

BSc Semester 2 – Chemistry (Hons)

Title of the Course: DSC-2: Subject code: 21BSC1C1CHE2L Paper: Chemistry – 2

Number of Theory Credits	Number of lecture hrs/semester	Number of practical Credits	Number of practical hrs/ sem
4	56	2	56
Content of Theory Course 2			56Hrs
Unit – 1 Chemical bonding, molecular structure & Periodicity of elements.			14
<p>Ionic Bonding: General characteristics of ionic compounds. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Born-Landé equation and calculation of lattice energy. Born-Haber cycle and its applications.</p> <p>Polarizing power and polarizability: Fajan's rules, ionic character in covalent compounds and percentage of ionic character.</p> <p>Covalent bonding: General characteristics of covalent compounds. VB approach, shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements. Concept of resonance and resonating structures of NO_3^-, CO_3^{2-} and SO_4^{2-}.</p> <p>Molecular Orbital Theory: LCAO method, bonding and antibonding MOs and their characteristics for s-s, s-p and p-p combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules and ions of 1st and 2nd periods and heteronuclear diatomic molecules such as CO, NO and NO^+. Comparison of VB and MO approaches. Numerical problems are to be solved wherever applicable. (14 Lectures)</p>			

Unit - 2 Acidic Strengths of Organic compounds and Stereochemistry:	14
<p>Strengths of Organic acid and bases: Comparative study with emphasis on factors effecting pK values. Relative strength of aliphatic and aromatic carboxylic acids- Acetic acid and chloroacetic acid, acetic acid and propionic acid, acetic acid and Benzoic acid. Steric effect- Relative stability of trans and cis-2-butene.</p> <p>Concept of Confirmation analysis with referee to Ethane & n-Butane with staggered & eclipsed confirmations & energy profile diagrams. (04 Lectures)</p> <p>Stereoisomerism: Definition of stereoisomerism, conformational isomers and configurational isomers (distinction between conformation and configuration). Newman, Sawhorse and Fischer projection formulae and their interconversions.</p> <p>Geometrical isomerism: Definition, reason for geometrical isomerism, E and Z notation -CIP rules and examples, determination of configuration of geometric isomers by dipole moment method and anhydride formation method, <i>syn</i> and <i>anti</i> isomers in compounds containing C=N.</p> <p>Optical isomerism: Chirality/asymmetry, enantiomerism, diastereomerism and meso compounds. R and S notations (compounds with two asymmetric centers), D and L configurations and <i>threo</i> and <i>erythro</i> nomenclature, racemic mixture and racemization,</p> <p>Resolution: Definition, Resolution of racemic mixture by: i) Mechanical separation ii) Formation of diastereomers iii) Biochemical methods. Biological significance of chirality. Problems are to be solved wherever applicable. (10 Lectures)</p>	
Unit - 3 Solids & Liquid crystals	14
<p>Solids: Types of solids. Symmetry elements, unit cells, crystal systems, Bravais lattice types and identification of lattice planes. Laws of Crystallography - Law of constancy of interfacial angles, Law of rational indices. Miller indices. X-Ray diffraction by crystals, Bragg's law. Structures of NaCl, KCl and CsCl. Defects in crystals.</p> <p>Liquid Crystals: Explanation, classification with examples- Smectic, nematic, cholesteric, disc shaped and polymeric. Structures of nematic and cholesteric phasesmolecular arrangements in nematic and cholesteric liquid crystals. Applications of liquid crystals in LCDs and thermal sensing. Numerical problems are to be solved wherever applicable. (7 Lectures)</p> <p>Chemical Kinetics: Review of reaction rates, order and molecularity. Factors affecting rates of reaction: concentration pressure, temperature, catalyst, etc. Examples for different orders of reactions. Derivation of integrated rate equations for zero and second order reactions (both for equal and unequal concentrations of reactants). Half-life of a reaction (numerical problems). Methods for determination of order of a reaction by half life period and differential equation method. Effect of temperature on reaction rates,</p>	

