

**UNIVERSITY OF MADRAS**  
**B.Sc. DEGREE PROGRAMME IN MICROBIOLOGY**  
**SYLLABUS WITH EFFECT FROM 2023-2024**

| Subject Code        | Subject Name  | Category              | L | T | P | S | Credits | Inst. Hours | Marks        |                   |       |
|---------------------|---|-----------------------|---|---|---|---|---------|-------------|--------------|-------------------|-------|
|                     |   |                       |   |   |   |   |         |             | CIA          | External          | Total |
| 236C3A              | Molecular Biology and Microbial Genetics  | Core Course V -Theory | 4 | 1 | - | - | 5       | 5           | 25           | 75                | 100   |
| Learning Objectives |   |                       |   |   |   |   |         |             |              |                   |       |
| CO1                 | Provide knowledge on structure and replication of DNA.  |                       |   |   |   |   |         |             |              |                   |       |
| CO2                 | Illustrate the significance and functions of RNA in protein synthesis.  |                       |   |   |   |   |         |             |              |                   |       |
| CO3                 | Explain the cause and types of DNA mutation and DNA repair mechanisms.  |                       |   |   |   |   |         |             |              |                   |       |
| CO4                 | Outline the role of plasmids and phages in genetics.  |                       |   |   |   |   |         |             |              |                   |       |
| CO5                 | Examine mechanisms of gene transfer and recombination.  |                       |   |   |   |   |         |             |              |                   |       |
| Unit                | Details   |                       |   |   |   |   |         |             | No. of Hours | Course Objectives |       |
| I                   | DNA Structure - Salient features of double helix, forms of DNA. Denaturation and renaturation. DNA topology – Supercoiling, linking number, topoisomerases. DNA organization in prokaryotes, eukaryotes. Replication of DNA in prokaryotes and eukaryotes - Bidirectional and unidirectional replication, semi-conservative and semi-discontinuous replication. Mechanism of DNA replication – enzymes involved – DNA polymerases, DNA ligase, primase. |                       |   |   |   |   |         |             | 15           | CO1               |       |
| II                  | Transcription in Prokaryotes. Concept of transcription. RNA Polymerases - prokaryotic and eukaryotic. General transcription factors in eukaryotes. Translation in prokaryotes and eukaryotes - Translational machinery - ribosome structure in prokaryotes and eukaryotes, tRNA structure and processing. Inhibitors of protein synthesis in prokaryotes and eukaryotes. Overview of regulation of gene expression - <i>lac</i> operons as example.     |                       |   |   |   |   |         |             | 15           | CO2               |       |
| III                 | Mutation - Definition and types of mutations. Physical and chemical mutagens. Reversion and suppression. Uses of mutations. Repair Mechanisms - Photoreactivation, Nucleotide Repair, Base Excision Repair, Methyl Directed Mismatch Repair and SOS Repair.   |                       |   |   |   |   |         |             | 15           | CO3               |       |
| IV                  | Plasmid – Structure, types, replication, plasmid incompatibility, plasmid amplification and curing of plasmids. Bacteriophage-T4 Phage – Structure and lifecycle, Lambda phage-Structure, Lytic and Lysogenic cycle. Applications of Phages in Microbial Genetics.  |                       |   |   |   |   |         |             | 15           | CO4               |       |
| V                   | Gene Transfer Mechanisms - Conjugation and its uses. Transduction - Generalized and Specialized, Transformation - Natural and Artificial Transformation. Transposable elements - Prokaryotic transposable elements – insertion sequences, composite, and non-composite transposons. Transposition and Types of Transposition reactions. Mechanism of transposition: Replicative and non- replicative transposition. Uses of transposons.                |                       |   |   |   |   |         |             | 15           | CO5               |       |
|                     | Total   |                       |   |   |   |   |         |             | 75           |                   |       |

