# Semester III

## Protein Chemistry and Function

**Marks: 150**

Protein chemistry and function is a discipline, which aims at understanding the chemical properties of the amino acids, structural architecture of the proteins and how proteins fold to their native, functional forms. The defect in the folding of proteins and their link to various genetics/metabolic diseases is studied. This course includes various analytical techniques used in characterization of the proteins and a detailed account of how enzymes function: their kinetics, regulation and inhibition.

**THEORY** **Total Lectures: 48**

**Unit I: Properties of amino acids and metabolism: (04 Lectures)**
**(Chapter 3, 18: Nelson and Cox)**

Structure and classification of amino acids, concept of pKa, zwitterion, isoelectric point, Optical properties, Lamberts-Beer Law, Molar ellipcities of chromophoric groups, overview of amino acid metabolism (phenylalanine and one branched chain amino acid).

**Unit II: Peptide conformation (08 Lectures)**
**(Chapter 4: Nelson and Cox)**

Definition of peptide, peptide unit, peptide group, bond length, cis and trans conformation, Ramachandran Plot, primary, secondary (alpha helix, beta sheet, beta turn, collagen helix and other non repetitive helices), tertiary structure (with examples), Motifs, super secondary structures, Domain and Quaternary structures (with examples).

**Unit III: Protein stability and folding (08 Lectures)**
**(Chapter 4: Nelson and Cox)**

Definition of native and denatured state, protein stability, forces that maintains the native state stability, Protein denaturation by chaotropic agents (urea, GdmCl), SDS and heat, Protein folding (hydrophobic collapse, Anfinsen Experiments, Levinthal Paradox), chaperone-assisted protein folding.

**Unit IV: Analytical methods in protein characterization (12 Lectures)**
**(Chapter 3: Nelson and Cox)**

Paper and Thin-layer chromatography, Ion exchange chromatography, Gel filtration and Affinity chromatography, SDS-PAGE, IEF, 2D-Gel electrophoresis, Dialysis, Mass Spectrometry, N-terminal and C-terminal sequencing.

**Unit V: Enzymes (12 Lectures)**
**(Chapter 6: Nelson and Cox)**

Introduction to enzyme, concept of lock and key and induced fit theory, concept of activation energy and binding energy. Enzyme kinetics, the Michaelis-Menten equation and its physiological significances, double reciprocal plots. Enzyme Inhibition, types of inhibitors of enzyme and their examples. Turnover Number.

Regulatory enzymes: General properties of allosteric enzymes, regulation by covalent modification (including co-enzymes), negative and positive cooperativity. Zymogens, Isoenzymes.

**Unit VI: Protein misfolding and diseases (04 Lectures)**
**(Chapter 4: Nelson and Cox)**

How and why certain proteins misfold and how this misfolding is linked to many disease processes. Introduction to certain conformational diseases: Alzheimer's, Parkinson, Prion Diseases, p53 disorder in cancer.

## PRACTICALS

1. Verification of Beer's Law
2. Protein estimation by any one method: Lowry's/Bradford method.
3. Separation of amino acids by thin layer chromatography.
4. To perform salting in and salting out by ammonium sulphate, using leaf extract or any other extract and to desalt by dialysis.
5. Calculation of void volume of Sephadex G -25 column, using blue dextran
6. Assay of any one enzyme under optimal conditions.
7. To study the effect of temperature on the activity of enzyme.
8. To study the effect pH on the activity of enzyme.

**ESSENTIAL BOOKS**


1. Lehninger Principles of Biochemistry, 5$^{th}$edition (2012), David L. Nelson and Michael M. Cox; W. H. Freeman.
2. An Introduction to Practical Biochemistry, 3$^{rd}$ edition (1987), Plummer, McGraw-Hill College.


**SUGGESTED BOOKS**


1. Introduction to Protein Structure, 2$^{nd}$ edition (1999), Carl Branden and John Tooze; Garland Science.
2. Principles and Techniques of Practical Biochemistry, 5$^{th}$edition (2000), Keith Wilson and John Walker; Cambridge University Press.
3. Protein Folding, 1$^{st}$ edition (1992), Thomas E. Creighton; W. H. Freeman Company.
4. Structure and Function of Intrinsically Disordered Proteins, 1$^{st}$ edition (2010), Peter Tompa; CRC Press.