MICROBIOLOGY MAJOR – SYLLABUS

Course 6

Course Structure (Semester III)

Course	Title of the Course	No. of Hrs/Week	No. of Credits
6	Molecular biology and bacterial Genetics	3	3
	Molecular biology and bacterial Genetics-Practical	2	1

SEMESTER-III

COURSE 6: MOLECULAR BIOLOGY AND BACTERIAL GENETICS

Theory **Credits: 3** **3 hrs/week**

I. Learning Objectives:

1. Explore experiments demonstrating DNA/RNA as genetic material, prokaryotic replication, and plasmids/transposons.
2. Examine gene concepts, structure, and transcription in prokaryotes and eukaryotes.
3. Illustrate translation, genetic code, and bacterial gene regulation.
4. Analyze mutations, their molecular basis, and DNA repair mechanisms.
5. Investigate bacterial recombination through conjugation, transformation, and transduction.

II. Course Outcomes: On completion of this course students will be able to:

1. Explain the experiments demonstrating DNA/RNA as genetic material, DNA replication, and plasmids/transposons.
2. Describe gene concepts, structure, and transcription.
3. Illustrate translation and bacterial gene regulation.
4. Classify mutations and summarize DNA repair.
5. Explain bacterial recombination and its applications.

III. Syllabus of Theory:

Unit - 1: DNA/RNA as genetic material, Replication of DNA **9 Hrs.**

1.1 DNA and RNA as genetic material (Griffith, Avery-MacLeod-McCarty Experiment, Hershey & Chase). Genome organization in prokaryotes.

1.2 Replication of DNA in prokaryotes. Bidirectional and unidirectional replication, Semiconservative Replication: Proof Mechanism.

1.3 Extrachromosomal genetic elements: General characters, types and applications of Plasmids and transposons.

Unit - 2: Concept of gene, Transcription **9 Hrs**

2.1 Classical Concept of gene: Muton, Recon and Cistron; One gene-one enzyme, one gene-one polypeptide.

2.2 Modern concept of gene: Definition of gene; Open reading frame; Types of genes (structural, constitutive and regulatory genes); Gene splicing – concept of introns and exons.

2.3 Transcription – Definition, mechanism of transcription.

Unit - 3: Translation and regulation of gene expression **9 Hrs.**

3.1 Genetic code: Salient features, Wobble hypothesis.

3.2 Translation – Mechanisms of initiation, elongation and termination of polypeptides. Inhibitors of protein synthesis.

3.3 Regulation of gene expression in bacteria – lac operon.

Unit - 4: Mutations and DNA repair **9 Hrs**

4.1 Mutations: Definition and types of Mutations (Spontaneous and induced, Somatic and germline); Physical and chemical mutagens.

4.2 Molecular basis of mutations (base pair changes, frame shifts, deletions, inversions, tandem duplications, insertions); Functional mutants (loss and gain of function mutants); Uses of mutations.

4.3 Outlines of DNA repair mechanisms: Direct, Excision, Mismatch, Recombination Repair, SOS Repair.

Unit - 5: Genetic recombination in bacteria **9 Hrs**

5.1 Conjugation – Definition, F-factor, F+ & Hfr, mechanism of conjugation, applications of conjugation.

5.2 Transformation – Discovery, mechanism of transformation, factors affecting transformation and application of transformation.

5.3 Transduction – discovery, mechanism and types of transduction.

IV. Co-curricular activities:

1. Prepare and present a poster or model illustrating DNA replication, plasmids, and transposons.

2. Perform a simulation or virtual lab on transcription, translation, and bacterial gene regulation.

3. Conduct a case study or discussion on mutations, DNA repair, and bacterial recombination, highlighting real-world applications.

V. Reference Books:

1. James D. Watson, Tania A. Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Losick, 2013, Molecular Biology of the Gene, 5th Edition, Pearson Edu Publishers.

2. Roger Y. Stanier, Edward A. Adelberg, John L. Ingraham, 1977, General Microbiology 5th edition, London Macmillan.

3. David Freifelder, 1986, Molecular Biology 3rd edition, Jones & Bartlett Publishers.

4. T.A. Brown, Gene Cloning and DNA Analysis – An Introduction, 4th edition.

5. Bernard R. Glick and Jack J. Pasternak, Molecular Biotechnology, 3rd edition.

6. David Freifelder, Essentials of Molecular Biology, Jones and Bartlett Publishers, 1998.

SEMESTER-III

COURSE 6: MOLECULAR BIOLOGY AND BACTERIAL GENETICS

Practical	Credits: 1	2 hrs/week

I. Course Outcomes: On successful completion of this practical course, student shall be able to:

1. Isolate and visualize DNA/RNA and plasmids using electrophoresis micrographs and schematic representations.
2. Solve DNA/RNA, transcription, translation problems and study bacterial mutations.
3. Demonstrate molecular biology equipment like transformation, PCR, and ultracentrifugation.

II. Laboratory/Field exercises:

1. Isolation of genomic DNA from E. coli.
2. Study of different types of DNA and RNA using micrographs and model / schematic representations.
3. Study of semi-conservative replication of DNA through micrographs / schematic representations.
4. Resolution and visualization of DNA by Agarose Gel Electrophoresis.
5. Study of different conformations of plasmid DNA through agarose gel electrophoresis.
6. Problems related to DNA and RNA characteristics, Transcription and Translation.
7. Induction of mutations in bacteria by UV light.
8. Demonstration of bacterial transformation.
9. Instrumentation in molecular biology – Ultra centrifuge, Transilluminator, PCR.