TECHNO INDIA UNIVERSITY

WEST BENGAL

# DEPARTMENT OF MICROBIOLOGY

## SYLLABUS STRUCTURE AND COURSE DETAILS

## w.e.f 2024-25

# SEMESTER 4

## MOLECULAR BIOLOGY (Theory)

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|---|---|
| **Program:** B. Sc. in Microbiology | **Year, Semester:** 2nd Yr., 4th Sem |
| **Course Title:** MOLECULAR BIOLOGY (Theory) | **Subject Code:** TIU-UMB-MJ-T22201 |
| **Contact Hours/Week**: 2–1–0 (L–T–P) | **Credit:** 3 |

**COURSE OBJECTIVE :**

Enable the student to:

1. To understand the different types of genetic material, focusing on DNA and RNA (mRNA, tRNA, rRNA, miRNA, snRNA).
2. To understand the mechanisms of DNA replication, with a focus on the semi-conservative model, as evidenced by the Meselson-Stahl experiment.
3. To define transcription and distinguish it from DNA replication.
4. To understand the molecular machinery involved in translation, including the structure and function of tRNA and aminoacyl tRNA synthetases.
5. To understand the principles of transcriptional regulation in both prokaryotes and eukaryotes.

**COURSE OUTCOME :**

On completion of the course, the student will be able to:

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| CO-1: | Understand What is Central Dogma | K2 |
| CO-2: | Briefly outlined the Nature and Organization of Genetic Material | K1 |
| CO-3: | Explain DNA Replication Mechanisms | K4 |
| CO-4: | Comprehend Transcription in Prokaryotes and Eukaryotes | K5 |
| CO-5: | Explain the Process of Translation | K3 |
| CO-6: | Understand the Regulation of Gene Expression | K2 |

**COURSE CONTENT :**

| **MODULE 1:** | **GENETIC MATERIAL AND ITS FEATURES** | **8 Hours** |
|---|---|---|
| Types of Genetic material: DNA and RNA (mRNA, tRNA, rRNA, miRNA, snRNA etc.). Denaturation and Renaturation of DNA: Hyperchromic effect, Tm, Cot curves. DNA topology and topoisomerase enzyme- linking number, twist number, writhing number. Organization of DNA in Prokaryotes (nucleoid), Eukaryotes (nucleosome-10 nm model, 30 nm model, scaffold arrangement). Organelle DNA - mitochondrial and chloroplast DNA. The Central Dogma. | | |
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| MODULE 2: | REPLICATION OF PROKARYOTIC DNA | 10 Hours |
|---|---|---|
| DNA replication - Meselson-Stahl experiment as evidence of semi-conservative replication, Bidirectional and unidirectional replication, Semi- discontinuous replication. Mechanism of DNA replication: Enzymes and proteins involved in DNA replication, differences with eukaryotic replication –DNA polymerases, DNA ligase, primase, telomerase – for replication of linear ends. Various models of DNA replication including Θ (theta), rolling circle mode of replication and other accessory proteins, fidelity of DNA replication. | | |
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| **MODULE 3:** | **TRANSCRIPTION IN PROKARYOTES AND EUKARYOTES** | **10 Hours** |
| Transcription: Definition, difference from replication, promoter - concept and strength of Promoter, RNA Polymerase and the transcription unit. Mechanism of transcription (initiation, elongation and termination). Transcription in Eukaryotes: major difference with prokaryotic system, important modifications of eukaryotic RNA: concept of introns and exons, RNA splicing, concept of alternative splicing, Polyadenylation and capping, Processing of rRNA and tRNA. | | |
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| **MODULE 4:** | **TRANSLATION (PROKARYOTES AND EUKARYOTES)** | **7 Hours** |
| Translational machinery, Charging of tRNA, aminoacyl tRNA synthetases, genetic code and its features, mechanism of initiation, elongation and termination of translation in both prokaryotes and eukaryotes, Fidelity of translation, Inhibitors of protein synthesis in prokaryotes and eukaryote. | | |
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| **MODULE 5:** | **REGULATION OF GENE EXPRESSION IN PROKARYOTES AND EUKARYOTES** | **10 Hours** |
| Principles of transcriptional regulation, regulation at initiation with examples from lac and trp operons, Yeast mating type switching, changes in chromatin structure: DNA methylation and Histone acetylation mechanisms | | |
| **TOTAL LECTURES** | | **45 Hours**** |

**Books:**


1. Watson JD, Baker TA, Bell SP, Gann A, Levine M and Losick R (2008) Molecular Biology of the Gene, 6th edition, Cold Spring Harbour Lab. Press, Pearson Publication
2. Becker WM, Kleinsmith LJ, Hardin J and Bertoni GP (2009) The World of the Cell, 7th edition, Pearson Benjamin Cummings Publishing, San Francisco
3. Burton E. Tropp Molecular Biology Genes to Proteins, 3rd Edition, Jones and Bartlett Publishers
4. Robert F. Weaver, Molecular Biology, Fourth Edition, McGraw-Hill International Publishers.
5. De Robertis EDP and De Robertis EMF (2006) Cell and Molecular Biology, 8th edition.