temperature coefficient, Concept of activation energy and its calculation from Arrhenius equation. Theories of Reaction Rates: Collision theory and Activated Complex theory of bimolecular reactions. Comparison of the two theories (qualitative treatment only). Numerical problems are to be solved wherever required. (7 Lectures)	
Unit - 4 ANALYTICAL CHEMISTRY	14
<p>Liquid state: Molecular forces and general properties of liquids.</p> <p>Surface tension: surface tension, surface energy, effect of temperature on surface tension, shapes of liquid drops and soap bubbles, capillary action, determination of surface tension by capillary rise method, drop weight and drop number methods using stalagmometer. Effect of temperature on surface tension. Parachor, Additive and constitutive properties: atomic and structural parachor. Elucidation of structure of benzene and benzoquinone.</p> <p>Viscosity: Definition, viscosity coefficient, fluidity, molecular viscosity, relative viscosity and absolute viscosity, determination of coefficient of viscosity using Ostwald viscometer. Effect of temperature, size, weight, shape of molecules and intermolecular forces.</p> <p>Refractive index: Definition, Specific and molar refraction. Determination of refractive index using Abbe's refractometer. Additive and constitutive properties: Elucidation of structure of molecules. Numerical problems are to be solved wherever applicable. (8 Lectures)</p> <p>Gravimetric Analysis: Stages in gravimetric analysis, requisites of precipitation, theories of precipitation, factors influencing precipitation, coprecipitation and postprecipitation. Structure, specificity, conditions and applications of organic reagents such as salcylaldehyde, oxine, dimethylglyoxime, cupron and cupferron in inorganic analysis. Advantages of organic reagents over inorganic reagents. (6 Lectures)</p>	

Reference Books

1. Inorganic Chemistry

1. Lee, J.D. *Concise Inorganic Chemistry* ELBS, 1991.
2. Cotton, F.A., Wilkinson, G. & Gaus, P.L. *Basic Inorganic Chemistry*, 3rd ed., Wiley.
3. Douglas, B.E., McDaniel, D.H. & Alexander, J. J. *Concepts and Models in Inorganic Chemistry*, John Wiley & Sons.
4. Huheey, J. E., Keiter, E.A., Keiter, R.L. & Medhi, O. K. *Inorganic Chemistry: Principles of Structure and Reactivity*, Pearson Education India, 2006.
5. Shriver, D.F. & Atkins, P.W. *Inorganic Chemistry*, Oxford University Press.
6. Wulfsberg, G. *Inorganic Chemistry*, Viva Books Pvt. Ltd.
7. Rodgers, G. E. *Inorganic & Solid State Chemistry*, Cengage Learning India Ltd., 2008.
8. Mark Weller and Fraser Armstrong, 5th Edition, Oxford University Press (2011-2012)
9. Adam, D.M. *Inorganic Solids: An introduction to concepts in solid-state structural chemistry*. John Wiley & Sons, 1974.
10. G.L. Miessler & Donald A. Tarr: *Inorganic Chemistry*, Pearson Publication.
11. Mahan, B.H. *University Chemistry* 3rd Ed. Narosa (1998).
12. Petrucci, R.H. *General Chemistry* 5th Ed. Macmillan Publishing Co.: New York (1985).

Organic Chemistry

1. Organic Chemistry-P. Y. Bruice, 7th Edition, Pearson Education Pvt. Ltd., New Delhi (2013).
2. Heterocyclic Chemistry- R. K. Bansal, 3rd Edition, New- Age International, New Delhi, 2004
3. McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.
4. Sykes, P. *A Guidebook to Mechanism in Organic Chemistry*, Orient Longman, New Delhi (1988).
5. Stereochemistry-Conformation and Mechanism-P. S. Kalsi, Wiley-Eastern Ltd, New Delhi.
6. Morrison, R.T. & Boyd, R.N. *Organic Chemistry*, Pearson, 2010.
7. Bahl, A. & Bahl, B.S. *Advanced Organic Chemistry*, S. Chand, 2010.
8. Graham Solomons, T. W., Fryhle, C.B. & Snyder, S.A. *Organic Chemistry*, John Wiley & Sons (2014).
9. Organic Chemistry Volume-I, II- I. L. Finar, 6th Edition, ELBS London (2004).
10. Organic Chemistry-F.A. Carey, 4th Edition, McGraw Hill (2000).
11. Modern Organic Chemistry - R.O.C. Norman and D.J. Waddington, ELBS, 1983
12. Understanding Organic reaction mechanisms - A. Jacobs, Cambridge Univ. Press, 1998
13. Organic Chemistry - L. Ferguson, Von Nostrand, 1985
14. Organic Chemistry - M. K. Jain, Nagin & Co., 1987
15. Organic Chemistry- Mehta and Mehta.

