

# MB 201 Molecular Genetics of Bacteria and Bacteriophages

## Section - I

### Unit - 1 DNA Damage, Repair, Recombination and Gene Regulation

15 hours

- 1.1. Mutations and Mutagenesis: Biochemical Basis of Mutation, Spontaneous Mutation, Fluctuation Test, Useful Phenotypes in bacterial genetics, Mutation Rate, Expression and Selection of Mutant Cell, Types of Mutation, Mutagens, Reversion and suppression of mutation
- 1.2. DNA Repair Evidences of DNA Repair, Specific repair pathway, General repair mechanisms, Repair pathway in E. coli, Bacteria phage repair pathway
- 1.3. Recombination: Overview of recombination, Molecular Model Recombination, Molecular basis for recombination in E. coli, Phage recombination, illegitimate recombination, Genetic and Functional Analysis of Recombination
- 1.4. Regulation of gene expression: Overview of gene regulation, Transcriptional regulation in bacteria, Negative regulation, Positive regulation, Regulation by attenuation, Feedback inhibition, Translational control.

### Unit-2 Plasmid, Transposition and Conjugation

15 hours

- 2.1. Plasmid Molecular Biology: What is plasmid, Types and properties of plasmid: Replication, Control of Copy Number, Partitioning, Incompatibility, Maintaining Plasmid belonging to the same incompatibility group. Conjugal Functions, Pilus Production, Transfer DNA Replication
- 2.2. Properties of Particular Plasmids :Major Chromosome-Mobilizing other than F, Bacteriocins, Resistance Plasmids, Agrobacterium plasmid Ti, Broad Host Range Plasmids
- 2.3. Conjugation: Discovery of Conjugation, Mechanism of DNA transfer during conjugation in Gram Negative Bacteria, Chromosome transfer by Plasmid, Genetic mapping with Hfr crosses, Chromosome mobilization, Prime factors, Transfer systems of gram Positive bacteria.
- 2.4. Transposition and site specific recombination : Insertion sequences, Detection of transposition in bacteria, Types of bacterial Transposon, Transposition, Transposon Mutagenesis, Site specific recombination, Phage Mu

## Section - II

### Unit-3 Bacteriophage Genetics and Transformation

15 hours

- 3.1. Genetics of temperate bacteriophages: T<sub>4</sub> Bacteriophage as a Model Genetic System, Morphology and Composition, Experimental Methods Used to Study Phage Infection, Genetic Organization of T<sub>4</sub>, DNA Replication, Molecular Biology of T<sub>4</sub> Phage Infection, Morphogenesis and Maturation; Properties of some other common temperate bacteriophages.
- 3.2. Genetics of Temperate Bacteriophages: Overview of various temperate bacteriophages, General Nature of the Temperate Response, Bacteriophage Lambda as the Archetypal Temperate Phage, Genetic Map of Lambda. Lytic Cycle, Lysogeny Cycle, Lysogenic phage and bacterial pathogenesis.
- 3.3. Transduction: Bacteriophage Lambda: A Specialized Transducing Phage, Production of Transducing Particles, Physiology and Genetic Consequences of Transduction, Specialized Transducing Phages Other than Lambda, Generalized Transduction, Cotransduction.
- 3.4. Genetic Transformation: Standard Genetic Transformation Systems, Discovery of Genetic Transformation, Competent Cells, DNA Uptake and Entry, Establishment of Donor DNA in the Recipient Cell, Other Transformation Systems, Transfection, Genetic Mapping Using Transformation

- 4.1. Bacterial and Bacteriophage Evolution : What Is Evolution, Expression of Evolutionary Relationships, Specific Examples of Evolution, Genetic Structure of the Chromosome, Bacteria, Bacteriophage ;
- 4.2. Advanced Regulatory Topics : Global Regulatory Mechanism: Catabolic sensitive Operon, Regulation of Nitrogen assimilation, Porin synthesis, Heat shock protein, Virulence genes, Endospore formation, Ribosome and t RNA synthesis; Two component regulation system; Inteins, Small RNA Molecules
- 4.3. Strain Construction: Construction of Bacterial strains, Operon and Gene fusion, Construction of Phage Mutants
- 4.4. Genetic Methods for Investigating Bacteria: Metabolic pathways, Microbial physiology, Bacterial virulence, Specific mutagenesis, Taxonomy, evolution and epidemiology

#### List of Experiments

1. Ultraviolet irradiation survival curve
2. Fluctuation test, rapid - plate technology.
3. Isolation of auxotrophic mutant
4. Isolation Respiratory deficient mutant
5. Isolation of temperature sensitive mutant
6. Isolation of streptomycin resistant mutant by gradient plate technique
7. Ames test
8. Conjugation in E. coli
9. Transduction
10. Plasmid curing
11. Phage titration

#### List of Reference Books

1. Trun and Trempey, Fundamental Bacterial genetics
2. Syndeer and Champness, Molecular genetics of bacteria
3. Maloy, Microbial genetics.
4. Edward, Bacterial and Bacteriophage Genetics.
5. Dale, Molecular Genetics of Bacteria.
6. Streips, Modern Microbial genetics.
7. Alan, Principles of Molecular Virology