



# बिरसा मुंडा ट्रायबल युनिवर्सिटी Birsā Mūṇḁā Tribal University

राजपिपला, जि. नर्मदा Rajpipla, Dist. Narmada

Established by Tribal Development Department, Govt. of Gujarat

## School of Science B.Sc. (Zoology) Programme

**Subject Code & Name:** BS05MJZOO2 Molecular Biology and Biotechnology

### Teaching and Evaluation Scheme:

| Teaching Scheme |   |   |       | Examination Scheme  |     |      |     |
|-----------------|---|---|-------|---------------------|-----|------|-----|
| Credits         |   |   |       | Component Weightage |     |      |     |
|                 |   |   |       | CCE                 |     | SEE  |     |
| L               | T | P | Total | TH                  | PWE | TH   | PWE |
| 4               | - | - | 4     | 50 %                | -   | 50 % | -   |

|                               |                                     |
|-------------------------------|-------------------------------------|
| Programme Name                | B.Sc. Zoology                       |
| Semester                      | V                                   |
| Course Code                   | BS05MJZOO2                          |
| Course Title                  | Molecular Biology and Biotechnology |
| Course Content Type (Th./Pr.) | Theory                              |
| Course Credit                 | 4                                   |
| Sessions                      | 4                                   |
| Total Teaching/Lab. Hours     | 60 Theory Hours                     |

### Learning Objectives

- Provide a deep understanding of the chemical and physical nature of genetic material (DNA and RNA).
- Elucidate the complex mechanisms of DNA replication, transcription, and translation in both prokaryotic and eukaryotic systems.
- Analyze the causes of DNA damage and the sophisticated repair pathways that maintain genomic integrity. Introduce the foundational principles of Recombinant DNA Technology and its role in modern genetic engineering. Also Explore the ethical and practical applications of Animal Biotechnology.

### Prerequisites (if any)

Students enrolling in this course should have a foundational background about:

- Familiarity with cell structure, organelles, and the basic cell cycle.
- Basic understanding of biomolecules (nucleic acids, proteins, lipids) and chemical bonding (hydrogen bonds, phosphodiester bonds).
- Basic Genetics: Understanding of Mendelian inheritance and the concept of a "gene."

### Learning Outcomes

On the Completion of this course, students will be able to:

- Upon completing this course, students will achieve several key skills. They will be able to analyze DNA structures and non-genetic RNA functions, explain DNA replication and translation processes, and evaluate the types of DNA damage and repair methods. Additionally, students will learn the workflow of recombinant DNA techniques, assess the effects of biotechnological applications, and understand animal tissue culture and reproductive technologies.







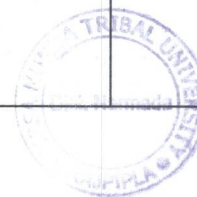
# बिरसा मुंडा ट्रायबल युनिवर्सिटी Birsā Mūṇḍā Drāyabhal Yūnīvārsīṭī

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| Detailed Contents |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                |
|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| UNIT              | TOPIC/SUB-TOPIC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | TEACHING HOURS |
| I                 | <b>Identification and Chemical Nature of the Genetic Materials:</b> <ul style="list-style-type: none"><li>• Direct evidences for DNA as the genetic material- Transformation and Blender Experiment</li><li>• Evidences for RNA as the Genetic material of some viruses</li></ul> <b>Deoxyribonucleic Acid (DNA):</b> <ul style="list-style-type: none"><li>• Watson and Crick's Structural Model of DNA</li><li>• A, B and Z type of DNA.</li></ul> <b>Replication of DNA:</b> <ul style="list-style-type: none"><li>• Enzymes involved in Replication.</li><li>• Mechanism of DNA Replication in Prokaryotes</li><li>• DNA Replication in Eukaryotes (Overview)</li></ul>                                                                                                                                       | 15             |
| II                | <b>Ribonucleic Acid (RNA), Transcription, Central Dogma of Molecular Biology:</b> <ul style="list-style-type: none"><li>• RNA types (mRNA, tRNA, rRNA) and their biological roles</li><li>• Comparison between DNA replication and Transcription</li></ul> <b>Mechanism of Prokaryotic Transcription:</b> <ul style="list-style-type: none"><li>• Types of Non-Genetic RNA and Processing</li></ul> <b>Genetic Code:</b> <ul style="list-style-type: none"><li>• Characteristics of Genetic Codes</li><li>• Wobble Hypothesis</li></ul> <b>Protein Synthesis:</b> <ul style="list-style-type: none"><li>• Minimum necessary materials</li><li>• Mechanism of Protein Synthesis: Initiation, Elongation and Termination</li></ul>                                                                                  | 15             |
| III               | <b>Gene Regulation, Molecular Basis of Mutation, DNA damage and Repair</b><br><b>Regulation of Gene Action:</b> <ul style="list-style-type: none"><li>• Regulation of Gene Action in Prokaryotes</li></ul> <b>Mutations:</b> <ul style="list-style-type: none"><li>• Chromosomal Aberrations</li><li>• Point and Frame shift mutations.</li></ul> <b>DNA Damage and Repair:</b> <ul style="list-style-type: none"><li>• Types of Damage: DNA lesions Single-strand breaks, and Double-strand breaks</li></ul> <b>Repair Mechanisms:</b> <ul style="list-style-type: none"><li>• Nucleotide Excision Repair (NER): Repairs bulky adducts, such as those caused by UV damage</li><li>• Base Excision Repair (BER): Corrects damaged bases</li><li>• Mismatch Repair (MMR): Corrects mismatched base pairs</li></ul> | 15             |







