AC 28/5/2026/Sfc/03 ITEM NO: 1.4.3

Deccan Education Society's

Kirti M. Doongursee College of Arts, Science and Commerce (AUTONOMOUS)

Dadar (W), Mumbai -28

Affiliated to

UNIVERSITY OF MUMBAI

Bachelor of Science

A- U.G. Certificate in Biotechnology

B- U.G. Diploma in Biotechnology

C- **B.Sc** Biotechnology

Syllabus for

Semester – Sem I & II

Ref: GR dated 20th April, 2023 for Credit Structure of UG

(With effect from the academic year 2026-27 Progressively)

PROGRAM OUTCOMES

PO	Description
A student completing Bachelor's Degree in Science **Biotechnology** Program will be able to	
PO1	Understand scope and applications of Biotechnology and its interdisciplinary approach.
PO2	Understand Fundamentals of Biotechnology. Acquire and Demonstrate Comprehensive knowledge and good experimental and Laboratory skills in Biotechnology
PO3	Build strong Knowledge and conceptual learning through systematic thinking and self -study.
PO4	Understand and apply appropriate tools and techniques in Biotechnology Acquire the knowledge of upcoming fields of Biotechnology, make the learner competent to pursue higher studies.
PO5	Acquire an ability to analyze and scientific problems and develop scientific research ability
PO6	Learn appropriate skills in conduction of Biotechnological experiments learn good oral and written communication skills as well as nurturing creativity
PO7	Employee skill and knowledge in environmental management and sustainable development Impart skills and Knowledge in designing entrepreneurial courses in the field of biotechnology.
PO8	Environment and Sustainability: Understand the impact of the scientific solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.

PROGRAM SPECIFIC OUTCOMES

PSO	Description
PSO1	Apply comprehensive knowledge of biotechnology, including microbiology, molecular biology, genetics, and environmental science, to understand biological systems and their applications.
PSO 2	Demonstrate proficiency in laboratory techniques such as microbial cultivation, staining, molecular methods, plant and animal biotechnology experiments, and analytical instrumentation.
PSO 3	Analyze and apply biotechnological principles in agriculture, healthcare, environmental management, industrial processes, and sustainable development.
PSO 4	Develop research aptitude, critical thinking, scientific communication skills with exposure to national research frameworks for higher education, industry, and innovation in biotechnology.

Sr. No.	Heading	Particulars	
1	**Title of program** **O: Biotechnology A**	**A**	**U.G. Certificate in _____**
	O: Biotechnology B	**B**	**U.G. Diploma in _____**
	O: BiotechnologyC	**C**	**B.Sc. Biotechnology**
2	**Eligibility** **O: _____A**	**A**	HSC(Science) **OR** Passed Equivalent Academic Level 4.0
	O: _____B	**B**	Under Graduate Certificate in _____ **OR** Passed Equivalent Academic Level 4.5
	O: _____C	**C**	Under Graduate Diploma in Biotechnology **OR** Passed Equivalent Academic Level 5.0
3	**Duration of program R:**	**A**	One Year
		B	Two Years
		C	Three Years
4	**Intake Capacity R:**	**120**	

Deccan Education Society's

Kirti M. Doongursee College of Arts, Science and Commerce (AUTONOMOUS)

Sign of the HOD & Coordinator
BOS in _____

Sign of the NEP Coordinator, DES's Kirti M. Doongursee College

Sign of Principal DES's Kirti M. Doongursee College, Mumbai 28.

Preamble

1) Introduction

Biotechnology is a multidisciplinary subject that primarily deals with the application of biological processes for solving problems and designing eco-friendly products and processes. At Undergraduate level learners are offered various subjects that would strengthen their fundamentals in basic sciences as well as explore the fundamentals as well as applications of biotechnology. Subjects such as Chemistry, Biology and Information Technology, computer language form an integral part of the syllabus. Biotechnology plays a key role in industries such as refining, environmental remediation, agriculture and food production, healthcare, pharmacy, animal husbandry, textiles, and nutrition. Learners after completing their biotechnology course can find suitable employment in the research and development, laboratories, pharmacies etc. The syllabus herein discusses the subjects offered at undergraduate level highlighting the respective course as well as program outcomes.

