

**Model Syllabus for 4-Year UG Honours in B.Sc. (Biotechnology) as Major
in consonance with Curriculum framework w.e.f. AY 2026-27**

COURSE STRUCTURE (for Semester III)

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
II	III	5	Biophysical Techniques	3	3
			Biophysical Techniques-Practical	2	1
		6	Basic Molecular Biology	3	3
			Basic Molecular Biology-Practical	2	1
		7	Genetic Engineering	3	3
			Genetic Engineering-Practical	2	1

SEMESTER - III

COURSE 7: GENETIC ENGINEERING

Theory

Credits: 3

3 hrs/week

Course Objectives:

1. To introduce the principles, scope, and applications of genetic engineering.
2. To study molecular tools such as enzymes, cloning vectors, and transformation methods.
3. To understand hybridization techniques, PCR, and their applications in research.
4. To learn strategies for construction of genomic/cDNA libraries and protein expression.
5. To explore advanced genetic manipulation techniques such as CRISPR, site-directed mutagenesis, and next-generation sequencing.

Learning Outcomes:

After completion of this course, students will be able to:

1. Explain the history, scope, and tools used in genetic engineering.
2. Describe cloning vectors and transformation techniques in bacteria, yeast, plants, and animals.
3. Apply hybridization and PCR techniques for molecular analysis.
4. Construct and analyze genomic and cDNA libraries for gene studies.
5. Evaluate modern techniques such as CRISPR-Cas9, gene silencing, and next-generation sequencing.

Syllabus

UNIT – I

History, scope, and recent developments in Genetic Engineering. Molecular tools in genetic engineering – Restriction enzymes: Endonucleases and Exonucleases. DNA Modifying enzymes. Ligation (cohesive-end and blunt-end ligation), use of linkers and adaptors. Guidelines and strategies in plant and animal genetic engineering.

UNIT – II

Cloning vectors: Definition, properties and types. Plasmid vectors – pUC19 and pBR322. Phage vectors – λ (lambda) and M13. Cosmid vectors, shuttle vectors, and expression vectors. YAC vectors (*Saccharomyces cerevisiae* as a model) and BAC vectors (*E. coli*). Bacterial transformation. Screening and selection of recombinants – GUS and GFP assisted selection.

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UNIT – III

Hybridization techniques: Probes (radioactive and non-radioactive) and their labelling. DNA labelling methods – Nick translation, random priming, and primer extension. Southern blotting and Northern blotting – principles and applications. Polymerase Chain Reaction (PCR): Principle, types of PCR, and applications.

UNIT – IV

Construction of genomic and cDNA libraries. Vector engineering – role of promoters. Codon optimization and *in vitro* translation. Strategies for protein overexpression in bacteria, yeast, insects, plants, and mammalian cell lines.

UNIT – V

Chromosome engineering and targeted gene replacement. Gene editing – CRISPR-Cas9. Manipulation of gene regulation and gene silencing. Site-directed mutagenesis. DNA sequencing methods – Maxam-Gilbert (chemical method), Sanger's method, and Next Generation Sequencing (NGS) with applications.

Reference books:

1. Brown, T.A. (2016). *Gene Cloning and DNA Analysis: An Introduction*. 7th Edition, Wiley-Blackwell.
2. Primrose, S.B. & Twyman, R.M. (2006). *Principles of Gene Manipulation and Genomics*. 7th Edition, Blackwell Publishing.
3. Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. & Losick, R. (2017). *Molecular Biology of the Gene*. 7th Edition, Pearson Education.
4. Glick, B.R., Pasternak, J.J. & Patten, C.L. (2010). *Molecular Biotechnology: Principles and Applications of Recombinant DNA*. 4th Edition, ASM Press.
5. Alberts, B., Johnson, A., Lewis, J., Morgan, D., Raff, M., Roberts, K. & Walter, P. (2014). *Molecular Biology of the Cell*. 6th Edition, Garland Science.
6. Weaver, R.F. (2018). *Molecular Biology*. 6th Edition, McGraw Hill Education.
7. Channarayappa, C. (2014). *Molecular Biotechnology: Principles and Practices*. Universities Press, India.

Ch. Jayashree

SEMESTER - III

COURSE 7: GENETIC ENGINEERING

Practical

Credits: 1

2 hrs/week

Practical Component:

1. Problem solving related to restriction enzymes sites in Genetic engineering.
2. Transformation in Bacteria using plasmid
3. Restriction digestion of DNA and its electrophoretic separation.
4. Ligation of DNA molecules and their testing using electrophoresis.
5. Activity of DNAase and RNAse on DNA and RNA.
6. Isolation of Plasmid DNA
7. Demonstration of PCR

U. Jayashankar

4- Year UG Honours, Major
Syllabus
(2026-27)
Semester-III

Model Question Paper

Time : 3hrs

Marks:75

Part-A

Answer any Five Questions. Each Question carries 3 Marks.

5x3=15

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.
- 9.
- 10.

Answer the following questions. Each question carries 12 Marks

5x12=60

11. a) Unit-I
(Or)
b) Unit-I

12. a) Unit-II
(Or)
b) Unit-II

13. a) Unit-III
(Or)
b) Unit-III

14. a) Unit-IV
(Or)
b) Unit-IV

15. a) Unit-V
(Or)
b) Unit-V