Lippincott Williams and Wilkins, Philadelphia
6. Karp G (2010) Cell and Molecular Biology: Concepts and Experiments, 6th edition, John Wiley & Sons. Inc.
7. Sambrook J and Russell DW. (2001). Molecular Cloning: A Laboratory Manual. 4th Edition, Cold Spring Harbour Laboratory press.
8. Krebs J, Goldstein E, Kilpatrick S (2013). Lewin's Essential Genes, 3rd Ed., Jones and Bartlett Learning
9. Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8th Ed. Wiley-India

# MOLECULAR BIOLOGY (Practical)

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|---|---|
| **Program:** B. Sc. in Microbiology | **Year, Semester:** 2nd Yr., 4th Sem |
| **Course Title:** MOLECULAR BIOLOGY (Practical) | **Subject Code:** TIU-UMB-MJ-L22201 |
| **Contact Hours/Week**: 0–0–1 (L–T–P) | **Credit: 1** |

**COURSE OBJECTIVE :**

Enable the student to:

1. To understand and apply the methods for isolating high-quality genomic DNA (gDNA) from E. coli.
2. To learn the principles of DNA quantification using a UV spectrophotometer, focusing on absorbance at 260 nm (A260).
3. To understand the principles of RNA quantification using a UV spectrophotometer, focusing on absorbance at 260 nm (A260) and its relationship to RNA concentration.

**COURSE OUTCOME :**

On completion of the course, the student will be able to:

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|---|---|---|
| CO-1: | Understand the Isolation and Visualization of Genomic DNA from E. coli | K3 |
| CO-2: | Estimation of DNA Concentration Using UV Spectrophotometry | K3 |
| CO-3: | Estimation of RNA Concentration Using UV Spectrophotometry | K4 |
| CO-4: | Gain hands-on experience in DNA and RNA quantification techniques critical for molecular biology experiments. | K4 |
| CO-5: | Develop an understanding of electrophoresis and spectrophotometry as essential tools for genetic analysis. | K4 |
| CO-6: | Apply the knowledge in research applications such as gene cloning, expression analysis, and molecular diagnostics. | K4 |

**COURSE CONTENT :**

| **MODULE 1:** | **Molecular characterization of Genetic material** | **15 Hours** |
|---|---|---|
| Isolation of genomic DNA from *E. coli* and visualization of gDNA in Agarose gel electrophoresis<br>2. Estimation of salmon sperm / calf thymus DNA using UV spectrophotometer (A260 measurement)<br>3. Estimation of RNA using UV spectrophotometer (A260 measurement) | | |
| **TOTAL LECTURES** | | **15 Hours**** |

# CELL BIOLOGY (Theory)

| **Program:** B. Sc. in Microbiology | **Year, Semester:** 2nd Yr., 4th Sem |
|---|---|
| **Course Title:** CELL BIOLOGY (Theory) | **Subject Code:** TIU-UMB-MJ-T22202 |
| **Contact Hours/Week**: 2–1–0 (L–T–P) | **Credit:** 3 |

**COURSE OBJECTIVE :**

Enable the student to:

1. To introduce and compare the structural organization of prokaryotic and eukaryotic cells, highlighting the key differences between plant and animal cells
2. To introduce the roles of ribosomes in protein synthesis and their association with the endoplasmic reticulum (ER) in protein sorting and transport.
3. To define signaling molecules and their types, including hormones, neurotransmitters, and growth factors, and their interactions with cell surface receptors.

