

## **Programme: M.Sc. Bioinformatics**

### **Syllabus: Evolution and Comparative Genomics**

#### **Module 1: Gene evolution**

- (a) Molecular basis of evolution
- (b) Genetic polymorphism, evolution, and selection
- (c) Phylogenetic trees and inferences – distance and character methods, accuracies and statistical tests
- (d) Molecular clocks and linearized trees

#### **Module 2: From genes to genomes**

- (a) Genome projects – organization and objectives
- (b) Genome evolution – prokaryote, eukaryote, vertebrate, human
- (c) Genome sequencing and annotation
- (d) Genome architecture predictions, functional annotations, inference of biological pathways

#### **Module 3: Population genomics**

- (a) Population trees from genetic markers
- (e) Comparative genomics and phylogenomics
- (f) The “-omics”
- (g) Handling genomic data – resources and computation

#### **Module 4: Paper presentation and discussion on recent advances in the field**

#### **References:**

1. “Evolutionary Genomics and Proteomics” by Mark Pagel & Andrew Pomiankowski
2. Research and review articles

### **Syllabus: Next-Generation Sequencing Analysis**

#### **Module 1: Background**

- (a) The need of NGS
- (b) Alternative strategies – competing or complementary

#### **Module 2: Types and platforms**

- (a) Short-read NGS – sequencing by ligation, sequencing by synthesis
- (b) Comparison of short-read platforms
- (c) Long-read sequencing – single-molecule, synthetic
- (d) Comparison of long-read platforms

#### **Module 3: Applications**

- (a) Data generation and processing
- (b) Analysis tools and pipelines
- (c) Quality control

#### **Module 4: Paper presentation and discussion on recent advances in the field**

#### **References: Based on research and review articles**

### **Syllabus: Metagenomics and Microbiome**

#### **Module 1: Introduction to metagenomics**

- (a) Metadata annotations in large-scale data mining
- (b) Metagenome sequencing – whole-genome shotgun metagenomics
- (c) Application of metabolomics and proteomics to metagenomics
- (d) Limitations of assembly algorithms

#### **Module 2: Human microbiome**

- (a) Gut microbiome

- (b) Oral microbiome
- (c) Other human biomes
- (d) Cross-talk between infectious disease and host microbiome
- (e) Viromes and human health

**Module 3:** Software tools to tackle metagenome projects

**Module 4:** Paper presentation and discussion on recent advances in the field

**References:** Based on research and review articles

### **Syllabus: Bioinformatics and Big Data**

**Module 1:** Introduction

- (a) How big is big data, types of big data in bioinformatics
- (b) Significance of big data problems in bioinformatics

**Module 2:** Big data analytics

- (a) Techniques
- (b) Architectures
- (c) Machine learning

**Module 3:** Available tools and challenges

**Module 4:** Paper presentation and discussion on recent advances in the field

**References:** Based on research and review articles

### **Syllabus: Career Development and Business**

**Module 1:** Overview

- (a) Bioinformatics as an industry
- (b) Applications
- (c) R&D workflow

**Module 2:** Ethics and policies

- (a) Intellectual property, innovation and approvals in agriculture, drug and diagnostic discovery
- (b) Use of human and animal subjects, patient care, bioethics, and privacy

**Module 3:** Company formation fundamentals

- (a) Finance
- (b) Marketing
- (c) Licensing, alliances, mergers

**Module 4:** Preparation

- (a) Career opportunities
- (b) resume building, job talk and interview practice

**References:** Based on popular and research articles on the Indian and world market scenarios in the field