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UNIVERSITY OF MUMBAI

Syllabus for the Bridge Course
Chemistry

(Credit Based Semester and Grading System with effect from the academic year 2013–2014)

M. Sc. Bridge Course Syllabus in CHEMISTRY,
Credit Based and Grading System
To be implemented from the Academic year 2013-2014

Course	TOPICS	Credits	L / Week
PGBCH1	**. Colligative Properties of Dilute Solutions (2L)** **1.1** Dilute solution, colligate properties, Raoult's law, relative lowering of vapour pressure. **1.2** Elevation in boiling point of a solution and the molar mass of the non-volatile solute. (derivation not expected). **1.3** Depression in freezing point of a solution, and the molar mass of the non-volatile solute. (derivation not expected). **2 Phase Rule (2L)** **2.1** Gibb's phase rule and terms involved in the equation. **2.2** Application of phase rule to ONE component systems (i) water system, (ii) (Lead-Silver system), desilverisation of lead. **2.3** Introduction to three component system **3 Surface Chemistry & Catalysis (2L)** **3.1 Adsorption:** Physical and Chemical Adsorption, types of adsorption isotherms **.** Langmuir's adsorption isotherm (Postulates expected). B.E.T. equation for multilayer adsorption, (derivation not expected). significance of the terms involved,determination of surface area of an adsorbent using B.E.T. equation. Numericals on surface area determination are expected. **3.2 Catalysis:** Homogeneous and heterogeneous catalysis, catalytic activity and selectivity, promoters, inhibitors, **4 Colloids (2L)** **4.1** Introduction to colloidal state of matter. **4.2** Origin of charge on colloidal particles. Concept of electrical double layer, zeta potential, Helmholtz and Stern model,. **5. Introduction to Polymers (2L)** **5.1** Basic terms : macromolecule, monomer, repeat unit, degree of polymerization. **5.2**. Classification of polymers based on (i) source, (ii) structure, (iii) thermal response, (iv) physical properties. **5.3** Molar masses of polymers: 1. Number average molar mass, 2.Weight average molar mass, 3. Viscosity average molar mass, monodispersity, polydispersity.	**3**	**1**

	6.Quantum Mechanics (2L) Concept of operators : definition, addition, subtraction and multiplication of operators, commutative and non-commutative operators, linear operator, Hamiltonian operator, Eigen function and eigen value, eigen value equation. **7. Nuclear Magnetic Resonance Spectroscopy (1 L)** Nuclear spin, magnetic moment, nuclear 'g' factor, energy levels, Larmor precession, Relaxation processes in n.m.r. (spin-spin relaxation and spin-lattice relaxation). **8. Nuclear Chemistry (2L)** Nuclear reactions – nuclear transmutation, artificial radioactivity, Q- value of nuclear reaction, threshold energy. **8.1** Fissile and fertile material, nuclear fission, chain reaction, factor controlling fission process (multiplication factor and critical size or mass of fissionable material)., nuclear power reactor and breeder reactor. **8.2** Nuclear fusion, characteristics of nuclear fusion, thermonuclear reactions occurring in stellar bodies.		
	1.Molecular Symmetry (2L) 1.1 Introduction and Importance. 1.2 Symmetry elements and symmetry operations. 1.3 Concept of a Point Group with illustrations using the following point gro ups: (i) $C_{\alpha v}$ (HCl), (ii) $D_{\alpha h}$ (H_2), (iii) C2v (H_2O) , (iv) C_{3v} (NH_3 **2. Molecular Orbital Theory for Polyatomic Species (03L)** 2.1 Simple triatomic species: H_3^+ and H_3 (correlation between bond angle and Molecular orbitals). 2.2 Other molecules (considering only σ-bonding): i) BeH_2, ii) H_2O, **3. Structures of Solids (2L)** 3.1 Classification of solids on the basis of bonding. 3.2 Explanation of terms iz.crystal lattice, lattice points, unit cells and lattice constants. 3.3 packing density in simple cubic, bcc, fcc and hcp lattices (numerical problems expected). **4.Acid-base Chemistry in Aqueous Medium (1L)** Acidity of mono- and polyatomic cations. (discussion for above should Include Latimer equation and predominance diagrams). **5.Chemistry in Non-aqueous Solvents (2L)** 5.1 Classification of solvents and importance of non-	**3**	**1**