**COURSE OUTCOME :**

On completion of the course, the student will be able to:

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| CO-1: | Recall the differences in organization between prokaryotic and eukaryotic cells. | K2 |
| CO-2: | Explain the structure and function of the plasma membrane, including mechanisms of transport. | K2 |

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|---|---|---|
| CO-3: | Explain the role of the nuclear pore complex and nucleoporins in nuclear transport. | K2 |
| CO-4: | Analyse the process of protein targeting and insertion into the ER. | K4 |
| CO-5: | Identify common signaling molecules and their corresponding receptors. | K1 |
| CO-6: | Explain the processes of mitosis and meiosis. | K3 |

**COURSE CONTENT :**

| **MODULE 1:** | **STRUCTURE AND ORGANIZATION OF CELL** | **10 Hours** |
|---|---|---|
| Cell Organization – Prokaryotic and Eukaryotic (Plant and animal cells) Plasma membrane: Structure and transport of small molecules Cell Wall: Eukaryotic cell wall, extracellular matrix and cell matrix interactions, Cell-Cell Interactions - adhesion junctions, tight junctions, gap junctions, and plasmodesmata (only structural aspects) Mitochondria, chloroplasts and peroxisomes Cytoskeleton: Structure and organization of actin filaments, association of actin filaments with plasma membrane, cell surface protrusions, intermediate filaments, microtubules | | |
| | | |
| **MODULE 2:** | **NUCLEUS** | **7 Hours** |
| Nuclear envelope, nuclear pore complex, nucleoporins and nuclear lamina, nuclear transport Nucleolus-composition and functions | | |
| | | |
| **MODULE 3:** | **PROTEIN SORTING AND TRANSPORT AND TARGETING** | **8 Hours** |
| Ribosomes, Endoplasmic Reticulum – Structure, targeting and insertion of proteins in the ER, protein folding, processing and quality control in ER, smooth ER and lipid synthesis, export of proteins and lipids Golgi Apparatus – Organization, protein glycosylation, protein sorting and export from Golgi Apparatus Protein targeting to Lysosomes | | |
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| **MODULE 4:** | **CELL SIGNALING** | **10 Hours** |
| Signaling molecules and their receptors Function of cell surface receptors Pathways of intra-cellular receptors – Cyclic AMP pathway, cyclic GMP and MAP kinase pathway | | |
| | | |
| **MODULE 5:** | **CELL CYCLE, CELL DEATH AND CELL RENEWAL** | **10 Hours** |
| Eukaryotic cell cycle and its regulation, Mitosis and Meiosis, Development of cancer, causes and types, Programmed cell death, Stem cells:Embryonic stem cell, induced pluripotent stem cells | | |
| **TOTAL LECTURES** | | **45 Hours**** |

**Books:**

1. Alberts, B. et al. (2008) Molecular Biology of the cell. 5th edition. Garland Science

2. Hardin J, Bertoni G and Kleinsmith LJ. (2010). Becker's World of the Cell. 8th edition. Pearson.
3. Karp G. (2010) Cell and Molecular Biology: Concepts and Experiments. 6th edition. John Wiley & Sons. Inc.
4. De Robertis, EDP and De Robertis EMF. (2006). Cell and Molecular Biology. 8th edition, Lipincott Williams and Wilkins, Philadelphia.
5. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. 5th Edition, ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
6. Watson JD. et al. (2008) Molecular Biology of the Gene. 6th edition, Cold Spring Harbor Laboratory Press

# CELL BIOLOGY (Practical)

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|---|---|
| **Program:** B. Sc. in Microbiology | **Year, Semester:** 2nd Yr., 4th Sem |
| **Course Title:** CELL BIOLOGY (Practical) | **Subject Code:** TIU-UMB-MJ-L22202 |
| **Contact Hours/Week**: 0–0–1 (L–T–P) | **Credit:** 1 |

**COURSE OBJECTIVE :**

Enable the student to:

1. To introduce the principles and methodology of the Feulgen reaction for the cytochemical detection and staining of DNA in cells.
2. To explore the concept of polyploidy and its occurrence in nature, emphasizing the significance of chromosome number changes in cells.
3. To provide a detailed understanding of the stages of mitosis, including prophase, metaphase, anaphase, and telophase, as well as the transition between these stages.
4. To explore the stages of meiosis, including meiosis I and meiosis II, and understand their significance in reducing chromosome number and ensuring genetic diversity.

