

B.Sc. 5th SEMESTER
DISCIPLINE SPECIFIC ELECTIVES (DSEs)
OPTION-I

CH520DA: CHEMISTRY: NUCLEAR CHEMISTRY, HETEROATOMS AND SOLUTION THERMODYNAMICS

Course Weightage: 04 Credit (Theory)

Max. Marks: 60
No. of Contact Hours: 60

Course Objectives:

To introduce students to nuclear chemistry, heteroatom (nitrogen) chemistry and applications of thermodynamics to solutions.

Course outcomes: The students after learning the course will be able to understand:

1. *The nuclear structure, radioactivity and its applications.*
2. *The preparation and chemical reactivity of nitro-compounds, amines and aromatic heterocycles.*
3. *The applications of thermodynamic principles to solutions.*

UNIT I: Nuclear Chemistry (15 Contact hours)

The nucleus: Subatomic particles, nuclear forces (Meson theory), nuclear size and density. Stability of nucleus: n/p ratio, binding energy, packing fraction, structure of nucleus- Shell model and Liquid drop model.

Radioactivity: Natural and induced. Radioactive decay- α -decay, β -decay, γ -decay; neutron, emission, positron emission and electron capture. Group displacement law and radioactive series. Measurement of radioactivity: ionization chamber, geiger counters, scintillation counters. **Applications:** Carbon dating, neutron activation and isotope dilution analyses

Radiation chemistry: Units of radiation; LET and G-Value. Dosimetry, radiation chemistry of oxygen.

UNIT II: Nitrogen bearing compounds (15 Contact hours)

Nitro-compounds: Classification, general properties and preparation (nitration).

Reactions: Reaction with nitrous acid, reduction of nitro compounds by chemical and electrolytic methods. Di- substitution of aromatic nitro compounds: synthesis of o-, m-, p-dinitrobenzenes.

Amines: Classification and preparation via ammonolysis of halides, reductive amination, reduction of nitriles, Gabriel-Phthalamide reaction and Hofmann Bromamide reaction.

Basicity of amines, factors affecting basicity. Carbylamine reaction, Hinsberg Test, Schotten-Baumann Reaction.

Electrophilic substitutions in aniline: Nitration, bromination, sulphonation. Diazonium salts: Preparation and reactions; Sandmeyer Reaction, Gattermann reaction. Synthesis of phenols and carboxylic acids from diazonium salts. Coupling of diazonium salts.

UNIT III: Heterocyclic compounds (15 Contact hours)

Naming monocyclic compounds with one and more than one heteroatom, handling the extra hydrogen. Structural features of pyrrolidine, pyrrole, furan, thiophene, pyridine, piperidine. Comparison of basicity of pyrrolidine, pyrrole, piperidine and pyridine. Pall-Knorr synthesis of pyrrole, furan and thiophene. Electrophilic substitution reactions of pyrrole, furan and thiophene and their relative reactivity. Mechanistic details in the preparations of indole and quinoline using Fischer-Indole and Bishlier-Napierlaski synthesis.

UNIT IV: Thermodynamics of solutions

(15 Contact hours)

Thermodynamics of ideal solution: Free energy change of mixing, Enthalpy, Volume and Entropy change of mixing, Non-ideal solutions, Concept of activity and activity coefficient, Chemical potential and its variation with pressure and temperature, Gibbs Duhem equation

Thermodynamics of colligative properties: Elevation of boiling point and depression of freezing point. Excess thermodynamic functions of non-ideal solutions.

Books Recommended:

1. Principles of Inorganic Chemistry; B.R. Puri, L.R. Sharma and K.C. Kalia; 33rd Edn. Milestone Publishers & Distributors/ Vishal Publishing Co., 2017.
2. Essentials of Nuclear Chemistry; H. J. Arnikar; 4th ed.; New Age; 2002
3. Introduction to Nuclear Chemistry; D. J. Carswell; Elsevier; 1967.
4. Fundamentals of Heterocyclic Chemistry by Louis D. Quin and John A. Tyrell.
5. March's Advanced Organic Chemistry: Reactions, Mechanisms and Structure; M. B. Smith; 7th Edition, Wiley, 2013.
6. Principles of Physical Chemistry; B.R. Puri, L.R. Sharma and L.S. Pathania; 47thEdn, Vishal Pubs & Co, 2017.
7. Atkins' Physical Chemistry; P. Atkins, J. de Paula, J. Keeler; 11thEdn. Oxford University Press, 2018.
8. Physical Chemistry; T. Engel, P. Reid,; 3rdEdn., Pearson India, 2013.
9. A Textbook of Physical Chemistry, Thermodynamics and Chemical Equilibrium (SI Units) - Vol. 2; K.L Kapoor; 6thEdn, McGraw Hill Education, 2019.

