

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

Title of the Course	GENERAL CHEMISTRY-I						
Paper No.	Core I						
Category	Core	Year	I	Credits	5	Course Code	124C1A
		Semester	I				
Instructional hours per week	Lecture	Tutorial	Lab Practice		Total		
	4	1	-		5		
Prerequisites	Higher secondary chemistry						
Objectives of the course	The course aims at giving an overall view of the <ul style="list-style-type: none"> • various atomic models and atomic structure • wave particle duality of matter • periodic table, periodicity in properties and its application in explaining the chemical behavior • nature of chemical bonding • fundamental concepts of organic chemistry 						
Course Outline	UNIT I Atomic structure and Periodic trends Moseley's Experiment and Atomic number, Atomic Spectra; Black-Body Radiation and Planck's quantum theory - Bohr's model of atom; The Franck-Hertz Experiment; Interpretation of H- spectrum; Photoelectric effect, Compton effect; Dual nature of Matter- De- Broglie wavelength-Davisson and Germer experiment Heisenberg's Uncertainty Principle; Electronic Configuration of Atoms and ions- Hund's rule, Pauli's exclusion principle and Aufbau principle						
	Unit II Introduction to Quantum mechanics Classical mechanics, Wave mechanical model of atom, distinction between a Bohr orbit and orbital; Postulates of quantum mechanics; interpretation of wave functions, Formulation of Schrodinger wave equation - Probability and electron density-visualizing the orbitals -Probability density and significance of Ψ and Ψ^2 . Modern Periodic Table Cause of periodicity; Features of the periodic table; classification of elements - Periodic trends for atomic size- Atomic radii, Ionic and Covalent radii; ionization energy, electron affinity, electronegativity- electronegativity scales, applications of electronegativity.						

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<p>UNIT-III: Structure and bonding - I</p> <p>Ionic bond</p> <p>Lewis dot structure of ionic compounds; properties of ionic compounds; Energy involved in ionic compounds; Born Haber cycle – lattice energies, Madelung constant; relative effect of lattice energy and solvation energy; Ion polarisation – polarising power and polarizability; Fajans’ rules - effects of polarisation on properties of compounds; problems involving the core concepts.</p> <p>Covalent bond</p> <p>Shapes of orbitals, overlap of orbitals – σ and Π bonds; directed valency - hybridization; VSEPR theory - shapes of molecules of the type AB_2, AB_3, AB_4, AB_5, AB_6 and AB_7</p>
<p>UNIT-IV: Structure and bonding - II</p> <p>VB theory – application to hydrogen molecule; concept of resonance - resonance structures of some inorganic species – CO_2, NO_2, CO_3^{2-}, NO_3^-; limitations of VBT; MO theory - bonding, antibonding and nonbonding orbitals, bond order; MO diagrams of H_2, C_2, O_2, O_2^+, O_2^{2-}, $O_2 N_2^{2-}$, NO, HF, CO; magnetic characteristics, comparison of VB and MO theories.</p> <p>Coordinate bond: Definition, Formation of BF_3, NH_3, NH_4^+, H_3O^+ properties</p> <p>Metallic bond-electron sea model, VB model; Band theory-mechanism of conduction in solids; conductors, insulator, semiconductor – types, applications of semiconductors</p>
<p>UNIT-V:</p> <p>Basic concepts in Organic Chemistry and Electronic effects</p> <p>Types of bond cleavage – heterolytic and homolytic; arrow pushing in organic reactions; reagents and substrates; types of reagents - electrophiles, nucleophiles, free radicals; reaction intermediates – carbanions, carbocations, carbenes, arynes and nitrynes.</p> <p>Inductive effect - reactivity of alkyl halides, acidity of halo acids, basicity of amines; inductomeric and electromeric effects.</p> <p>Resonance – resonance energy, conditions for resonance - acidity of phenols, basicity of aromatic amines, stability of carbonium ions, carbanions and free</p>

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	<p>radicals, reactivity of vinyl chloride, dipole moment of vinyl chloride and nitrobenzene, bond lengths; steric inhibition to resonance.</p> <p>Hyperconjugation - stability of alkenes, bond length, orienting effect of methyl group, dipole moment of aldehydes and nitromethane</p> <p>Types of organic reactions- addition, substitution, elimination and rearrangements</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 and 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. Madan, R. D. and Sathya Prakash, <i>Modern Inorganic Chemistry</i>, 2nded.; S. Chand and Company: New Delhi,2003. 2. Rao, C.N. R. University General Chemistry, Macmillan Publication: New Delhi,2000. 3. Puri,B.R.andSharma,L.R.<i>PrinciplesofPhysicalChemistry</i>, 38thed.;Vishal Publishing Company: Jalandhar, 2002. 4. Bruce, P. Y. and PrasadK. J. R. <i>Essential Organic Chemistry</i>, Pearson Education: New Delhi,2008. 5. Dash UN, Dharmarha OP, Soni P.L. Textbook ofPhysical Chemistry, Sultan Chand & Sons: New Delhi,2016
Reference Books	<ol style="list-style-type: none"> 1. Maron, S. H. and Prutton C. P. <i>Principles of PhysicalChemistry</i>,4thed.; The Macmillan Company: Newyork,1972. 2. Lee, J. D. <i>Concise Inorganic Chemistry</i>, 4th ed.; ELBS William Heinemann:London,1991. 3. Gurudeep Raj, <i>Advanced Inorganic Chemistry</i>, 26thed.; Goel Publishing House: Meerut,2001. 4. Atkins, P.W. & Paula, J. <i>Physical Chemistry</i>, 10th ed.; Oxford University Press:New York,2014. 5. Huheey,J.E.<i>InorganicChemistry:PrinciplesofStructureandReactivity</i>, 4thed .; Addison, Wesley Publishing Company: India,1993.
Website and e-learning source	<ol style="list-style-type: none"> 1) https://onlinecourses.nptel.ac.in 2) http://www.mikeblaber.org/oldwine/chm1045/notes_m.htm 3) http://www.ias.ac.in/initiat/sci_ed/resources/chemistry/Inorganic.html 4) https://swayam.gov.in/course/64-atomic-structure-and-chemical-bonding 5) https://www.chemtube3d.com/

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Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

- CO1:** explain the atomic structure, wave particle duality of matter, periodic properties bonding, and properties of compounds.
- CO2:** classify the elements in the periodic table, types of bonds, reaction intermediates electronic effects in organic compounds, types of reagents.
- CO3:** apply the theories of atomic structure, bonding, to calculate energy of a spectral transition, Δx , Δp electronegativity, percentage ionic character and bond order.
- CO4:** evaluate the relationship existing between electronic configuration, bonding, geometry of molecules and reactions; structure reactivity and electronic effects
- CO5:** construct MO diagrams, predict trends in periodic properties, assess the properties of elements, and explain hybridization in molecules, nature of H – bonding and organic reaction mechanisms.

	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 / PSO	PSO1	PSO2	PSO3	PSO4	PSO5
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'