Scheme of Examination for Undergraduate Program under Multiple Entry-Exit, Internship and CBCS-LOCF

(In accordance with NEP-2020 w.e.f. 2025-26)

Department of Biotechnology

Faculty of Life Sciences

Chaudhary Bansi Lal University (CBLU) Bhiwani

2025-26

Department of Biotechnology

Semester- I

Credits-22 **Marks-540**

SN	Paper Code	Subject	Course Type	Weekly contact hours			Credits			Examination Scheme			
				T	P	Total	T	P	Total	T	Int	P	Total
1	25UN-BIT-101	Introductory Cell Biology	CC1	3	-	3	3	-	3	50	20	-	70
		Practical		-	2	2	-	1	1	-	-	30	30
2	25UN-BIT-102	Introductory Microbiology	CC2	3	-	3	3	-	3	50	20	-	70
		Practical		-	2	2	-	1	1	-	-	30	30
3	25UN-BIT-103	Microbial Diversity	CCM1	3	-	3	3	-	3	50	20	-	70
		Practical		-	2	2	-	1	1	-	-	30	30
4	*	Available MDC	MDC1	3	-	3	3	-	3	50	20	-	70
5		Available AEC	AEC1	2	-	2	2	-	2	35	15	-	50
6		Available SEC	SEC1	3	-	3	3	-	3	50	20	-	70
7	25UN-BIT-VAC101	Human Values and Ethics	VAC1	2	-	2	2	-	2	35	15	-	50
		Total		**19**	**6**	**25**	**19**	**3**	**22**	**320**	**130**	**90**	**540**

CC: Core Course, **CCM:** Core Course Minor, **MDC:** Multidisciplinary Course, **AEC:** Ability Enhancement Course, **SEC:** Skill Enhancement Course, **VAC:** Value Added Course
* Student will select a particular course of choice from the list provided or as offered by the university

Semester- II

Credits-22 **Marks-540**

SN	Paper Code	Subject	Course Type	Weekly contact hours			Credits			Examination Scheme			
				T	P	Total	T	P	Total	T	Int	P	Total
1	25UN-BIT-201	Basics of Biomolecules	CC3	3	-	3	3	-	3	50	20	-	70
		Practical		-	2	2	-	1	1	-	-	30	30
2	25UN-BIT-202	Fundamental Molecular Biology	DSEC1	3	-	3	3	-	3	50	20	-	70
		Practical		-	2	2	-	1	1	-	-	30	30
3	25UN-BIT-203	Environmental Microbiology	CCM2	3	-	3	3	-	3	50	20	-	70
		Practical		-	2	2	-	1	1	-	-	30	30
4	*	Available MDC	MDC2	3	-	3	3	-	3	50	20	-	70
5		Available AEC	AEC2	2	-	2	2	-	2	35	15	-	50
6		Available SEC	SEC2	3	-	3	3	-	3	50	20	-	70
7	25UN-BIT-VAC102	Environmental Studies	VAC2	2	-	2	2	-	2	35	15	-	50
		Total		**19**	**6**	**25**	**19**	**3**	**22**	**320**	**130**	**90**	**540**

CC: Core Course, **DSEC:** Discipline Skill Enhancement Course, **CCM:** Core Course Minor, **MDC:** Multidisciplinary Course, **AEC:** Ability Enhancement Course, **SEC:** Skill Enhancement Course, **VAC:** Value Added Course
* The student will select a particular course of choice from the list provided or as offered by the university
Students who exit after 1 year should undergo an internship (4 credits) to receive a UG certificate in Biotech.

B.Sc. Biotechnology (Semester I)

25UN-BIT-101
Introductory Cell Biology

MM: 100, Theory Examination: 50 Time: 3 hrs
Internal Assessment: 20 Practical Examination: 30

Note: *There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of ten (ten marks) short answer type questions covering the entire syllabus. Two questions (each for 10 marks) will be asked from each unit. Students will have to attempt one question from each unit. Each question shall carry equal marks.*

Objectives: To provide students with a comprehensive understanding of the structure and function of prokaryotic and eukaryotic cells, their organelles, and membrane transport systems. To explore cell division, apoptosis, and the biogenesis and degradation of cellular components, along with practical skills in cell analysis.

