Programme: B.Sc.   **Semester: V**

BIOTECHNOLOGY PAPER V

MOLECULAR BIOTECHNOLOGY

Course Code: 18VBT5   **No. of Hours: 45**

COURSE OBJECTIVES:

- The aim of this paper is to extend understanding of the molecular mechanisms via which genetic information is stored, expressed and transmitted among generations.
- It is also intended at exposing the students to the historical developments of molecular development, manipulation of nucleic acid molecules, and organization and expression mechanism of genetic systems.
- For the benefit of students, biological data analysis and structure prediction and other related topics are included under Bioinformatics.

LEARNING OUTCOMES: On completion of the course, students will develop skills regarding

- It gives in-depth knowledge of biological processes along with molecular basis.
- An understanding of chemical and molecular processes that occur within and outside cells.
- Understanding the bioinformatics softwares and tools used to extract information from large databases for computer modelling.

UNIT I GENETIC MATERIAL   **07 HRS**

Central dogma, Experimental evidences for DNA and RNA as genetic material. DNA replication in prokaryotes and eukaryotes (*Mechanism, accessory proteins and enzymes involved in replication*). **DNA damage and DNA repair mechanism** - Types: *Photo reactivation, base and nucleotide Excision repair and SOS repair*]

UNIT II GENE AND GENE EXPRESSION   **10 HRS**

Structure of gene [*cistron, recon and muton*]. **Prokaryotic and eukaryotic Transcription** [*mechanism of initiation, elongation and termination*]. Differences between prokaryotic and eukaryotic transcription. Post transcriptional modification of eukaryotic mRNA [*capping, polyadnylation and splicing*]. **Genetic code -** *salient features.* **Translation in prokaryotes and eukaryotes** [*mechanism of initiation, elongation and termination*].

Regulation of Gene expression: induction and repression. Operon model [*lac and trp operon*]. Brief note on Britton and Davidson's Model for regulation of gene expression.

Gene silencing [*definition, Transcriptional and Post-transcriptional gene silencing*].

UNIT III TOOLS USED IN GENETIC ENGINEERING TECHNIQUE   07 HRS

Scope of Genetic engineering, isolation of Genomic and Plasmid DNA, cDNA synthesis and Genomic libraries. Enzymes for DNA modification and mode of actions of endonucleases, ligases, polymerases, phosphatases and kinases. Briefintroduction to End modifiers (*Adapters and linkers*)

UNIT IV CLONING TECHNIQUES   08 HRS

Vectors: General characteristics. Types (*Cloning, Expression and Shuttle vectors*). Structural details about vectors (Bacterial vectors [*pBR322, pUC 18/19*], Phage vectors - λ vectors*,* Eukaryotic vectors: BAC and YAC). **Amplification of Gene (PCR) Transformation techniques**: Chemical and Physical methods. **Screening and selection of transformants** (*Antibiotic sensitivity and Lac Z*). **Blotting techniques** (*Southern, Northern and Western method*).

UNIT V BIOINFORMATICS TOOLS   08 HRS

Introduction to Bioinformatics. Bioinformatics tools: Database – Definition and types (Nucleotide sequence database - *EMBL, NCBI and DDBJ.* Protein structure database - PDB).

Sequence alignment: Dynamic programming, Pair wise *BLAST and FASTA* and Multiple sequence Alignments (*Clustal W*) Primer designing: ORF. Structure prediction: RasMol. Application of Bioinformatics in Drug design and Nanotechnology.

UNIT VI GENOMICS AND PROTEOMICS   05 HRS

Human genome project and *DNA microarray***. Genomics:** Definition. Types (*Structural and functional*). Comparative genomics of organelles. DNA sequencing methods (Sa*nger method).***Proteomics**: Definition, types and applications

REFERENCES:
1. Glick .B. R and Pasternak J .J. Molecular biotechnology, Principles and applications of recombinant DNA, Washington D.C. ASM Press. (1998)
2. Sambrook *et al.,* Molecular cloning Volumes I, II & III, Cold spring Harbor Laboratory Press, New York, USA.(2000)
3. Karp. G Cell & Molecular Biology, 3rd Edition, John Wiley & Sons; INC. (2019)
4. Walker J.M. and Gingold. E.B. Molecular Biology &Biotechnology (Indian Edition) Royal Society of Chemistry U.K.(1983)
5. Harvey Lodish, Arnold Berk, Chris A. Kaiser, Angelika Amon, HiddePloegh, Anthony Bretscher, Monty Krieger and Kelsey C. Martin , Moelcular Cell biology, Macmillan Learning, Science. (2016).
6. Howe C. Gene cloning and manipulation, Cambridge University Press, USA.(1995)
7. Benjamin Lewin, Jocelyn E. Krebs and Elliott S. Goldstein Lewin's Gene XII Jones & Bartlett Learning.(2018)
8. Chawla H. S. Introduction to Plant Biotechnology (3/e), CRC press.(2011).
9. S. Harisha Fundamentals of Bioinformatics, I. K. International Pvt Ltd. (2013).

10. JinXiong, Essential Bioinformatics, CRC Press. (2006).
11. Arthur Lesk, Introduction to Bioinformatics, Oxford University Publications. (2019).
12. Introduction to Bioinformatics, T. K. Attwood & D. J. Parry-Smith, Pearson Education Publications. (2003).

PRACTICAL - PAPER V: MOLECULAR BIOTECHNOLOGY **15 UNITS**

1. Isolation of DNA from Plant & Animal sources   2 UNITS
2. Isolation of Plasmid DNA   1 UNIT
3. Estimation of DNA by Diphenylamine (DPA) method and RNA by Orcinol method
    2 UNITS
4. Restriction Digestion of DNA   1 UNIT
5. Competent cell preparation by Calcium chloride method   1 UNIT
6. Transformation of DNA and selection   2 UNITS
7. Amplification of DNA by PCR   1 UNIT
8. Bioinformatics: 04 UNITS
    a. Protein & Nucleotide Databases & Retrieval of information
    b. Structure prediction by Rasmol,
    c. Sequence alignments and analysis by BLAST and Clustal W

Tests and Repetition.