

JCL 312 (Aug) (3-0-0)**Chemical Biology*****Instructor: T. Govindaraju***

Introduction to the structural aspects of biomolecules: Periodic table of life, General Introduction on structure and function of Proteins, nucleic acids, Carbohydrate, Lipids and their building blocks and derived systems and materials; Structural forces in biological macromolecules.

Chemical and biological synthesis: Introduction to synthesis in chemical biology; Biological synthesis of biomolecules- proteins; nucleic acids, oligosaccharides and lipids; Chemical synthesis of peptides, proteins; nucleic acids; oligosaccharides; Chemical synthesis of lipids. Manual to automated synthesis.

Protein engineering and in vitro evolution: General Introduction; Protein chemical ligation: Native Chemical ligation (NCL), Expressed protein ligation (EPL) and recent developments.

Molecular biology as a toolset for chemical biology: Key concepts in molecular biology, tools and techniques in molecular biology, Cloning and identification of genes in DNA, Integrating cloning and expression, Site-directed mutagenesis.

Molecular recognition and binding: Molecular recognition and binding in chemical biology, Theoretical models of binding, Analysing molecular recognition and binding, Biological molecular recognition studies.

Kinetics and catalysis: Catalysis in chemical biology, Steady state kinetic schemes, Pre-steady-state kinetics, Theories of biocatalysis.

Electron transfer Molecular selection and evolution: Chemical biology and the origins of life, Molecular breeding; natural selection acting on self-organisation, Directed evolution of protein function, Directed evolution of nucleic acids, Catalytic antibodies.

Molecular tools for imaging in chemical biology: Design and application of biological sensors. Small molecular probes: chemical genetics: Chemical probes and tool compounds, diversity oriented synthesis (DOS), Biologically oriented organic synthesis (BIOS), Target discovery and validation: drug discovery, high throughput screening, Small molecule arrays, DNA arrays, protein arrays

Chemical Biology in animal models: Genetic loss of function vs chemical perturbation, In vivo visualization of biological activities, Crossing the blood-brain barrier to engage targets in the brain, Chemical probes applied in tissues and living organisms.

Special topics: Activity based protein profiling and chemoproteomics; peptide-mimic-peptoid in drug discovery; Posttranslational modifications; Bioconjugation (Bio-orthogonal conjugation chemistries, Labeling tools and methods etc.; Bioinformatics resources to aid chemical biology.

Reference Books:

1. Nucleic Acids in Chemistry and Biology- Blackburn, G. M. and Gait, M.
 2. Introduction to Protein Structure. Garland- Branden, C. & Tooze, J.
 3. Essentials of Chemical Biology: Structure and Dynamics of Biological Macromolecules-A. D. Miller and J. Tanner.
 4. The Organic Chemistry of Drug Design-Silverman, R. B.
 5. Chemical Biology: From Small Molecules to System Biology and Drug Design - Stuart L. Schreiber and others.
 6. Chemical Biology: Approaches to Drug Discovery and Development to Targeting Disease – Natanya Civjan
 7. Posttranslational Modification of Proteins: Expanding Nature's Inventory - Christopher T. Walsh
 8. Primary literature, reviews will be used/referred extensively
-