**Course title**: **Microbial genomics and metagenomics**

**Credit requirement**: (L-T-P: 3-1-0, Credit: 4)

**Committee for approval**: PGPEC

**Name of the department**: Department of Biotechnology

**Level of the subject**: PG Level

**Compulsory or Elective**: Elective

**Prerequisite**: Nil

**Faculty members willing to teach the subject:**

Pinaki Sar (Department of Biotechnology)
Mrinal K Maiti (Department of Biotechnology)
Ananta K Ghosh (Department of Biotechnology)

**Syllabus:**

Introduction to the basic and applied aspects of genomics; structural and functional components of genomes. From genomics to metagenomics, application to cultured and uncultured microbial diversity (metagenomics), including the use of informational macromolecules such as 16S rRNA. Methods for large-scale sequencing; sequencing platforms, chemistries, and applications. Data management of bioinformatics: basics of genome and metagenome assembly and annotation:assembly of raw sequence data into assembled genomes, alignment of rawsequence data to existing reference genomes. Principles for annotation, annotation systems, problemsassociated with automation of the annotation process. Applications/case studies for genomics and metagenomics in the fields of plant-microbe interactions, metabolic engineering, enzyme/drug discovery, climate change mitigation and geomicrobiology, public health, energy and environment. Global mega projects on microbial genomics and metagenomics in agriculture, food, healthcare, earth system and environmental biotechnology.

**Text books:**

1. Metagenomics Theory, Methods and Applications, Diana Marco (ed), Caister Academic Press, 2010.

2. The Science and Application of Microbial Genomics. E R Choffins (eds). The national academies press, Washington DC, 2013

**Reference books:**

l. Methods in Enzymology Vol 531: Microbial metagenomics, metatranscriptomics and metaproteomics, E F DeLong (Ed) . Academic press, 2013

2. Metagenomics methods and protocols. S Wolfgang, D Rolf (Eds.), Springer, 2010

**Content: Lectures and tutorials (total: 48 hours):**

Introduction to the basic and applications of microbial genomics and Metagenomics; industrial applications (2 lectures)

Structural and functional components of genomes (viral, prokaryotic microorganisms and eukaryotic organisms), Horizontal gene transfer in prokaryotic microbiomes (3 lectures)

From genomics to metagenomics: definitions, why metagenomics, what microbes can do? Understanding microbial communities and promises of genomics, why genomics is not enough? (4 lectures)

Designing a successful metagenomic project: best practices and future needs: Parallels with traditional microbial genome sequencing (2 lectures)

Metagenomics step by step: getting the most out of metagenomic studies, 16S rRNA base surveys, l6S rRNA phylogenetic and functional anchors: A hybrid approach, hybridization and array based analyses (4 lectures)

Sequencing technologies and expression systems; Sanger sequencing and next generation sequencing, Shotgun metagenomics and marker gene metagenomics (4 lectures)

Bioinformatics of genomic and metagenomic sequence data: web based and platform based pipelines/portals. Sequence assembly, binning, annotation; experimental design and statistical analysis, data sharing and storage (8 lectures/tutorials)

Analysis of complex microbial communities through metagenomic survey; public data resources as the foundation for a worldwide metagenomics data infrastructure (5 lectures/tutorials)

Investigation of plant-microbe interactions using genomic and tools, application of metagenomics to bioremediation, for industrial bioproducts (4 lectures)

Case studies for genomics and metagenomics in the field of metabolic engineering, enzyme/drug discovery, pathogen detection, climate change, waste water treatment, etc. (8 lectures)

Archaeal metagenomics: Bioprospecting novel genes and exploring new concepts (2 lectures)

Metagenomics and its applications to the study of the human microbiome (2 lectures).