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| Course Outcomes  |   |                   |
|------------------|---|-------------------|
| Course Outcomes  | On completion of this course, students will;  |                   |
| CO1              | Analyze the significance of DNA and elucidate the replication mechanism.  | PO4, PO5, PO7,PO9 |
| CO2              | Illustrate the types of RNA and protein synthesis machinery.  | PO4, PO7,PO9      |
| CO3              | Infer the causes and types of DNA mutation and summarize the DNA repair mechanisms.   | PO5, PO7,PO9      |
| CO4              | Evaluate the importance of plasmids and phages in genetics.   | PO7,PO9           |
| CO5              | Analyze gene transfer and recombination methods.  | PO5, PO6, PO7,PO9 |
| Text Books       |   |                   |
| 1.               | Malacinski G.M. (2008). Freifelder's Essentials of Molecular Biology. 4 <sup>th</sup> Edition. Narosa Publishing House, New Delhi.  |                   |
| 2.               | Gardner E. J. Simmons M. J. and SnustedD.P.(2006). Principles of Genetics. 8 <sup>th</sup> Edition. Wiley India Pvt. Ltd.   |                   |
| 3.               | Trun N. and Trempy J. (2009). Fundamental Bacterial Genetics. 1 <sup>st</sup> Edition. Blackwell Science Ltd.   |                   |
| 4.               | Brown T. A. (2016). Gene Cloning and DNA Analysis- An Introduction. (7 <sup>th</sup> Edition). John Wiley and Sons, Ltd.  |                   |
| 5.               | Dale J. W., Schantz M.V. and Plant N. (2012). From Gene to Genomes – Concepts and Applications of DNA Technology. (3 <sup>rd</sup> Edition). John Wileys and Sons Ltd.          |                   |
| References Books |   |                   |
| 1.               | Glick B. R. and Patten C.L. (2018). Molecular Biotechnology – Principles and Applications of Recombinant DNA. 5 <sup>th</sup> Edition. ASM Press.                               |                   |
| 2.               | Russell P.J. (2010). iGenetics - A Molecular Approach, 3rd Edition., Pearson New International edn.   |                   |
| 3.               | Nelson, D.L. and Cox, M.M. Lehninger(2017). Principles of Biochemistry. 7 <sup>th</sup> Edition, W.H. Freeman.  |                   |
| 4.               | Synder L., Peters J. E., Henkin T.M. and Champness W. (2013). Molecular Genetics of Bacteria, 4 <sup>th</sup> Edition, ASM Press Washington-D.C. ASM Press.                     |                   |
| 5.               | Primrose S.B. and Twyman R. M. (2006). Principles of Gene Manipulation and Genomics. (7 <sup>th</sup> Edition). Blackwell Publishing  |                   |
| Web Resources    |   |                   |
| 1.               | <a href="#">[PDF] Lehninger Principles of Biochemistry (8th Edition) By David L. Nelson and Michael M. Cox Book Free Download - StudyMaterialz.in</a>                           |                   |
| 2.               | <a href="https://microbenotes.com/gene-cloning-requirements-principle-steps-applications/">https://microbenotes.com/gene-cloning-requirements-principle-steps-applications/</a> |                   |
| 3.               | <a href="https://courses.lumenlearning.com/boundless-biology/chapter/dna-replication/">https://courses.lumenlearning.com/boundless-biology/chapter/dna-replication/</a>         |                   |
| 4.               | <a href="#">Molecular Biology Notes - Microbe Notes</a>   |                   |
| 5.               | <a href="#">Molecular Biology Lecture Notes &amp; Study Materials   Easy Biology Class</a>  |                   |

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| <b>Methods of Evaluation</b>       |   |           |
|------------------------------------|---|-----------|
| <b>Internal Evaluation</b>         | Continuous Internal Assessment Test   | 25 Marks  |
|                                    | Assignments   |           |
|                                    | Seminars  |           |
|                                    | Attendance and Class Participation  |           |
| <b>External Evaluation</b>         | End Semester Examination  | 75 Marks  |
|                                    | Total   | 100 Marks |
| <b>Methods of Assessment</b>       |   |           |
| <b>Recall (K1)</b>                 | Simple definitions, MCQ, Recall steps, Concept definitions  |           |
| <b>Understand/ Comprehend (K2)</b> | MCQ, True/False, Short essays, Concept explanations, Short summary or overview                                  |           |
| <b>Application (K3)</b>            | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain                          |           |
| <b>Analyze (K4)</b>                | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge |           |
| <b>Evaluate (K5)</b>               | Longer essay/ Evaluation essay, Critique or justify with pros and cons  |           |
| <b>Create (K6)</b>                 | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations                        |           |

**Mapping with Programme Outcomes:**

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|
| CO1 |     |     |     | S   | S   | M   | S   | M   | S   | M    |      |
| CO2 |     |     |     | S   | M   | M   | S   | M   | S   | L    |      |
| CO3 |     |     |     | M   | S   | M   | S   | M   | S   | L    |      |
| CO4 |     |     |     | M   | M   | M   | S   | M   | S   | L    |      |
| CO5 |     |     |     | M   | S   | S   | S   | M   | S   | L    |      |