# Drug Design and Translational Biology (SSB-911) (CHR: 03)

## Educational Objectives

The objectives of the course are

- To describe the process of drug design and development
- To identify the challenges faced in each step of the drug discovery process
- To establish process protocols for drug design
- To gain a basic knowledge of computational methods used in drug discovery
- To organise information into a clear report
- To be able to demonstrate the ability to work in teams and communicate scientific information effectively

## Course outcomes

Students are introduced to the principles and practice of Molecular modeling and modern drug discovery. An awareness of rational drug design, based on understanding of three-dimensional (3D) structures and physicochemical properties of drugs and receptors will be created.

## Course Contents

1. **Introduction to Drug Design and Development**

**Drug Discovery as a Process**

- Drug design, skills and knowledge in terms of computational and structural chemistry

- Drug design by integrating synthetic organic chemistry, molecular cell biology, genomics, proteomics, physiology, pharmacology, toxicology, and clinical biochemistry, amongst others.

2. **Target Identification and Validation**

- Role of genomics and bioinformatics in target selection and drug design and development
- Genetic approaches for identification of target candidates
- Genomics and proteomics
- Role of bioinformatics in the analysis of nucleic acid sequence
- Protein sequence and structure
- Expression databases

3. **Approaches to new drug design**

- Drugs Derived from Natural Products
- Existing Drugs as a Source for New Drug Discovery
- Screening for New Drug Leads
- Modern “Rational Approach” to Drug Design
- Approaches to Lead Optimization
- Bioisosteric replacement
- Conformation restriction
- Homolgation of alkyl chain(s) or alteration of chain branching
- Alteration of stereochemistry, or design of geometric isomers or stereo isomers
- Design of fragments of the lead molecule that contain the pharmacophoric group

4. **Combinatorial and Medicinal Chemistry**

- Introduction: Concepts and Terms
- Chemical constitution and biological activity: (Receptor, Theory, Structure Activity Relationships (SAR) and Drug Metabolism)

5. **Drug targets and Drug Designing**

- Introduction and types of drug targets
- Introduction to molecular modeling and computational chemistry
- Structure based designing
- Ligand based designing
- Techniques in drug synthesis

6. **Targets: Membrane Proteins**

- Advantages and disadvantages of membrane proteins as drug targets
- Membrane proteins such as receptors, ion channels and transporters.

7 **Targets: Receptors**

- Receptor Theory
- Receptor Complexes and Allosteric Modulators
- Second and Third Messenger Systems
- Molecular Biology of Receptors
- Receptor Models and Nomenclature
- Receptor Binding Assays
- Lead Compound Discovery of Receptor agonists and antagonists

8 **Targets: DNA, RNA, Enzymes**

- DNA, messenger RNA, and ribosomal RNA as drug targets
- Development of gene-specific inhibitors of transcription
- mRNA blockers
- Inhibition of gene expression at the level of translation

9 **Computer-Aided Drug Design** (CADD)

10 **Molecular Modelling**

- In silico manipulation of molecular structures

- Methods for geometry optimization
- Molecular dynamics simulation & conformational searching.

11 **Ligand-based Drug Design**

- Computational methods for modeling
- Prediction of properties of new leads
- Quantitative structure-activity relationship (QSAR)
- Pharmacophore determination.

12 **Structure Determination and Structure-based Drug Design**

- X-ray crystallography
- NMR spectroscopy
- Mass spectrometry

13 **Prodrug design and applications**

- Concept &Applications
- Prodrug Design Considerations
- Prodrug Forms of Various Functional Groups

14 **Biopharmaceutical aspects in drug design**

- Drug considerations
- Drug product considerations
- Patient considerations

15 **Drug Delivery**

- Bioavailability
- Pharmacokinetics
- Impact of pharmacokinetics on a drug’s bioavailability
- Barriers to drug action
- Pro-drugs as drug delivery systems
- Application of pharmacokinetics and pharmacodynamics in drug delivery

**Recommended Books**

- Computational Drug Design: A Guide for Computational and Medicinal Chemists by David C Young
- Drug-Like Properties Concepts, Structure Design and Methods from ADME to Toxicity Optimization by Li Di & Edward Kerns 2nd Edition