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|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| IV | <p><b>Introduction to Genetic Engineering:</b></p> <ul style="list-style-type: none"><li>• Scope of Genetic Engineering</li></ul> <p><b>Recombinant DNA Technology:</b></p> <ul style="list-style-type: none"><li>• Steps involved in the construction of rDNA.</li><li>• Application of rDNA</li></ul> <p><b>Gene Cloning:</b></p> <ul style="list-style-type: none"><li>• Preparation of desired gene, Isolation of plasmid, Insertion of desired gene into the plasmid and Introduction of rDNA into host cells.</li></ul> <p><b>Application of Genetic Engineering:</b></p> <ul style="list-style-type: none"><li>• Transgenic Animals</li><li>• Genetically Engineered Microorganisms (GEMOs) and their uses</li><li>• Gene Therapy</li><li>• DNA Fingerprinting and Forensic Analysis</li></ul> <p><b>Animal Biotechnology:</b></p> <ul style="list-style-type: none"><li>• Animal Tissue Culture (Overview) and application</li></ul> | 15 |
|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|

### Text Book(s)

1. Molecular Biology by P.S. Verma and V.K. Agarwal (S. Chand)
2. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology by P. S. Verma and V.K. Agarwal (S. Chand)
3. A Textbook of Biotechnology by R.C. Dubey
4. Textbook of Biotechnology by H.K. Das
5. Biotechnology: Expanding Horizons by B.D. Singh
6. Molecular Biology by N. Arumugam
7. Molecular Biology and Genetic Engineering by N. Arumugam et al.
8. Biotechnology by V. Kumaresan
9. Techniques in Biotechnology by V. Kumaresan and N. Arumugam
10. Animal Biotechnology and Bioinformatics by V. Kumaresan and N. Arumugam

### Reference Books

1. Molecular Biology and Biotechnology by Ralph Rapley and David Whitehouse
2. Cell and Molecular Biology: Concepts and Experiments by Gerald Karp
3. Molecular Biology of the Cell by Bruce Alberts et al
4. Gene VIII/IX/X/XI/XII (Series) by Benjamin Lewin
5. Molecular Biology by David Freifelder
6. iGenetics: A Molecular Approach by Peter J. Russell
7. Principles of Gene Manipulation and Genomics by S.B. Primrose & R. Twyman
8. Molecular Biotechnology: Principles and Applications of Recombinant DNA by B.R. Glick & C.L. Patten
9. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology
10. Lehninger Principles of Biochemistry by David L. Nelson and Michael M. Cox







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### Web Resources

1. National Digital Library of India (NDLI) – <https://ndl.iitkgp.ac.in>
2. SWAYAM – Online Courses by Government of India – <https://swayam.gov.in>
3. NPTEL Biotechnology Courses – <https://nptel.ac.in/courses/102105083>
4. NCBI (National Center for Biotechnology Information) – <https://www.ncbi.nlm.nih.gov>
5. PubMed Database – <https://pubmed.ncbi.nlm.nih.gov>
6. DNA from the Beginning (Interactive Molecular Biology) – <https://www.dnafb.org>
7. HHMI BioInteractive – <https://www.biointeractive.org>
8. Khan Academy Biology – <https://www.khanacademy.org/science/biology>
9. Cold Spring Harbor Laboratory – DNA Learning Center – <https://dnlc.cshl.edu>
10. Biotechnology Innovation Organization – <https://www.bio.org>
11. Addgene Molecular Biology Resources – <https://www.addgene.org/mol-bio-reference>
12. JoVE Science Education Videos – <https://www.jove.com/science-education-library>

**L::** Lecture, **T::** Tutorial, **P::** Practical

**CCE::** Continuous and Comprehensive Evaluation

(CCE Theory includes Mid Semester Examination, Assignment, MCQ quizzes, Seminar, Reflective notes, class participation, case analysis and presentation, slip tests (announced/surprised), attendance etc. or any combination of these)

**PWE::** Practical Work Examination

(PWE includes Laboratory practical work, project work, viva simulation exercise work etc.)

**SEE::** Semester End Evaluation.