Physical Chemistry

1. Barrow, G.M. *Physical Chemistry* Tata McGraw-Hill (2007).
2. Castellan, G.W. *Physical Chemistry* 4th Ed. Narosa (2004).
3. Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry* Cengage Learning India Pvt. Ltd., New Delhi (2009).
4. P.W. Atkins: *Physical Chemistry*.
5. W.J. Moore: *Physical Chemistry*
6. Text Book of Physical Chemistry - P.L. Soni, S. Chand & Co., 1993
7. Text Book of physical chemistry - S. Glasstone, Mackmillan India Ltd., 1982
8. Principles of Physical Chemistry - B. R. Puri, L.R. Sharma and M.S. Patania, S.L.N. Chand & Co. 1987

9. Physical Chemistry - Alberty R. A. and Silbey, R.J. John Wiley and sons, 1992
10. Physical Chemistry - G.M. Barrow, Mc Graw Hill, 1986
11. Physical Chemistry (3rd Edition) - Gilbert W. Castilian, Narosa Publishing House, 1985
12. Chemical Kinetics by K. J. Laidler, Tata McGraw Hill Publishing Co., New Delhi.
13. Kinetics and Reaction Mechanisms by Frost and Pearson, Wiley, New York.

Analytical Chemistry

1. Jeffery, G.H., Bassett, J., Mendham, J. & Denney, R.C. *Vogel's Textbook of Quantitative Chemical Analysis*, John Wiley & Sons, 1989.
2. Willard, H. H., Merritt, L.L., Dean, J. & Settle, F.A. *Instrumental Methods of Analysis*, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.
3. Christian, G.D; *Analytical Chemistry*, VI Ed. John Wiley & Sons, New York, 2004.
4. Harris, D. C. *Exploring Chemical Analysis*, Ed. New York, W.H. Freeman, 2001.
5. Skoog, D. A. Holler F.J. & Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Ed.

Content of Chemistry Lab-2: List of Experiments to be conducted
Title of the Course: DSC-2: Subject code: 21BSC1C1CHE2P; Paper: Chemistry Lab-2

PART-A Inorganic Chemistry

TITRIMETRY

1. Determination of carbonate and hydroxide present in a mixture.
2. Determination of oxalic acid and sodium oxalate in a given mixture using standard $\text{KMnO}_4/\text{NaOH}$ solution
3. Standardization of potassium permanganate solution and determination of nitrite in a water sample
4. Standardization of silver nitrate and determination of chloride in a water sample (demonstration)
5. Determination of alkali content in antacids
6. Determination of chlorine in bleaching powder using iodometric method.

GRAVIMETRY

1. Determination of Ba^{2+} as BaSO_4
2. Determination of Cu^{2+} as CuSCN

PART-B Physical Chemistry

1. Safety Practices in the Chemistry Laboratory, Knowledge about common toxic chemicals and safety measures in their handling, cleaning and drying of glassware's
2. Determination of density using specific gravity bottle and viscosity of liquids using Ostwald's viscometer (Ethyl acetate, Toluene, Chloroform, Chlorobenzene or any other non-hazardous liquids).
3. Study of the variation of viscosity of sucrose solution with the concentration of a solute.
4. Determination of the density using specific gravity bottle and surface tension of liquids using Stalagmometer (Ethyl acetate, Toluene, Chlorobenzene, any other non-hazardous liquids).
5. Study of variation of surface tension of detergent solution with concentration.
6. Determination of specific and molar refraction by Abbes Refractometer. (Ethyl acetate, Methyl acetate, Ethylene Chloride).
7. Determination of the composition of liquid mixture by refractometry. (Toluene & Alcohol, Water & Sucrose).
8. Determination of partition/distribution coefficient - i) Acetic acid in water and cyclohexane.
ii) Acetic acid in Water and Butanol. iii) Benzoic acid in water and toluene.

** Standard solution is to be prepared by students for both in regular and in practical examination.

Examination

In the practical examination, in a batch at least 15 (Fifteen) students may be made. At least two experiments one from inorganic and one from organic experiments is given. Selection of experiments may be done by the students based on lots. Viva questions may be asked on any of the experiments prescribed in the practical syllabus. *Manual is not allowed in the examination.*

Deduction of marks for accuracy: : ± 0.2 CC -15 marks, ± 0.4 CC- 12 marks, ± 0.6 CC- 09 marks, ± 0.8 CC- 06 marks, ± 0.9 CC- 03 marks, above ± 0.9 – zero marks.