2) Aims and Objectives

The course aims at empowering the learners with a strong knowledge base of fundamental sciences, as well as applied sciences that would be useful in process development in various sectors of Biotechnology. On completion of the course the learner will be skilled and equipped with contemporary knowledge in Biotechnology and would be eligible for jobs in varied industrial sectors.

3) Learning Outcomes

The Undergraduate program in Biotechnology has been designed on learning outcome-based curriculum framework. The course covers three areas of Biotechnology along with fundamental Sciences with a range of core subjects in each semester. Along with providing the requisite biotechnology knowledge, the course has enough scope for inter- and multidisciplinary subjects in the form of electives. This course also caters the skill enhancement needs of the learners as well as provides opportunities for exchanges and learning from other disciplines. Every semester has a practical course for strengthening skills in designing and conducting experiments in the field of Biotechnology.

4) Any other point

The present syllabus also aims to develop Entrepreneur skills and Research aptitude in the learners.

Semester	Course Code	Course Title	Vertical	Credit
I	26BIOTECHMJ111	Fundamentals of Biotechnology-I	Major	2
	26BIOTECHMJ112	Molecular Biology and Genetics -2	Major	2
	26BIOTECHMJP11	Practical (Fundamentals of Biotechnology+Molecular Biology and genetics)	Major	2
	26BIOTECHOE131	Basics of Food Science	OE	2
	26BIOTECHVSC141	Fermentation Technology	VSC	2
	26BIOTECHSE151	Microbial Culture Techniques	SEC	2
II	26BIOTECHMJ211	Fundamentals of Biotechnology-2	Major	2
	26BIOTECHMJ212	Cell biology and Immunology	Major	2
	26BIOTECHMJP21	Practical-2 (Fundamentals of biotechnology-2 +Cell biology, physiology, immunology)	Major	2
	26BIOTECHMR221/ 26BIOTECHMR222	Microbiology-I/ Life Science-I	Minor	2
	26BIOTECHVSC241	Analytical Instrumentation Techniques	VSC	2
	26BIOTECHSE251	Crop improvement strategies, Composting and Solid waste management	SEC	2

Course Code	MAJOR-I SEM – I	Credits	Lectures /Week
26BIOTECHMJ111	Fundamentals of biotechnology-1	2	2

Course Objectives(CO):

CO1. To Recall fundamental concepts, scope, branches, and developments in biotechnology and fermentation technology.
CO2. To Explain applications of biotechnology in agriculture, marine systems, and industrial fermentation processes.
CO3. To Apply principles of biotechnology to examples such as GM crops, fermentation processes, and fermenter design.
CO4. To Analyse biotechnology advancements, industrial processes, case studies, and ethical issues including public perception and misuse.

Course Outcomes (OC):

After successful completion of this course, students would be able to

OC1. Comprehend fundamental concepts, scope, history, and branches of biotechnology and fermentation technology.
OC2. Apply principles of biotechnology in agriculture, marine systems, and industrial fermentation processes.
OC3. Execute understanding of biotechnology concepts through examples such as GM crops, screening methods, and fermenter systems.
OC4. Understand advancements, case studies, industrial processes, and ethical issues in biotechnology including public perception and misuse.

Unit	Topics	No of Lectures
I	**Scope and Introduction to Biotechnology** **Biotechnology** –an interdisciplinary biological science; Biotechnology – definition; History & Introduction to Biotechnology; Traditional and Modern Biotechnology; Scope and importance of biotechnology; World of Biotechnology- Pharmaceutical Biotechnology, Plant Biotechnology, Industrial Biotechnology, Marine Biotechnology, Animal Biotechnology, Medical Biotechnology, Environmental Biotechnology. Biotechnology in India – bio-business in India, booming biotech market, success story of biotech market, policy initiatives; and global trends; Biotechnology research in India; Potential of modern biotechnology	15

	Achievement of biotechnology; Prevention of misuse of biotechnology; Biotechnology Institutions in India (Public and Private Sector); Public Perception of Biotechnology.	
II	**Applications of Biotechnology and fermentation technology** **Applications in Plant and Animal Biotechnology** GM Fruits , Insect resistant Transgenic plants Transgenic Animals : