4) Qualitative analysis of Amino acids (Ninhydrin, Xanthoproteic, Millon's, and lead acetate test)
5) Qualitative test for Carbohydrates: monosaccharides, disaccharides, and polysaccharides (Molisch, Fehling/ Benedict, Barfoed, Seliwanoff's, Osazone and Iodine test)
6) To determine the Iodine Number of oil/fat.
7) Qualitative test for Nucleic acid (Orcinol and DPA).

ESSENTIAL/RECOMMENDED READINGS

1) Nelson, D.L. and Cox, M.M. (2017). Lehninger: Principles of Biochemistry (7th ed.). W.H. Freeman & Company (New York), ISBN:13: 9781464126116 / ISBN:10-1464126119.
2) Berg, J. M., Tymoczko J. L. and Stryer L. (2011) 7th Edition. Biochemistry. New York, USA: W. H. Freeman and Co. ISBN-13: 978142927635.
3) An Introduction to Practical Biochemistry (1998) 3rd ed., Plummer D. T., Tata McGraw Hill Education Pvt. Ltd. (New Delhi), ISBN:13: 978-0-07-099487-4 / ISBN:10: 0-07-099487-0.

SUGGESTIVE READING:

1) Devlin, T.M., (2011). Textbook of Biochemistry with Clinical Correlations. 7th edition John Wiley & Sons, Inc. (New York). ISBN: 978-0-4710-28173-4.
2) Campbell, M.K. and Farrel, S.O. (2017). 9th Edition. Biochemistry. Boston, USA: Brooks/Cole Cengage Learning. ISBN-13: 978-1305961135

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC CORE COURSE – 2 (DSC-2): Proteins

Credit distribution, Eligibility and Prerequisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Proteins DSC 2	4	2	0	2	Class XII Science (Combination I: Chemistry + Biology/ Biological Studies/ Biotechnology/	NIL

Biochemistry + Physics OR

Combination II: Chemistry + Biology/ Biological Studies/ Biotechnology/ Biochemistry + Mathematics)

Learning Objectives

The course aims to introduce "proteins" and their importance to modern biochemistry, highlighting their structural features and unique characteristics that help them participate in every physiological process in life, thus also playing an important role in disease manifestation and their interventions.

Learning Outcomes

After completion of the course, a student will

- Understand the diverse functions of proteins in a cell
- Understand the hierarchy of protein architecture – primary, secondary, tertiary & quaternary structure, with the ability to distinguish features of globular & fibrous proteins
- Be able to comprehend the fundamental mechanisms of protein folding and stability and their relation to conformational diseases
- Understand specialized proteins like structural proteins
- Gain comprehension of structure-function relationship of proteins and their significance in physiology, diseases and applications in industry and medicine.

SYLLABUS OF DSC - 2

THEORY

Unit – 1 **(2 Hours)**

Introduction to proteins: Introduction to peptides and proteins. Structural and functional diversity. Classification of proteins – simple and conjugated proteins; monomeric and multimeric proteins.

Unit – 2 **(12 Hours)**

Hierarchy of protein structure organization: Organization of protein structure into primary, secondary, tertiary and quaternary structures. Forces stabilizing the protein structure - covalent

(disulfide bridges) and non-covalent (electrostatic interactions and salt bridges, hydrophobic, hydrogen bonding, van der Waals). The peptide bond, dihedral angles psi and phi, helices, sheets, turns and loops, Ramachandran map. Motifs and domains. Structural proteins - α-keratin, silk fibroin, collagen. Globular and fibrous proteins, membrane proteins.

Unit – 3 **(05 Hours)**

Protein sequencing and Databases: Sequencing techniques - N-terminal and C-terminal amino acid analysis, Edman degradation. Generation of overlap peptides using different enzymes and chemical reagents. Disulfide bonds and their location. Solid phase peptide synthesis. Protein databases – sequence and structure based.

Unit – 4 **(05 Hours)**

Protein folding and conformational diseases: Denaturation and renaturation of Ribonuclease A – discovery of protein folding. Introduction to thermodynamics of protein folding. Assisted folding by molecular chaperones, chaperonins and PDI. Diseases associated with protein misfolding – Alzheimer's and Creutzfeldt-Jakob disease.

Unit – 4 **(6 Hours)**

Specialized proteins: Transport protein: myoglobin and haemoglobin - Oxygen binding curves, influence of 2,3-BPG, CO2 and H^+; Cooperativity between subunits and models to explain the phenomena - concerted and sequential models. Haemoglobin disorders – Sickle cell anemia.

PRACTICAL

(60 Hours)

1) Scanning of proteins using UV-visible absorbance method
2) Solvent perturbation and denaturation studies of a protein
3) Estimation of proteins using Biuret method.
4) Estimation of proteins using Lowry/Bradford method.
5) Determination of isoelectric point of protein
6) Understanding protein sequence databases and homology modeling of proteins
7) Molecular Visualization Softwares: Pymol and Rasmol for protein structures from PDB

ESSENTIAL/ RECOMMENDED READINGS

1) Nelson, D.L., Cox, M.M. (2017). Lehninger: Principles of Biochemistry (7th ed.). New York, WH: Freeman and Company. ISBN13: 9781464126116, ISBN10: 1464126119
2) Schulz, G.E., Schirmer, R.H. (1979). Principles of protein structure. Springer, ISBN 978-1-4612- 6137-7
3) Scopes, R.K. (1994) Protein Purification. Principles and Practice (3rd ed). Springer, ISBN 978-1-4737-2333-5