Course Outcomes:
CO1: Understand the structures and functions of basic components of plant and animal cells.
CO2: Understand how these cellular components are synthesized and degraded in cells.
CO3: Describe the various models and solute transporter systems belonging to the cell membrane.
CO4: Understanding the importance of cell division, death, and renewal.

Unit I

Basics of Cell Biology and cell organelle: Preface, discovery of cell and Cell Theory; Prokaryotic and eukaryotic cell structure and main features; Comparison between plant and animal cells; Structure and function of Protoplasm, Cell wall, Cytoskeleton, Mitochondria, Chloroplast, ER, Golgi complex, and Plasma membrane.

Unit II

Cell organelle and biogenesis. Structure and function of Lysosome, and microbodies, Ribosome, Centriole, Nucleus, Chromosomes. Biogenesis of mitochondria, chloroplast, ER, and Golgi complex. Biosynthetic process in ER and Golgi apparatus, Degradation of cellular components.

Unit III

Membrane structure and transport: Membrane composition, lipids, proteins, and carbohydrates; Models of membrane structure; Passive and active transport. Modification of plasma membrane and intracellular junctions. Role of membrane and cytoskeleton in cell mobility.

Unit IV

Cell division and apoptosis: An overview of cell cycle and cell division, Components of cell cycle control system, Mitosis and Meiosis, Cell death and cell renewal.

Suggested Readings:

1. Molecular Biology of the Cell – Bruce Alberts et al., Garland Publications.
2. Animal Cytology & Evolution – MJD White, Cambridge University Publications.
3. Molecular Cell Biology – Daniel, Scientific American Books.
4. Cell Biology – Jack D. Burke, The William Wilkins Company.
5. Cell Biology – Ambrose & Dorothy M. Easty, ELBS Publications.
6. Fundamentals of Cytology – Sharp, McGraw Hill Company.
7. Cytology – Wilson & Morrison, Reinhold Publications.
8. Molecular Biology – Smith, Faber & Faber Publications.
9. Cell Biology & Molecular Biology – EDP Roberties & EMF Roberties, Sauder College.

Note: The latest edition of these books is proposed or as recommended by the concerned faculty.

Practical:
1. Observation of plant and animal cells (e.g., onion epidermal cells, cheek cells) using a light microscope.
2. Preparation of temporary slides to study cell structure (e.g., *Elodea* leaf cells).
3. Staining of bacterial cells to observe cell morphology (e.g., methylene blue staining).
4. Study of mitosis using onion root tip slides under a microscope.
5. Observation of cell organelles using prepared slides (e.g., mitochondria, chloroplasts).
6. Demonstration of osmosis in plant cells using potato strips.
7. Analysis of cell division stages in pre-prepared animal tissue slides.
8. Measurement of cell size using a calibrated ocular micrometer.

25UN-BIT-102
Introductory Microbiology

Maximum Marks: 100 Theory Examination: 50 Time: 3 hrs
Internal Assessment: 20 Practical Examination: 30

Note: *There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of ten (ten marks) short answer type questions covering the entire syllabus. Two questions (each for 10 marks) will be asked from each unit. Students will have to attempt one question from each unit. Each question shall carry equal marks.*

Objectives: To provide students with a comprehensive understanding of microbiology, including the history, classification, and characteristics of microorganisms, their growth, reproduction, and control measures. To explore the role of microbes in food, water, and industrial applications, and to develop practical skills in microbial isolation, staining, and enumeration.

Course Outcomes:
CO1: Illustrate the knowledge of various approaches to study the microbes and their various features.
CO2: Illustrate the knowledge of microbial growth, isolation, purification, and preservation.
CO3: Gain the knowledge of characteristics of viruses, their types, and mode of multiplication.
CO4: Analyze the role of microbes in environmental processes, sewage disposal, foods, and disease prevention.

Unit I

Introduction: History and evolution of microbiology with special reference to the contribution of different scientists. Distribution and characterization: Prokaryotic cells, Morphology and cell structure of major groups of microorganisms e.g., Bacteria, Algae, Fungi, and Protozoa. Stains and staining procedures: Acidic, basic, and neutral stains, Gram staining, Acid-fast staining, Flagella staining, Endospore staining.

Unit II

Cultivation and maintenance of microorganisms: Nutritional requirements of microorganisms. Methods of isolation, purification, and preservation of microorganisms. Microbial growth: Study of growth curve, generation time. Bacterial Reproduction: Transformation, Transduction, and Conjugation.

