MICROBIOLOGY MAJOR – SYLLABUS

Course 7

Course Structure (Semester III)

Course	Title of the Course	No. of Hrs/Week	No. of Credits
7	r DNA Technology, Bioinformatics and Biostatistics	3	3
	r DNA Technology, Bioinformatics and Biostatistics-Practical	2	1

SEMESTER-III

COURSE 7: R DNA TECHNOLOGY, BIOINFORMATICS AND BIOSTATISTICS

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

I. Learning Objectives:

1. To learn principles, tools, and vectors used in gene cloning.
2. To understand blotting, DNA sequencing, PCR, and RFLP techniques.
3. To impart knowledge about gene libraries, recombinant DNA applications, and intellectual property rights.
4. To explore bioinformatic databases, tools, sequence alignment, and ChIP.
5. To understand measures of central tendency, dispersion, and data presentation.

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

1. Explain the fundamental principles and tools of genetic engineering, including gene cloning steps, vectors, and DNA transformation methods.
2. Outline genomic techniques and explain major applications of recombinant DNA technology in various fields.
3. Describe key genetic engineering techniques and recognize the importance of intellectual property rights in biotechnology.
4. Utilize major bioinformatics databases and tools for sequence retrieval, alignment, and analysis.
5. Apply basic biostatistical methods for data analysis and effectively use statistical software for biological data interpretation.

III. Syllabus of Theory:

UNIT- 1: Gene cloning – Tools and techniques **9 Hrs.**

1.1 Steps in gene cloning.

1.2 Cloning tools: Restriction endonucleases Type II, DNA polymerases, ligases, Exonucleases, DNase, polynucleotide kinase, Alkaline phosphotase; Use of linkers and adaptors.

1.3 Cloning Vectors: Plasmid (pBR 322), Bacteriophages, Cosmid, BAC, YAC, Expression vector – E.coli lac promoter-based vector.

1.4 Brief account on transformation of DNA (Chemical method, Electroporation).

UNIT- 2: Techniques in genetic engineering **9 Hrs.**

2.1 Blotting Techniques: Southern, Northern and Western blotting techniques.

2.2 DNA Sequencing – Sanger's method.

2.3 Basics of Polymerase Chain Reaction; RFLP.

UNIT- 3: Gene libraries, Applications of r-DNA technology and IPR **9 Hrs.**

3.1 Genomic and c-DNA Libraries: Preparation and uses.

3.2 Application of genetic engineering in industry, agriculture and medicine, Hybridoma Technology.

3.3 Outlines of Intellectual Property Rights: Patents, Trademark, Copyright.

UNIT- 4: Bioinformatics **9 Hrs**

4.1 Bioinformatic resources: NCBI, EMBL, DDBJ, PUBMED, BIOMED.

4.2 Sequence Databases – GENBANK, BLAST, FASTA, ExPASy, PDB, NDB, UNIPROT – SWISS PROT.

4.3 Sequence alignment – Sequence homology, pairwise sequence alignment, automated DNA sequencing, ChIP.

UNIT- 5: Biostatistics **9 Hrs**

5.1 Measurement of central tendency: Mean, Median, Mode.

5.2 Measurement of dispersion: Standard Deviation, Standard error, t-test and Chi square test.

5.3 Sample and population: Types of Data, methods of Data presentation.

5.4 Use of Biostatistics software: IBM-SPSS or Minitab.

IV. Co-curricular activities:

1. Create a model or poster showing cloning steps and vectors.
2. Demonstrate PCR or virtual blotting techniques in a workshop.
3. Prepare a chart/poster on r-DNA applications and IPR concepts.
4. Hands-on session using BLAST or GenBank for sequence analysis.

V. Reference Books:

1. Brown, T. A. (2010). Gene Cloning and DNA Analysis (6th ed.). Blackwell Publishing, Oxford, UK.

2. Campbell, A. M., & Heyer, L. J. (2006). Discovering Genomics, Proteomics and Bioinformatics (2nd ed.). Benjamin Cummings.

3. Clark, D. P., & Pazdernik, N. J. (2009). Biotechnology: Applying the Genetic Revolution. Elsevier Academic Press, USA.

4. Ghosh, Z., & Bibekanand, M. (2008). Bioinformatics: Principles and Applications. Oxford University Press.

5. Glick, B. R., Pasternak, J. J., & Patten, C. L. (2010). Molecular Biotechnology (4th ed.). ASM Press.

6. Gupta, P. K. (2009). Elements of Biotechnology (2nd ed.). Rastogi Publications.

7. Pevsner, J. (2009). Bioinformatics and Functional Genomics (2nd ed.). Wiley-Blackwell.

8. Primrose, S. B., & Twyman, R. M. (2008). Genomics: Applications in Human Biology. Blackwell Publishing, Oxford, UK.

9. Ratledge, C., & Kristiansen, B. (2001). Basic Biotechnology (2nd ed.). Cambridge University Press.

10. Sambrook, J., & Russell, D. (2001). Molecular Cloning: A Laboratory Manual (3rd ed.). Cold Spring Harbor Laboratory Press.

11. Swartz, J. R. (2001). Advances in Escherichia coli production of therapeutic proteins. Current Opinion in Biotechnology, 12, 195–201.

SEMESTER-III

COURSE 7: R DNA TECHNOLOGY, BIOINFORMATICS AND BIOSTATISTICS

Practical	**Credits: 1**	**2 hrs/week**

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

1. Isolate, digest, ligate, and amplify DNA using standard molecular biology techniques.
2. Analyse DNA fragments, interpret sequencing data, and perform RFLP analysis.
3. Retrieve and align sequences using bioinformatics tools like BLAST and Clustal W.

II. Laboratory/Field exercises:

1. Isolation of plasmid DNA by Agarose gel Electrophoresis.
2. Digestion of DNA using restriction enzymes and analysis by agarose gel electrophoresis.
3. Ligation of DNA fragments by using T4 DNA Ligase.
4. Amplification of DNA by PCR.
5. Demonstrate RFLP.
6. Interpretation of sequencing gel electropherograms.
7. Introduction to bioinformatics databases: NCBI, EMBL.
8. Sequence retrieval using BLAST.
9. Sequence alignment using Clustal W.