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Final semester examination: one experiment from PART-A and PART-B given as a major and minor with 20 +15 marks allotment and subdivision made accordingly by the examiners.

Open Elective Course-Chemistry

**Title of the Course: OEC-2: Subject code: 21BSC102CHE2; Paper: Molecules of Life
B.Sc. Semester – II**

Courses	Credits	No. of Classes/Week	Total No. of Lectures/Hours	Duration of Exam in hrs	Internal Assessment Marks	Semester End Exam Marks	Total Marks
Theory	03	03	42	2	40	60	100

UNIT I

Carbohydrates

Sugars, non-sugars, reducing and non-reducing sugars. Occurrence and general properties of glucose and fructose. Open chain and Haworth ring structures of glucose and fructose. Epimers, mutarotation and anomers.

Disaccharides: Occurrence of disaccharides (Sucrose, Maltose and Lactose). Glycosidic linkage in disaccharides. Ring structures of sucrose, maltose and lactose.

Polysaccharides: Starch – monomer units, glycosidic linkage, components-difference in their structure (explanation only) and solubility in water. Cellulose and glycogen – monosaccharide, glycosidic linkage, structure (explanation only). Biological importance of carbohydrates. **(8 Lecturers)**

Amino Acids, Peptides and Proteins

α - amino acids , general formula, zwitter ion form of α - amino acid, general formula. Isoelectric point and its importance. Classification of amino acids as essential and non-essential- examples. Configuration of optically active α -amino acids (found in proteins). Peptide bond. Proteins: classification based molecular shape –fibrous and globular, examples. Structure of protein – qualitative idea about primary, secondary, tertiary, and quaternary structures (diagrams not required). Denaturation of protein. **(6 lecturers)**

UNIT II

Enzymes and correlation with drug action

Mechanism of enzyme action, factors affecting enzyme action, Co-enzymes and cofactors and their role in biological reactions, Specificity of enzyme action (including stereospecificity), Enzyme inhibitors and their importance, phenomenon of inhibition (Competitive and Noncompetitive inhibition including allosteric inhibition). **(7 lecturers)**

Drug action- Receptor theory. Structure–activity relationships of drug molecules, binding role of –OH group, –NH₂ group, double bond and aromatic ring. **(4 lecturers)**

Oils and fats

Biological Importance of oils and fats. Fatty acids (saturated, unsaturated fatty acids, formation of triglycerides and general formula of triglycerides. Chemical nature of oils and fats-saponification, acid hydrolysis, rancidity and its prevention methods, refining of oils, hydrogenation of oils, drying of oils. Iodine value.

Introduction to lipids, classification. Biological importance of triglycerides, phospholipids, glycolipids, and steroids (cholesterol). **(6 lecturers)**

UNIT III

Nucleic Acids

Components of nucleic acids: Adenine, guanine, thymine and cytosine (Structure only), other components of nucleic acids, Nucleosides and nucleotides (nomenclature), Structure of polynucleotides; Structure of DNA (Watson-Crick model) and RNA (types of RNA), Genetic Code, Biological roles of DNA and RNA: Replication, Transcription and Translation. **(6 lecturers)**

Vitamins and Hormones

Classification and biological significance, source and structure of Vitamin A, B1(thiamine), B2(riboflavin), B6(pyridoxine), a-tocopherol, K1 (phylloquinone), C(ascorbic acid). Deficiency diseases of vitamins,

Hormones: definition, classification with examples, functions and deficiency diseases of hormones. **(5 lecturers)**

Course Outcome / Learning Outcome:

After studying this paper the student would be able to

1. Acquire knowledge about different types of sugars and their chemical structures.
2. Identify different types of amino acids and determine the structure of peptides.
3. Explain the actions of enzymes in our body and interpret enzyme inhibition.
4. Predict action of drugs. Depict the biological importance of oils and fats. Importance of lipids in the metabolism Differentiate RNA and DNA and their replication. Explain production of energy in our body.

Reference Books:

1. Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Finar, I. L. *Organic Chemistry (Volume 1)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Finar, I. L. *Organic Chemistry (Volume 2)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
4. Nelson, D. L. & Cox, M. M. *Lehninger's Principles of Biochemistry 7th Ed.*,
5. W. H. Freeman. Berg, J.M., Tymoczko, J.L. & Stryer, L. *Biochemistry*, 2002.