Unit III

Viruses: General characteristics of viruses, difference between virus and typical microbial cell, structure, different shapes and symmetries with one example of each type. Classification of viruses on the basis of nucleic acids. Phage and animal cell viruses, example of each and their importance. Brief idea of lytic cycle and lysogeny.

Unit IV

Microbiology of water and Food: Bacterial pollutants of water, coliforms, and non-coliforms. Sewage composition and its disposal. Microbial spoilage of foods. Major foodborne infections and intoxications. Microbiology of fermented foods.

Suggested Readings:

1. Introductory Mycology. Alexopoulos CJ, Mims CW, and Blackwell M. John and Sons, Inc.
2. Modern Food Microbiology. Jay JM, Loessner MJ, and Golden DA. CBS Publishers and Distributors, Delhi, India.
3. Introductory Phycology. Kumar HD. Affiliated East Western Press.
4. Brock Biology of Microorganisms. Madigan MT, Martinko JM, and Parker J. Pearson/Benjamin Cummings.
5. Microbiology. Pelczar MJ, Chan ECS, and Krieg NR. McGraw Hill Book Company.
6. General Microbiology. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. McMillan.
7. Microbiology: An Introduction. Tortora, G.J., Funke, B.R., and Case, C.L. Pearson Education.
8. Prescott's Microbiology. Willey, J., Sherwood, L., and Woolverton, C.J. McGraw-Hill Education.

Note: The latest edition of these books is proposed or as recommended by the concerned faculty.

Practical:

1. Preparation of nutrient agar and broth for microbial culturing.
2. Isolation of bacteria from soil or water using serial dilution and spread plate techniques.
3. Gram staining of bacterial samples to differentiate Gram-positive and Gram-negative bacteria.
4. Observation of fungal morphology using slides of Aspergillus or Rhizopus.
5. Streak plate technique to obtain pure bacterial colonies.
6. Testing microbial growth under different conditions (e.g., temperature or pH).
7. Microscopic observation of protozoa (e.g., Paramecium) from pond water samples.
8. Antibiotic sensitivity testing using the disc diffusion method.

B.Sc. Biotechnology (Semester I)

25UN-BIT-103 Maximum Marks: 100 Theory Examination: 50 Time: 3 hrs
Microbial Diversity Internal Assessment: 20 Practical Examination: 30

Note: *There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of ten (ten marks) short answer type questions covering the entire syllabus. Two questions (each for 10 marks) will be asked from each unit. Students will have to attempt one question from each unit. Each question shall carry equal marks.*

Objectives: This course helps to understand the diversity and classification systems of microorganisms.To explore the general characteristics, structure, and reproduction of acellular and cellular microorganisms. To examine the ecological distribution, morphology, and economic importance of bacteria, algae, fungi, and protozoa. To develop practical skills in identifying and analyzing microorganisms for their applications in various fields.

Outcomes:
CO1: Explain the principles of microbial classification and the differences between prokaryotics and eukaryotics.
CO2: Describe the morphology, reproduction, and ecological roles of acellular and cellular microorganisms.
CO3: Analyze the life cycles and reproductive strategies of algae & fungi, including their economic significance.
CO4: Apply laboratory techniques to identify and characterize microorganisms and evaluate their applications.

Unit I

Diversity of Microbial World: Systems of classification, Binomial Nomenclature, Whittaker's five kingdom and Carl Woese's three kingdom classification systems and their utility. Characteristic features and Differences between prokaryotic and eukaryotic microorganisms.

Unit II

General characteristics of different groups: Acellular microorganisms (Viruses, Viroids, Prions) and Cellular microorganisms (Bacteria, Algae, Fungi and Protozoa) with emphasis on distribution and occurrence, morphology, mode of reproduction and economic importance. Ultra-structure of microbes (bacteria, algae, fungi, protozoa)

Unit III

Algae and fungi: General characteristics of algae and fungi, thallus organization. Different types of life cycles in algae with suitable examples: Haplobiontic, Haplontic, Diplontic, Diplobiontic and Diplohaplontic life cycles. Fungal wall structure and synthesis. Reproduction in fungi asexual, sexual, heterokaryosis, heterothallism and parasexual.