B.Sc. 5th SEMESTER-CHEMISTRY
OPTION-I (LAB COURSE)

CH520DA: PRACTICALS

Max. Marks: 30

Course Weightage: 02 Credit

No. of Contact Hours: 60

1. Conductometry

- a. To determine the strength of the given acid conductometrically using standard alkali solutions.
- b. To determine the solubility and solubility product of a sparingly soluble electrolyte conductometrically.

2. pH metry

- a. To determine the concentration of a strong acid solution by titration with a strong base.
- b. To determine pK_a of a weak acid by pH metry.
- c. Estimation of acid content of soft drinks by pH metric titrations.

3. Gravimetry (Any Three)

- a. Estimation of Copper as CuSCN.
- b. Estimation of Nickel as [Ni(dm_g)₂].
- c. Estimation of Silver as AgCl.
- d. Estimation of Barium as BaSO₄.

4. Chromatography and Synthesis

- a. Separation of mixture of dyes by TLC / Column chromatography.
- b. Preparation of nitro and *m*-dinitrobenzene from Benzene.

Books Recommended:

1. Advanced Practical Physical Chemistry; J.B. Yadav; Krishna Prakashan Media (P) Limited, 2015.
2. Senior Practical Physical Chemistry PB; B. D. Khosla; V. C. Garg; A. R. Gulati; R. Chand & Co, 2008.
3. Advanced Physical Chemistry Experiments; J. N. Gurtu, A. Gurtu, PragatiPrakashan, 2008.
4. Vogel's Qualitative Inorganic Analysis; G. Svehla; 7th Ed., Pearson Education. 2013.
5. Advanced Practical Inorganic Chemistry; Gurdeep Raj; Krishna Prakashan Media (P) Ltd; 2013.
6. Vogel's Textbook of Quantitative Inorganic Analysis; Bassett, G. H. Jeffery, J. Basset, J. Mendham, R. C. Denny, 6th ed., ELBS; 2007.
7. Advanced Practical Organic Chemistry; N. K. Vishnoi; 3rdEdn; Vikas Publishing, 2009.
8. Vogel's Textbook of Practical Organic Chemistry; B.S. Furniss, A.J. Hannaford, P.W.G. Smith, & A.R., Tatchell; 5th Edn., Pearson India, 2003.
9. Laboratory Manual in Organic Chemistry; R.K. Bansal; 5th Revised Edn, New Age International Limited, 2008.
10. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis; V. K. Ahluwalia, R. Aggarwal; Universities Press, India, 2000.

B.Sc. 5th SEMESTER
DISCIPLINE SPECIFIC ELECTIVES (DSEs)
OPTION-II

CH520DB: CHEMISTRY: CHEMISTRY OF BIOMOLECULES

Course Weightage: 04 Credit (Theory)

Max. Marks: 60
No. of Contact Hours: 60

Course Objectives:

To impart knowledge about biomolecules and their role in bio-systems

Course outcomes: The students after learning the course will be able to understand;

1. The structure and properties of biomolecules (carbohydrates, amino acids, proteins, lipids, DNA, RNA) and their role in bio-systems.
2. The importance of metal ions in bio-systems.
3. The application of thermodynamics to bio-systems.

UNIT 1: Bio-organic chemistry-I (15 Contact hours)

Carbohydrates: Classification of carbohydrates, D and L-Notation, Configuration of aldoses and ketoses, Reactions of monosaccharides in basic solutions, Oxidation, reduction reactions of monosaccharides, Chain lengthening: Fischer Kiliani synthesis, Chain shortening: Wohldegration, Stereochemistry of glucose (Fischer proof). Open chain and cyclic structure of glucose and fructose, Anomers and mutarotation, Formation of glycosides, Anomeric effect, Reducing and non-reducing sugars, Structural features of disacharrides (sucrose, maltose, lactose) and polysacharrides (starch and cellulose).

