Approval: 9th Senate Meeting

Course Name: Protein Sciences in Therapeutics

Course Number: BY519

Credit: 3-0-0-3

Prerequisites: IC 136 - Understanding Biotechnology & its Applications or Consent of Faculty member

Students intended for: B. Tech. 3rd and 4th year, MS/M. Tech., Ph.D.

Elective or Compulsory: Elective

Semester: Odd/Even

Course Objectives:

This course is a blend of modern discoveries and applications in protein sciences along with conventional protein science concepts and methods. Recent discoveries that some proteins without having structure in physiological buffer conditions are abundant in nature, constituting up to 40% of human proteome in part or full, lead to a new branch of Intrinsically Disordered Proteins (IDPs). Given the fact that 75% regulatory proteins are disordered in full or part. IDPs are involved in cell responsible for a wide range of diseases. IDPs are also present in other domain of life and are responsible for many cellular functions. This course contains combination of ordered and disordered proteins, making a good combination for protein science understanding.

Course Outline:

Module 1 [2 Lectures]

Introduction and basic concepts of proteins. Protein structure and function.

Module 2 [6 Lectures]

Intrinsically Disordered Proteins: Sequence composition of IDPs, distribution of IDPs in nature and their physiological roles, intrinsically disordered regions, fuzzy complexes, designed linkers, folding and binding mechanisms of IDPs. Protein disorder in signaling and disease in human and plants.

Module 3 [12 Lectures]

Thermodynamics for therapeutics: a brief introduction and thermodynamic principles. Gibbs free energy, thermochemistry and calorimetry. Protein folding theories and structural transitions in polypeptides. Thermodynamic characterization of therapeutic proteins for highest stability and activities. Thermodynamic basis of protein-protein interaction inhibition.

Module 4 [8 Lectures]

Protein Engineering – Basic Principles and Rationale: Identification of putative enzymes in sequence databases. Enzymes, catalysis and kinetics, factors influencing the speed of enzymatic reaction. Enzyme applications, targets of protein engineering, protein engineering approaches, advantages and limitations. Successful stories of application of protein engineering to improve enzyme catalytic efficiency, enzyme stability and folding.

Module 5 [6 Lectures]

Therapeutic potentials of proteins with specific examples including insulin, anticoagulants, blood substitutes and vaccines. Sequence composition and heteromorphic pairs of proteins.

Module 6 [8 Lectures]

Protein misfolding and amyloid diseases: Alzheimer's disease, Parkinson's disease. Signalling involved in misfolding diseases. Transthyretin as amyloid diseases.

Text & Reference Books:

•Donald Voet, Charlotte W. Pratt, Judith G. Voet. Principles of Biochemistry, 4/e, Wiley, 2012.

•David L Nelson, Michael M Cox, Albert L Lehninger. Lehninger Principles of Biochemistry, 6/e New York : W.H. Freeman, 2013.

•Irwin H. Segel. Biochemical calculations: how to solve mathematical problems in general biochemistry, 2/e Wiley, 1976.

•T Palmer, P L Bonner. Enzymes, 2nd Edition Biochemistry, Biotechnology, Clinical Chemistry. 2/e Woodhead Publishing, 2007.

•Peter Tompa, Alan Fersht. Structure and Function of Intrinsically Disordered Proteins. CRC Press, 2009.

•David Sheehan. Physical Biochemistry: Principles and Applications, 2/e Wiley, 2009.

•Several recent papers from peer reviewed journals like Nature, Science, Molecular Therapy, PNAS, Biochemistry, JBC etc

Specialisation Laboratory courses:

The experiments proposed are listed against each theme of specialization electives. Each student will perform experiments from either "Systems Biology (ML1)" theme or "Medical and Nano-biotechnology (ML2)" theme. The proposed practicals will be finalized based on standardization and infrastructure development. Efforts are made to match the laboratory exercises with the special elective course components.