomenclature and classes of alkyl halides – isomerism, physical properties, Chemical reactions. Nucleophilic substitution reactions – SN_1, SN_2 and SN_i mechanisms with stereo chemical aspects and effect of solvent.</p> <p>Di, Tri & Tetra Halogen derivatives: Nomenclature, classification, preparation, properties and applications.</p> <p>Aromatic halogen compounds Nomenclature, preparation, properties and uses Mechanism of nucleophilic aromatic substitution – benzyne intermediate.</p> <p>Aryl alkyl halides Nomenclature, benzyl chloride – preparation – preparation properties and uses</p> <p>Alcohols: Nomenclature, classification, preparation, properties, use; conversions – ascent and descent of series; test for hydroxyl groups. Oxidation of diols by periodic acid and lead tetra acetate.</p>

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	<p>UNIT-V Phenols Nomenclature; classification, Preparation from diazonium salts, cumene, Dow's process, Raschig process; properties – acidic character and effect of substitution on acidity. Reactions – Fries, Claisen rearrangement, Electrophilic substitution reactions, Reimer Tiemann, Kolbe, Schmidt, Gattermann synthesis, Liebermann, nitro reaction, phthalein reaction.</p> <p>Resorcinol, quinol, picric acid – preparation, properties and uses.</p> <p>Aromatic alcohols Nomenclature, benzyl alcohol – methods of preparation – hydrolysis, reduction of benzaldehyde, Cannizzaro reaction, Grignard synthesis, physical properties, reactions – reaction with sodium, phosphorus pentachloride, thionyl chloride, acetic anhydride, hydrogen iodide, oxidation – substitution on the benzene nucleus, uses. Thiols: Nomenclature, structure, preparation and properties.</p>
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	<p>Questions related to the above topics, from various competitive examinations UPSC/JAM /TNPSC others to be solved (To be discussed during the Tutorial hours)</p>
Skills acquired from this course	<p>Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.</p>
Recommended Text	<ol style="list-style-type: none"> 1. B.R. Puri, L.R. Sharma, M.S. Pathania; Principles of Physical Chemistry, 46th edition, Vishal Publishing, 2020. 2. B.R. Puri, L.R. Sharma and K.C. Kalia, Principles of Inorganic Chemistry, Milestone Publishers and Distributors, New Delhi, thirtieth edition, 2009. 3. 4. P.L. Soni and Mohan Katyal, Textbook of Inorganic Chemistry, Sultan Chand & Sons, twentieth edition, 2006. 4. M. K. Jain, S. C. Sharma, Modern Organic Chemistry, Vishal Publishing, fourth reprint, 2003. 5. S.M. Mukherji, and S.P. Singh, Reaction Mechanism in Organic Chemistry, Macmillan India Ltd., third edition, 1994.

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Reference Books	<ol style="list-style-type: none"> 1. T. W. Graham Solomons, Organic Chemistry, John Wiley & Sons, fifth edition, 1992. 2. A. Carey Francis, Organic Chemistry, Tata McGraw-Hill Education Pvt., Ltd., New Delhi, seventh edition, 2009. 3. I. L. Finar, Organic Chemistry, Wesley Longman Ltd, England, sixth edition, 1996. 4. P. L. Soni, and H. M. Chawla - Text Book of Organic Chemistry, New Delhi, Sultan Chand & Sons, twenty ninth edition, 2007. J.D. Lee, Concise Inorganic Chemistry, Blackwell Science, fifth edition, 2005.
Website and e-learning source	<p>MOOC components</p> <p>https://nptel.ac.in/courses/104104101S solid state chemistry</p> <p>https://nptel.ac.in/courses/103106071N nuclear industries and safety</p> <p>https://nptel.ac.in/courses/104106119s Introduction to organic chemistry</p>
<p>Course Learning Outcomes (for Mapping with POs and PSOs) On completion of the course the students should be able to</p> <p>CO1: explain the kinetic properties of gases by using mathematical concepts.</p> <p>CO2: describe the physical properties of liquid and solids; identify various types of crystals with respect to its packing and apply the XRD method for crystal structure determinations.</p> <p>CO3: investigate the radioactivity, nuclear energy and its production, also the nuclear waste management.</p> <p>CO4: write the nomenclature, physical & chemical properties and basic mechanisms of halo organic compounds and alcohols.</p> <p>CO5: investigate the named organic reactions related to phenol; explain the preparation and properties of aromatic alcohol including thiol.</p>	

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	S	M	S	M
CO2	M	S	S	S	M	S	S	M	M	M
CO3	S	S	S	M	S	S	S	M	S	M
CO4	S	S	S	S	S	S	S	M	M	M
CO5	S	M	S	S	S	S	S	M	M	S

CO-PO Mapping (Course Articulation Matrix)

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CO /PO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PSO's and CO's