Unit IV

Protozoa and applications of microbes: Protozoa General characteristics with special reference to Amoeba, Plasmodium, and Giardia. Economic importance of algae and fungi with examples in agriculture, environment, Industry, medicine, and food, biodeterioration and mycotoxins.

Suggested Readings:

1. Brock Biology of Microorganisms. Madigan, MT, Martinko, JM, Bender, KS, Buckley, DH, Stahl, DA. Pearson.
2. Microbiology. Prescott, L. M., Harley, J. P., & Klein, D. A. McGraw-Hill Education.
3. Algae: Anatomy, Biochemistry, and Biotechnology. Barsanti, L., & Gualtieri, P. CRC Press.
4. Introduction to Fungi. Webster, J., & Weber, R. W. S. Cambridge University Press.
5. Articles from Journal of Microbiology & Applied & Environmental Microbiology on microbial diversity.

Note: The latest edition of these books is proposed or as recommended by the concerned faculty.

Practical:

1. Preparation and observation of bacterial smears using Gram staining to differentiate prokaryotic microorganisms.
2. Microscopic identification of algae (e.g., Chlamydomonas, Spirogyra) from freshwater samples.
3. Study of fungal morphology and reproductive structures using permanent slides (e.g., Aspergillus, Rhizopus).
4. Observation of protozoa (e.g., Amoeba, Paramecium) under a microscope using prepared slides or live samples.
5. Isolation and culturing of soil bacteria on nutrient agar to study microbial diversity.
6. Preparation of algal cultures and analysis of their growth under different conditions (e.g., light intensity).
7. Demonstration of fungal spore germination and mycelial growth on agar plates.
8. Field study to collect and identify economically important algae and fungi from the local environment.

25UN-BIT-201
Basics of Biomolecules

Maximum Marks: 100 Theory Examination: 50 Time: 3 hrs
Internal Assessment: 20 Practical Examination: 30

Note: *There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of ten (ten marks) short answer type questions covering the entire syllabus. Two questions (each for 10 marks) will be asked from each unit. Students will have to attempt one question from each unit. Each question shall carry equal marks.*

Objectives: The course aims to introduce students to the structure and function of key Biomolecules like carbohydrates, proteins, lipids, and nucleic acids, explain their roles in cellular processes, provide hands-on experience in analyzing Biomolecules using simple biochemical techniques, and highlight their significance in biotechnology and health.

Course Outcomes:
CO1: Understand the physical and chemical basis of biomolecules involved in life processes.
CO2: Classify carbohydrates, describe their structures, and correlate their properties to biological functions.
CO3: Gain fundamental knowledge of protein biochemistry.
CO4: Identify applications of Biomolecules in biotechnology and medicine.

Unit I

Carbohydrates: Overview of Biomolecules and their importance in living organisms. Polarity and solubility of Biomolecules. Carbohydrates definition, classification, and nomenclature. Structure, Function, and properties of Monosaccharides, Disaccharides, and Polysaccharides. Homo & Hetero Polysaccharides, Mucopolysaccharides, Glycoproteins, & their functions.

Unit II

Lipids: Introduction, classification, nomenclature, and properties of fats and fatty acids. Essential fatty acids. Structure and properties of phospholipids, sphingolipids, glycolipids, gangliosides, prostaglandins. Terpenoids and isoprenoids - definition and representative structures, steroids. Waxes.

Unit III

Proteins and Enzymes: Structure of proteins, including amino acids, peptide bonds, and levels of protein structure (primary, secondary, tertiary, quaternary); functions of proteins in catalysis, transport, and structural roles. Enzymes active sites and specificity. Common structural features of amino acids. Classification by R group, Zwitter ion structures, acid-base properties, and titration curves of amino acids. Amino acids reactions like Edman's, Sanger's, ninhydrin.

Unit IV

Nucleic acids and applications: Structure of nucleic acids, including DNA and RNA; Nucleosides, Nucleotides, and polynucleotides. Chargaff's rules, Watson Crick Model (B-DNA) and other forms of DNA (A- and Z-DNA). Functions of nucleic acids in genetic information storage and transfer; introduction to nucleotides and their role in energy transfer (e.g., ATP); applications of biomolecules in biotechnology, such as protein-based drugs and DNA diagnostics.