**COURSE OUTCOME :**

On completion of the course, the student will be able to:

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|---|---|---|
| CO-1: | Recall the chemical principles behind Feulgen's reaction for DNA staining. | K3 |
| CO-2: | Describe the preparation of samples and the significance of the Feulgen stain in identifying DNA content. | K2 |
| CO-3: | Perform Feulgen staining on a sample and analyze the results. | K4 |
| CO-4: | Interpret stained slides and determine the DNA content in different cell types. | K3 |
| CO-5: | Recall the mechanism by which colchicine induces polyploidy in plant cells. | K3 |

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|---|---|---|
| CO-6: | Design a visual representation of the stages of meiosis, highlighting key events such as synapsis and crossing over. | K3 |

**COURSE CONTENT :**

| **MODULE 1:** | **Study the different stages of Mitosis and Meosis** | **15 Hours** |
|---|---|---|
| 1. Cytochemical staining of DNA – Feulgen<br>2. Study of polyploidy in Onion root tip by colchicine treatment<br>3. Study of different stages of Mitosis<br>4. Study of different stages of Meiosis | | |
| **TOTAL LECTURES** | | **15 Hours**** |

# MICROBIAL GENETICS (Theory)

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|---|---|
| **Program:** B. Sc. in Microbiology | **Year, Semester:** 2nd Yr., 4th Sem |
| **Course Title:** MICROBIAL GENETICS (Theory) | **Subject Code:** TIU-UMB-MJ-T22203 |
| **Contact Hours/Week**: 2–1–0 (L–T–P) | **Credit:** 3 |

**COURSE OBJECTIVE :**

Enable the student to:

1. Understand the role of nucleic acids (DNA and RNA) as genetic material.
2. Understand the molecular mechanisms involved in each genetic exchange process.
3. Explore various DNA repair systems, including mismatch repair, nucleotide excision repair, photoreactivation, SOS repair, and error-prone repair.
4. Explore the types and functions of plasmids in bacteria and yeast.
5. Understand the mechanisms of transposition in prokaryotes and eukaryotes.

**COURSE OUTCOME :**

On completion of the course, the student will be able to:

| | | |
|---|---|---|
| CO-1: | To remember the genome organization in prokaryotic and eukaryotic cells | K1 |
| CO-2: | To describe the different mechanisms of gene transfer. | K3 |
| CO-3: | To demonstrate different mechanisms of mutations and repair | K4 |
| CO-4: | To analyse different plasmids and its applications. | K4 |
| CO-5: | To analyse phage genetics | K4 |
| CO-6: | To interpret different transposable elements in prokaryotic and eukaryotic systems | K4 |

**COURSE CONTENT :**

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|---|---|---|
| **MODULE 1:** | **NUCLEIC ACID AS GENETIC MATERIAL** | **7 Hours** |
| Experimental evidence for DNA and RNA as genetic material: experiments of Griffith, Avery MacLeod and McCarthy, Hershey and Chase, Fraenkel and Conrat. | | |
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| **MODULE 2:** | **MECHANISMS OF GENETIC EXCHANGE** | **8 Hours** |
| Transformation - Discovery, mechanism of natural competence Conjugation - Discovery, mechanism, Hfr and F' strains, Interrupted mating technique and time of entry mapping Transduction - Generalized transduction, specialized transduction, LFT & HFT lysates, Mapping by recombination and co-transduction of markers | | |
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| **MODULE 3:** | **MUTATIONS, REPAIR AND RECOMBINATION** | **15 Hours** |
| Mutations and mutagenesis: Definition and types of Mutations (tautomeric shift, base analog, alkylating agent, UV radiation and thymine dimers, replicational error). Mutagenic agents: Physical and chemical mutagens Molecular basis of mutations, Functional mutants (loss and gain of function mutants), Uses of mutations. Repair of DNA: Mismatch and nucleotide excision repair, photoreactivation, SOS repair, error prone repair Reversion and suppression: True revertant; Intra- and inter-genic suppression; Ames test; Mutator genes Recombination: Homologous recombination (Holiday structure-RecBCD system). | | |
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| **MODULE 4:** | **PLASMIDS** | **8 Hours** |
| Types of plasmids – F plasmid, R Plasmids, colicinogenic plasmids, Ti plasmids, linear plasmids. Yeast plasmids- 2 μ plasmid, Plasmid replication and partitioning, Host range, plasmid-incompatibility, Regulation of plasmid copy number, curing of plasmids | | |
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| **MODULE 5:** | **TRANSPOSABLE ELEMENTS** | **7 Hours** |
| Prokaryotic transposable elements – Insertion Sequences, composite and non-composite transposons, Replicative and Non replicative transposition, Mu transposon Eukaryotic transposable elements - Maize (Ac/Ds), LTR and Non-LTR transposons, LINES and SINES. Uses of transposons and transposition | | |
| **TOTAL LECTURES** | | **45 Hours**** |