UNIT II: Bio-organic chemistry -II (15 Contact hours)

Amino Acids: Classification of amino Acids, Essential amino acids, configuration of amino acids, Acid-base properties of amino acids and Iso-electric point.

Peptide and disulfide bonds, Synthesis of simple peptides (upto dipeptides) by N-protection (t-butyloxycarbonyl and phthaloyl) & C-activating groups and Merrifield solid phase synthesis.

Overview of primary, secondary, tertiary and quaternary structure of proteins. Determination of primary structure of polypeptides/proteins, End group analysis. Denaturation of Proteins.

Classification of lipids, oils and fats, common fatty acids present in oils and fats. Saponification value, Iodine number.

Components of nucleic-acids: Adenine, guanine, thymine and cytosine (structure only), other components of nucleic acids, nucleosides and nucleotides (nomenclature), Structure of polynucleotides; DNA, RNA.

UNIT III: Bio-inorganic chemistry 15 Contact hours

Concept of essentiality, criteria and classification of essential elements as per their role in living systems, bulk metals and trace metals, Role of alkali and alkaline earth metals in bio-systems with special reference to Na⁺, K⁺ and Mg²⁺ ions: Na⁺/K⁺ pump; Role of Mg²⁺ ions in energy production and chlorophyll. Role of Ca²⁺ in blood clotting, stabilization of protein structures and structural role (bones).Application of radioactive elements for biosystems.

Dioxygen transport (haemocyanin and hemoerythrin), Structure and physiological role of hemoglobin and myoglobin, Bohr effect and cooperativity.

UNIT IV: Biophysical chemistry**(15 Contact hours)**

Standard free energy, entropy and chemical potential change in biochemical reactions, effect of temperature and pH on ΔG° . Methods of determination of free energy changes. Relationship between K_{eq} and ΔG° . Oxidation-reduction reactions in biological systems. Free energy changes of oxidation-reduction changes. High energy compounds: ATP, structure and hydrolysis.

Buffer solutions, buffer in tissues, buffer action, buffer capacity. Coupled reactions and their significance in biological systems.

Mechanism of membrane transport: Transport through cell membrane, active and passive transport systems.

Books Recommended:

1. Lehninger's Principles of Biochemistry, Nelson, D. L. & Cox, M. M. 7th Ed., W. H. Freeman, 2017.
2. Bruice, P.Y. Organic Chemistry, 8th Edition, 2016.
3. Principles of Biochemistry; Voet, voet and Pratt, Wiley and Sons, 2016.
4. Biological Chemistry by James. P. Allen, Wiley Blackwell, 2008.
5. Bio inorganic Chemistry ; K. Hussain Reddy; New Age International (P) Ltd; 2005
6. Metal -Ions in Biochemistry; P. K. Bhattacharya; Narosa Publishing House; 2005.
7. Biophysical Chemistry-J.L. Gurth and A. GurthPragatiPrakashan 2009, 3rd Edition

B.Sc. 5th SEMESTER-CHEMISTRY
OPTION-II (LAB COURSE)

CH520DB: PRACTICALS
Course Weightage: 02 Credit

Max. Marks: 30
No. of Contact Hours: 60

1. Separation of a given mixture of sugars by paper Chromatography (2 exercises).
2. Separation of a given mixture of amino acids by paper Chromatography (2 exercises).
3. To determine the saponification value of an oil/fat.
4. To determine the iodine value of an oil/fat.
5. Differentiate between a reducing/non-reducing sugars.
6. To find the pKa of a given amino acid.
7. To study the titration curve of glycine.
8. To determine the concentration of glycine solution by formylation method.

Books Recommended:

1. Vogel's Textbook of Practical Organic Chemistry; B.S. Furniss, A.J. Hannaford, P.W.G. Smith, & A.R., Tatchell; 5th Edn., Pearson India, 2003.
2. Advanced Practical Organic Chemistry; N. K. Vishnoi; 3rdEdn; Vikas Publishing, 2009.
3. Laboratory Manual in Organic Chemistry; R.K. Bansal; 5th Revised Edn, Nw Age International Limited, 2008.
4. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis; V. K. Ahluwalia, R. Aggarwal; Universities Press, India, 2000.
5. Comprehensive Practical Organic Chemistry: Qualitative analysis Ahluwalia, V.K. & Sunita Dhingra; Universities Press, India, 2004.