Suggested Readings:

1. Lehninger: Principles of Biochemistry by David L. Nelson and M.M. W.H. Freeman & Company
2. Biochemistry for Life Sciences by Uma Bhardwaj
3. Biochemistry by R.H. Garrett and C.M. Grisham
4. Outlines of Biochemistry by E.E. Conn, P.K. Stumpf, G. Bruening, and Ray H. Doi, John Wiley
5. Biochemistry: International edition by Jeremy M. Berg, John L. Tymoczko, and Lubert Stryer
6. Biochemistry by J.L. Jain, S. Chand & Co.
7. Essentials of Biochemistry by Satyanarayana and Chakrapani, Elsevier, India
8. Chemistry of Biomolecules: An Introduction by R.J. Simmonds, Royal Society of Chemistry
9. Biochemistry. Voet, D., & Voet, J. G. Wiley

Note: The latest edition of these books is proposed or as recommended by the concerned faculty.

Practical:

1. Qualitative analysis of carbohydrates using Benedict's and Molisch's tests.
2. Detection of proteins in a sample using the Biuret test.
3. Identification of lipids using the Sudan III staining method.
4. Extraction and visualization of DNA from plant material (e.g., onion).
5. Quantification of proteins using a simple colorimetric assay (e.g., Bradford method).
6. Observation of enzyme activity (e.g., amylase) under varying conditions.
7. Separation of Biomolecules using paper chromatography.
8. Analysis of nucleic acid structure using UV spectroscopy.

25UN-BIT-202
Fundamental Molecular Biology

Maximum Marks: 100 Theory Examination: 50 Time: 3 hrs
Internal Assessment: 20 Practical Examination: 30

Note: *There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of ten (ten marks) short answer type questions covering the entire syllabus. Two questions (each for 10 marks) will be asked from each unit. Students will have to attempt one question from each unit. Each question shall carry equal marks.*

Objectives: The course aims to provide a comprehensive understanding of the principles of molecular biology by exploring the structure and function of nucleic acids and proteins. Enable students to evaluate the applications of molecular biology in advancing biotechnology, medical research, and genetic engineering.

Course outcomes:
CO1: Explain the molecular structure and function of DNA, RNA, and proteins in cellular processes.
CO2: Describe the processes of DNA replication, transcription, and translation, including their regulation.
CO3: Analyze the applications of molecular biology in biotechnology, medicine, and genetic engineering.

Unit I

Basics of Molecular Biology: Overview of molecular biology, including its importance in understanding life processes; structure of DNA, focusing on the double helix and base pairing; structure of RNA, including types like mRNA, tRNA, and rRNA and their roles; organization of genetic material in prokaryotes (circular DNA, plasmids) and eukaryotes (chromosomes, chromatin); central dogma of molecular biology, describing the flow of genetic information from DNA to RNA to protein in simple terms.

Unit II

DNA Replication and Repair: Mechanisms of DNA replication in prokaryotes and eukaryotes. Basic steps of replication, such as unwinding, replication fork, copying, and joining DNA. Differences between prokaryotic and eukaryotic replication, such as origins of replication and Okazaki fragments. Importance of DNA repair to fix mistakes during replication; Replication errors, such as mutations and their impact on genetic stability.

Unit III

Transcription and Gene Regulation: Process of transcription in prokaryotes and eukaryotes, including initiation, elongation, and termination. Post-transcriptional modifications, such as 5' capping, polyadenylation, and splicing in eukaryotes. Lac operon model, enhancers, and silencers in eukaryotes; epigenetic regulation, including DNA methylation and histone modification.

Unit IV

Translation and Applications of Molecular Biology: Mechanism of translation, including ribosome structure, tRNA charging, and stages of protein synthesis (initiation, elongation, termination). Post-translational modifications, such as phosphorylation and glycosylation. Applications of molecular biology in biotechnology, including gene cloning, gene editing, gene therapy. case studies on molecular biology breakthroughs, such as insulin production.

Suggested readings:

1. Lewin Genes by Jocelyn E Krebs et al., Jones & Bartlett Learning.
2. Essentials of Molecular Biology by Friefelder D et al., Boston.
3. Genetics: Analysis and Principles by Brooker, Robert J, McGraw-Hill Education.
4. Concepts of genetics by William S Klug et al., Pearson NY.
5. Genetics: A molecular approach by Brown TA, Chapman and Hall, London.
6. Gene Regulation by Gurbachan S, Narosa Publishers.
7. Molecular Biology of the Gene. Watson, J. D., et al., Pearson.
8. Molecular Biology of the Cell. Alberts, B., Johnson et al., Norton & amp Company.
9. Molecular Cell Biology. Lodish, H., et al., W.H. Freeman.