**Books:**

1Klug WS, Cummings MR, Spencer, C, Palladino, M (2011). Concepts of Genetics, 10th Ed., Benjamin Cummings

2. Krebs J, Goldstein E, Kilpatrick S (2013). Lewin's Essential Genes, 3rd Ed., Jones and Bartlett Learning
3. Pierce BA (2011) Genetics: A Conceptual Approach, 4th Ed., Macmillan Higher Education Learning
4. Watson JD, Baker TA, Bell SP et al. (2008) Molecular Biology of the Gene, 6th Ed., Benjamin Cummings
5. Karp G (2010) Cell and Molecular Biology: Concepts and Experiments, 6th edition, John Wiley & Sons. Inc.
6. Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8th Ed. Wiley-India
7. Russell PJ. (2009). i Genetics- A Molecular Approach. 3rd Ed, Benjamin Cummings
8. Sambrook J and Russell DW. (2001). Molecular Cloning: A Laboratory Manual. 4th Edition, Cold Spring Harbour Laboratory press.
9. Maloy SR, Cronan JE and Friefelder D (2004) Microbial Genetics 2nd Ed., Jones and Barlett Publishers

# MICROBIAL GENETICS (Practical)

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|---|---|
| **Program:** B. Sc. in Microbiology | **Year, Semester:** 2nd Yr., 4th Sem |
| **Course Title:** MICROBIAL GENETICS (Practical) | **Subject Code:** TIU-UMB-MJ-L22203 |
| **Contact Hours/Week**: 0–0–1 (L–T–P) | **Credit:** 1 |

**COURSE OBJECTIVE :**

Enable the student to:

1. Understand the impact of UV radiation on bacterial survival.
2. Learn how to plot survival curves.
3. Demonstration of Master and Replica Plate Preparation

**COURSE OUTCOME :**

On completion of the course, the student will be able to:

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|---|---|---|
| CO-1: | Understand about microbial genes | K2 |
| CO-2: | Analyse the effect of UV in bacteria | K4 |
| CO-3: | Analyse the growth pattern of bacteria | K4 |
| CO-4: | Conduct experiments of plasmid isolation | K3 |
| CO-5: | Analyse the principles of agarose gel electrophoresis | K4 |
| CO-6: | Analyse different bacterial conjugation processes | K4 |

**COURSE CONTENT :**

| MODULE 1: | STUDY AND VISUALIZATION OF BACTERIAL GENETIC MATERIAL | 15 Hours |
|---|---|---|
| 1. Effect of UV on bacteria and plotting of survival curve<br>2. Demonstration of Master and Replica plate preparation<br>3. Isolation of Plasmid DNA from *E. coli* and study of different conformations of plasmid DNA through Agarose gel electrophoresis<br>4. Bacterial Conjugation | | |
| **TOTAL LECTURES** | | **15 Hours**** |

# VIROLOGY (Theory)

| **Program:** B. Sc. in Microbiology | **Year, Semester:** 2nd Yr., 4th Sem |
|---|---|
| **Course Title:** Virology (Theory) | **Subject Code:** TIU-UMB-MJ-T22204 |
| **Contact Hours/Week**: 2–1–0 (L–T–P) | **Credit:** 3 |

**COURSE OBJECTIVE :**

Enable the student to:

1. Explore the concepts of viroids, virusoids, satellite viruses, and prions, and their biological significance.
2. Study the structure of viruses, focusing on capsid symmetry, and the differences between enveloped and non-enveloped viruses.
3. Understand the interaction of viruses with cellular receptors and the mechanisms by which viruses enter host cells.
4. Understand the concepts of oncogenes and proto-oncogenes, their roles in cancer development, and how they can be activated or inactivated by viral infections.

**COURSE OUTCOME :**

On completion of the course, the student will be able to:

| CO-1: | Understand the fundamental characteristics and nature of viruses | K2 |
|---|---|---|
| CO-2: | Analyze the genetic basis of lytic vs. lysogenic switches, particularly focusing on the lambda phage. | K4 |
| CO-3: | Understand genomic features like terminal cohesive ends | K2 |
| CO-4: | Explore the link between viruses and cancer. | K5 |
| CO-5: | Apply the understanding of viral genetics, replication, and transmission | K3 |
| CO-6: | Analyze and understand complex viral genetic features, their transmission, and the mechanisms they use to infect and replicate in host cells. | K4 |