PGBCH2	aqueous solvents. 5.2 Characteristics and study of liquid ammonia, as non-aqueous solvents with respect to (i) acid-base reactions and (ii) redox reactions **6 Electronic States and Terms for Polyelectronic Atoms (1L)** Introduction: electronic configuration and electronic states, Term symbols, coupling of spin momenta (M_s),orbital momenta (M_l)and spin- orbit coupling or Russell-Saunders coupling. **7 Stability of Complexes (2L)** 7.1 Thermodynamic stability and kinetic stability of complexes with examples. 7.2 Stability constants: Stepwise and overall constants and their inter-relationship. 7.3 Factors affecting thermodynamic stability. **8 Octahedral Complexes (1L)** 8.1 Introduction, types of reactions in complexes. 8.2 Ligand substitution reactions: basic mechanisms. **9 Electronic Spectra (1L)** Types of electronic transitions like intra –ligand transitions, charge transfer transitions and intra-metal transitions and (*d-d* or ligand field transitions for transition metals).		
	1.Stereochemistry (02L) 1.1 Stability ofcycloalkanes: Strains in cycloalkanes-angle,eclipising, transannular (3 to 8 membered). Conformations of cyclohexane, mono- and di- alkyl cyclohexanes and their relative stabilities. 1.2 Stereo selectivity and Stereo specificity: Idea of enantioselectivity (ee) and diastereoselectivity (de).Topicity-enantiotopic and diastereotopic atoms, groups and faces. . **2. Spectroscopy** (05L) **2.1** Introduction : Electromagnetic spectrum, units of wavelength and frequency. **2.2** UV- Visible Spectroscopy: Basic theory, solvents, nature of UV-VIS spectrum, **2.3** IR Spectrocopy: Basic theory, nature of IR spectrum, selection rule , fingerprint region. **2.4** PMR Spectroscopy: Basic theory of NMR, nature of PMR spectrum, chemical shift (∂ unit), standard for PMR, solvents used. Factors affecting chemical shift: (1) inductive effect (2) anisotropic effect (with reference to C=C, CΞC, C=O and		

PGBCH3	benzene ring). Spin- spin coupling and coupling constant. Proton exchange- application of deuterium exchange ,Application of PMR in structure determination. **2.5** Mass Spectrometry: Basic theory.Nature of mass spectrum. General rules of fragmentation. Importance of - molecular ion peak, isotopic peaks, basepeak, Nitrogen rule.Illustrative fragmentation of alkanes and aliphatic carbonyl compounds (No Mclafferty rearrangement). **3. Carbohydrates (02L)** 3.1 Introduction: Classification, Sources, Reducing and non-reducing sugars DL notation. 3.2 Structures of monosaccharides: Fischer projection (4-6 carbon monosaccharides and Haworth formula-Furanose and pyranose forms of pentoses and hexoses. Interconversion :open and Haworth forms of monosaccharides with 5 and 6 carbons. Chair conformation with stereochemistry of D-glucose and D-fructose. Stability of chair forms of D-glucose. **4. Heterocyclic Chemistry (02L)** **4.1** Introduction: aromaticity of furan,pyrrole,thiophene and pyridine. **4.2** Reactivity: Reactivity towards electrophilic substitution reactions- of furan, pyrrole and thiophene on basis of stability of intermediate; and of pyridine on the basis of electron distribution.Nucleophilic substitution reaction of pyridine on the basis of electron distribution. **5.Catalysts and Reagents (01L)** Study of the following catalysts and reagents with respect to functional group transformations and selectivity (no mechanism). **5.1 Catalysts**: stereo selective reduction of olefins.CHO (Rosenmund); Lindlar catalyst: alkynes; Wilkinson's catalyst for **5.2 Reagents**: (1)$LiAlH_4$ and Red-Al: reduction of CO,COOR, CN, NO_2. (2) $NaBH_4$: reduction of CO (3) SeO_2: hydroxylation of allylic and benzylic positions, **6. Natural Products (01L)** Structure determination of natural products: **6.1** Ozonolysis in terpenoids-Examples of open chain and monocyclic monoterpenes. **6.2** Hofmann exhaustive methylation and degradation in	**3**	**1**

	alkaloids –simple open chain and monocyclic amines. **7. Chemistry of some Important Biomolecules: (02L)** **7.1** α-Amino acids: Structure,configuration,Essential amino acids and their abbreviations, classification, Properties: pH dependency of ionic structure and isoelectric point. **7.2** Nucleic acids: Selective hydrolysis of nucleic acids.Sugars and bases in nucleic acids. Stuctures of nucleosides an nucleotides in DNA and RNA. Structure of nucleic acids (DNA and RNA): Base pairing in nucleic acids.		
PGBCH4	**1.Treatment of analytical data-I and sampling** **1.1 Treatment of Analytical Data (2L)** Types of errors, determinate and indeterminate errors, minimization of errors, constant and proportionate errors, accuracy and precision. **1.2 Sampling (2L)** Terms involved, importance of sampling, sampling techniques, sampling of gases, ambient and stack sampling, equipment used, sampling of homogeneous and heterogeneous liquids, sampling of static and flowing liquids, methods and equipments used, sampling of solids. **2.Treatment of Analytical Data (2L)** **2.2 C**riteria for rejection of result: 2.5d rule,4.0 rule and Q test, F teset, testing for significance, null hypothesis.[Numerical problems expected] **3.Solvent Extraction (2L)** **3.1** Partition coefficient and distribution ratio, extraction efficiency, role of complexing agents in solvent extraction, chelation, ion pair formation, solvation, types of solvent extraction: batch, continuous. [Numerical problems expected]. **3.2 Amperometric Titrations (1L)** Basic principles, rotating platinum electrode and nature of the titration curves, applications, advantages and limitations. **4.Concepts in Quality and miscellaneous methods** **4.1 Total quality management (1L)** Concept of quality,ISO series, Good laboratory practices. **4.2 Mass Spectrometry (1L)** Basic principles, introduction of components only. **4.3 Thermal Methods (1L)** Classification of thermal methods, thermogravimetric analysis,basic principles, instrumentation factors affecting	**3**	**1**

	the TG curve, applications **4.4 Introduction to Radio Analytical Techniques (2L)** Classification of the techniques, introduction to neutron activation analysis and its applications		