

Course code: JNC312

Credits: 3:0

Course Name: Chemical Biology

Instructor: T. Govindaraju

Syllabus

Introduction: Chemical Biology (1h)

Introduction to the structural aspects^[L]_[SEP] of biomolecules (2h): 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. ^[L]_[SEP]

Chemical and biological synthesis^[L]_[SEP] (6h): 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 (4h): General Introduction; Protein chemical ligation: Native Chemical ligation (NCL), Expressed protein ligation (EPL) and recent developments.

Molecular biology as a toolset for chemical biology (8h): 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 ^[L]_[SEP]

Molecular recognition and binding (6h): Molecular recognition and binding in chemical biology, Theoretical models of binding, Analysing molecular recognition and binding, Biological molecular recognition studies ^[L]_[SEP]

Kinetics and catalysis (4h): Catalysis in chemical biology, Steady state kinetic schemes, Pre-steady-state kinetics, Theories of biocatalysis, Electron transfer ^[L]_[SEP]

Molecular selection and evolution (2h): 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 ^[L]_[SEP]

Molecular tools for imaging in chemical biology (2h): Design and application of biological sensors.

Small molecular probes: chemical genetics (8h): 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

Specialtopics (4h):Activity based protein profiling and chemoproteomics; peptide-mimic-peptoid in drug discovery; Posttranslational modifications; Bioconjugation (Bio-orthogonal conjugation chemistries, Labelingtools and methods etc.; Bioinformatics resources to aid chemical biology.

Reference

- Nucleic Acids in Chemistry and Biology- Blackburn, G. M. and Gait, M.
- *Introduction to Protein Structure*. Garland- Branden, C. &Tooze, J. .
- Essentials of Chemical Biology: Structure and Dynamics of Biological Macromolecules-A. D. Miller and J. Tanner.
- The Organic Chemistry of Drug Design-Silverman, R. B.
- Chemical Biology: from small molecules to system biology and drug design - Stuart L. Schrieiber and others.
- Chemical Biology: Approaches to Drug Discovery and Development to Targeting Disease – NatanyaCivjan
- Posttranslational Modification of Proteins: Expanding Nature's Inventory - Christopher T. Walsh
- Primary literature, reviews will be used/referred extensively