**COURSE CONTENT :**

| | | |
|---|---|---|
| **MODULE 1:** | **NATURE AND PROPERTIES OF VIRUSES** | **10 Hours** |
| Introduction: Discovery of viruses, nature and definition of viruses, general properties, concept of viroids, virusoids, satellite viruses and Prions. Theories of viral origin Structure of Viruses: Capsid symmetry, enveloped and non-enveloped viruses Isolation,purification and cultivation of viruses Viral taxonomy: Classification and nomenclature of different groups of viruses | | |
| | | |
| **MODULE 2:** | **BACTERIOPHAGES** | **10 Hours** |
| Diversity, classification, one step multiplication curve, lytic and lysogenic phages (lambda phage) concept of early and late proteins, regulation of transcription in lambda phage, geneticbasis of lytic vs lysogenic switch of lambda phage | | |
| | | |
| **MODULE 3:** | **VIRAL TRANSMISSION, SALIENT FEATURES OF VIRAL NUCLEIC ACIDS AND REPLICATION** | **15 Hours** |
| Modes of viral transmission: Persistent, non-persistent, vertical and horizontal Salient features of viral Nucleic acid : Unusual bases (TMV,T4 phage), overlapping genes (ϕX174, Hepatitis B virus), alternate splicing (HIV), terminal redundancy (T4 phage), terminal cohesive ends (lambda phage), partial double stranded genomes (Hepatitis B), long terminal repeats (retrovirus), segmented (Influenza virus), and non-segmented genomes (picornavirus),capping and tailing (TMV) Viral multiplication and replication strategies: Interaction of viruses with cellular receptors and entry of viruses. Replication strategies of viruses as per Baltimore classification (phi X 174, Retroviridae, Vaccinia, Picorna) , Assembly, maturation and release of virions | | |
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| **MODULE 4:** | **VIRUSES AND CANCER** | **10 Hours** |
| Introduction to oncogenic viruses, types of oncogenic DNA and RNA viruses: Concepts of oncogenes and proto-oncogenes | | |
| **TOTAL LECTURES** | | **45 Hours**** |

**Books:**


1. Dimmock, NJ, Easton, AL, Leppard, KN (2007). Introduction to Modern Virology. 6th edition, Blackwell Publishing Ltd.
2. Carter J and Saunders V (2007). Virology: Principles and Applications. John Wiley and Sons.
3. Flint SJ, Enquist, LW, Krug, RM, Racaniello, VR, Skalka, AM (2004). Principles of Virology, Molecular biology, Pathogenesis and Control. 2nd edition. ASM press Washington DC.

4. Levy JA, Conrat HF, Owens RA. (2000). Virology. 3rd edition. Prentice Hall publication, New Jersey.
5. Wagner EK, Hewlett MJ. (2004). Basic Virology. 2nd edition. Blackwell Publishing. 6. Mathews. (2004). Plant Virology. Hull R. Academic Press, New York.
6. Nayudu MV. (2008). Plant Viruses. Tata McGraw Hill, India.
7. Bos L. (1999) Plant viruses-A text book of plant virology by. Backhuys Publishers.
8. Versteeg J. (1985). A Color Atlas of Virology. Wolfe Medical Publication

# VIROLOGY (Practical)

| | |
|---|---|
| **Program:** B. Sc. in Microbiology | **Year, Semester:** 2nd Yr., 4th Sem |
| **Course Title:** VIROLOGY (Practical) | **Subject Code:** TIU-UMB-MJ-L22204 |
| **Contact Hours/Week**: 0–0–1 (L–T–P) | **Credit:** 1 |

**COURSE OBJECTIVE :**

Enable the student to:

1. Study of the Structure of Important Animal Viruses (Rhabdo, Influenza, Paramyxo, Hepatitis B, and Retroviruses) Using Electron Micrographs
2. Study of the Structure of Important Plant Viruses (Caulimo, Gemini, Tobacco Ringspot, Cucumber Mosaic, and Alpha-Alpha Mosaic Viruses) Using Electron Micrographs
5. Isolation of Bacteriophages from Water/Sewage Sample Using Double Agar Layer Technique

**COURSE OUTCOME :**

On completion of the course, the student will be able to:

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|---|---|---|
| CO-1: | Recall the basic concepts and structures of animal viruses, plant viruses, and bacteriophages. | K3 |
| CO-2: | Understand the significance of the structural components of viruses and how they contribute to viral function. | K3 |
| CO-3: | Apply knowledge of virus structures to analyze electron micrographs and distinguish between various viruses. | K3 |
| CO-4: | Compare and contrast the structural features of animal, plant, and bacterial viruses based on electron microscopy images. | K2 |
| CO-5: | Evaluate the importance of electron microscopy in virus identification and classification. | K5 |
| CO-6: | Design a method for isolating bacteriophages from sewage water and apply the double-layer technique for bacteriophage isolation. | K4 |