Please note: The latest edition of these books is proposed or as recommended by the concerned faculty.

Practical:

1. Isolation of genomic DNA from bacterial cells (e.g., E. coli) and analysis by agarose gel electrophoresis.
2. Isolation of RNA from plant or animal tissue and quantification using UV spectroscopy.
3. Perform polymerase chain reaction (PCR) to amplify a specific DNA fragment.
4. Analysis of PCR products using agarose gel electrophoresis and visualization with ethidium bromide.
5. Protein extraction from microbial or plant samples and analysis by SDS-PAGE.
6. Demonstration of bacterial transformation with a plasmid containing a reporter gene (e.g., GFP).
7. Simulation of gene cloning using bioinformatics tools (e.g., SnapGene or Benchling).
8. Study of gene expression through RT-PCR analysis of a specific mRNA.

25UN-BIT-203
Environmental Microbiology

Maximum Marks: 100 Theory Examination: 50 Time: 3 hrs
Internal Assessment: 20 Practical Examination: 30

Note: *There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of ten (ten marks) short answer type questions covering the entire syllabus. Two questions (each for 10 marks) will be asked from each unit. Students will have to attempt one question from each unit. Each question shall carry equal marks.*

Objectives: The course aims to introduce students to the role of microorganisms in environmental processes, explore their applications in bioremediation and ecosystem management, develop practical skills in isolating and identifying environmental microbes, and highlight the significance of microbial diversity in maintaining ecological balance.

Course Outcomes:
CO1: Describe the role of microorganisms in environmental processes and ecosystems.
CO2: Perform basic techniques to isolate and identify environmental microbes.
CO3: Explain microbial applications in bioremediation and pollution control.
CO4: Students will assess the impact of microbes on environmental sustainability.

Unit I

Introduction to Environmental Microbiology: Overview, scope, and importance of environmental microbiology in ecosystems. Diversity of microorganisms in environments like soil, water, and air; role of microbes in nutrient cycling, including carbon, nitrogen, and sulfur cycles; Microbial ecology.

Unit II

Microbial Habitats and Adaptations: Microbial habitats, including terrestrial (soil, rhizosphere), aquatic (freshwater, marine), and extreme environments (hot springs, deep-sea vents). Adoptation strategies of thermophiles, halophiles, and psychrophiles. Formation, and ecological roles of microbial biofilms.

Unit III

Microbes in Bioremediation: Role of microbes in bioremediation, including degradation of pollutants like oil, pesticides, and heavy metals; mechanisms of bioremediation, such as bioaugmentation and biostimulation; Introduction to phytoremediation and its synergy with microbial processes.

Unit IV

Applications and Environmental Impact: Applications of environmental microbiology in composting, waste management, and wastewater treatment. Role of microbes in sustainable agriculture, such as biofertilizers and biopesticides. Environmental impact of microbial activities, including greenhouse gas production. Future trends in microbial biotechnology for environmental sustainability.

Suggested Readings:
1. Environmental Microbiology. Maier, R. M., Pepper, I. L., & Gerba, C. P. Academic Press.
2. Brock Biology of Microorganisms. Madigan, M. T., Martinko, J. M., & Bender, K. S. Pearson.
3. Manual of Environmental Microbiology. Hurst, C. J. ASM Press.
4. Articles from Applied and Environmental Microbiology and Environmental Microbiology on microbial applications.
Note: The latest edition of these books is proposed or as recommended by the concerned faculty.

Practical:
1. Isolation of soil bacteria and fungi using serial dilution and plating techniques.
2. Observation of microbial diversity in water samples using microscopy.
3. Bioremediation experiment to degrade a pollutant (e.g., dye) using microbial cultures.
4. Analysis of microbial growth under different environmental conditions (e.g., pH, temperature).
5. Preparation of compost and identification of composting microbes.
6. Study of nitrogen-fixing bacteria (e.g., *Rhizobium*) from root nodules.
7. Demonstration of biofilm formation on a solid surface.
8. Field study to collect and identify environmental microbes from local ecosystems.