**COURSE CONTENT :**

| **MODULE 1:** | **NATURE AND PROPERTIES OF VIRUSES** | **15 Hours** |
|---|---|---|
| Study of the structure of important animal viruses (rhabdo, influenza, paramyxo hepatitis B and retroviruses) using electron micrographs<br>2. Study of the structure of important plant viruses (caulimo, Gemini, tobacco ringspot,cucumber mosaic and alpha-alpha mosaic viruses) using electron micrographs<br>3. Study of the structure of important bacterial viruses (ϕX 174, T4, λ) using electron micrograph<br>4. Isolation of bacteriophages from water/sewage sample using double agar layer technique<br>5. Phage Titration<br>6. Isolation of Nucleic Acid from Phage | | |
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| **TOTAL LECTURES** | | **15 Hours**** |

## AGRICULTURAL MICROBIOLOGY (Theory)

| **Program:** B. Sc. in Microbiology | **Year, Semester:** 2nd Yr., 4th Sem |
|---|---|
| **Course Title:AGRICULTURAL MICROBIOLOGY (Theory)** | **Subject Code:** TIU-UBT-MI-T22201 |
| **Contact Hours/Week**: 2–1–0 (L–T–P) | **Credit:** 3 |

**COURSE OBJECTIVE :**

Enable the student to:

1. DUnderstand the fundamental concepts of microbiology and its applications in agriculture.
2. Explore the diversity and functions of soil microorganisms.
3. Examine the role of microbes in nutrient cycling and soil fertility.
4. Study plant-microbe interactions, including beneficial and pathogenic relationships.
5. Learn about biofertilizers, biopesticides, and their applications in sustainable agriculture.

**COURSE OUTCOME :**

On completion of the course, the student will be able to:

| | | |
|---|---|---|
| CO-1: | Recall the fundamental concepts, scope, and historical development of agricultural microbiology. | K1 |
| CO-2: | Explain the diversity, distribution, and functional roles of soil microorganisms in organic matter decomposition and nutrient cycling | K2 |
| CO-3: | Apply knowledge of plant-microbe interactions to evaluate the role of Rhizobium, mycorrhizae, and PGPR in plant growth and soil health. | K3 |
| CO-4: | Analyze the mechanisms of microbial infections in plants and assess their impact on plant health and disease development | K4 |
| CO-5: | Evaluate the effectiveness of biofertilizers and biopesticides in sustainable agriculture and integrated pest management (IPM). | K5 |
| CO-6: | Design sustainable agricultural strategies incorporating biofertilizers, biopesticides, and beneficial microbes for improved crop productivity. | K6 |

**COURSE CONTENT :**

| **MODULE 1:** | **INTRODUCTION TO AGRICULTURAL MICROBIOLOGY** | **10 Hours** |
|---|---|---|
| Definition and scope of agricultural microbiology. Historical development and significance in agriculture. Classification and characteristics of soil microorganisms. Microbial ecology and its relevance to agriculture. | | |
| | | |
| **MODULE 2:** | **SOIL MICROORGANISMS AND THEIR FUNCTIONS** | **10 Hours** |
| Diversity of soil microorganisms: bacteria, fungi, actinomycetes, and algae. Microbial populations and their distribution in soil. Role of microorganisms in organic matter decomposition. Microbial involvement in nutrient cycling: nitrogen, phosphorus, and sulfur cycles. Soil enzymes and their agricultural significance. | | |
| | | |
| **MODULE 3:** | **PLANT-MICROBE INTERACTIONS** | **15 Hours** |
| Symbiotic relationships: Rhizobium-legume symbiosis. Mycorrhizal associations and their impact on plant growth. Endophytes and their role in plant health. Plant growth-promoting rhizobacteria (PGPR) and their mechanisms. Microbial pathogens: types, mechanisms of infection, and disease development. | | |
| | | |
| **MODULE 4:** | **BIOFERTILIZERS AND BIOPESTICIDES** | **10 Hours** |
| Definition, types, and production of biofertilizers. Application methods and benefits in agriculture. Biopesticides: classification, modes of action, and examples. Integrated pest management (IPM) and the role of biopesticides. Regulatory aspects and quality control of biofertilizers and biopesticides. | | |
| **TOTAL LECTURES** | | **45 Hours**** |

**Books:**


1. Rangaswamy, N., & Bagyaraj, D. J. (2015). Agricultural Microbiology. Scientific Publishers.
2. Dubey, R. C., & Maheswari, D. K. (2013). A Textbook of Microbiology. S. Chand Publishing.


# AGRICULTURAL MICROBIOLOGY (Practical)

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|---|---|
| **Program:** B. Sc. in Microbiology | **Year, Semester:** 2nd Yr., 4th Sem |
| **Course Title:** AGRICULTURAL MICROBIOLOGY (Practical) | **Subject Code:** TIU-UBT-MI-L22201 |
| **Contact Hours/Week**: 0–0–1 (L–T–P) | **Credit:** 1 |

**COURSE OBJECTIVE :**

Enable the student to:

1. Apply aseptic techniques to isolate and enumerate bacteria, fungi, and actinomycetes from agricultural soil using serial dilution and plate count methods.
2. Isolate and identify nitrogen-fixing bacteria, specifically Rhizobium, from root nodules, demonstrating an understanding of symbiotic relationships.
3. Prepare and examine microscopic observations of phosphate-solubilizing microorganisms isolated from soil, correlating morphological characteristics with functional capabilities.

**COURSE OUTCOME :**

On completion of the course, the student will be able to:

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| CO-1: | Recall the principles and techniques used in the isolation of bacteria, fungi, and actinomycetes from agricultural soil | K1 |
| CO-2: | Explain the importance of serial dilution techniques in microbial enumeration and soil microbiome analysis | K2 |
| CO-3: | Perform serial dilution and plate count methods to determine the total viable count of soil microbial populations | K3 |
| CO-4: | Analyze soil microbial diversity by isolating and characterizing nitrogen-fixing bacteria such as Rhizobium from root nodules | K4 |

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|---|---|---|
| CO-5: | Evaluate the efficiency of phosphate-solubilizing microorganisms through microscopic observation and biochemical tests. | K5 |
| CO-6: | Design an optimized protocol for microbial isolation, enumeration, and identification from soil samples for agricultural applications. | K6 |

**COURSE CONTENT :**

| **MODULE 1:** | **NATURE AND PROPERTIES OF VIRUSES** | **15 Hours** |
|---|---|---|
| 1. Isolation of bacteria, fungi, and actinomycetes from agricultural soil.<br>2. Enumeration using the serial dilution technique.<br>3. Total viable count of Soil Microbial Population using serial dilution and plate count.<br>4. Isolation of nitrogen-fixing bacteria like Rhizobium from root nodules.<br>5. Isolation and observation under a microscope of Phosphate Solubilizing Microorganisms | | |
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| **TOTAL LECTURES** | | **15 Hours**** |

## SCIENTIFIC COMMUNICATION AND WRITING SKILLS

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| **Program:** B. Sc. in Microbiology | **Year, Semester:** 2nd Yr., 4th Sem |
| **Course Title:** SCIENTIFIC COMMUNICATION AND WRITING SKILLS | **Subject Code:** TIU-UMB-AEC-T2201 |
| **Contact Hours/Week**: 2–0–0 (L–T–P) | **Credit:** 2 |

**COURSE OBJECTIVE :**

Enable the student to:

1. To develop a strong foundation in scientific communication by understanding the principles, ethics, and importance of clear and effective communication in research and academia.
2. To enhance technical writing and documentation skills by learning the structure and format of scientific papers, reports, proposals, and dissertations.
3. To improve proficiency in oral and visual communication through the development of presentation skills, research posters, and public speaking techniques for scientific discussions.

4. To familiarize students with publication processes and ethical considerations in scientific writing, including plagiarism, citation styles, peer review, and journal selection.

**COURSE OUTCOME :**

On completion of the course, the student will be able to:

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| CO-1: | Understand the principles of scientific communication and explain its significance in research and academia. | K2 |
| CO-2: | Analyze and apply ethical standards in scientific writing**,** including plagiarism prevention, citation formats, and responsible authorship. | K4 |
| CO-3: | Demonstrate proficiency in technical writing by structuring research papers, proposals, and reports according to standard scientific formats. | K3 |
| CO-4: | Develop effective oral and visual presentation skills by preparing research posters, slide decks, and delivering academic presentations. | K6 |
| CO-5: | Critically evaluate and review scientific literature to synthesize information and construct well-supported arguments in writing. | K5 |
| CO-6: | Remember and get knowledge of the publication process to select appropriate journals, format manuscripts, and understand peer review mechanisms. | K1 |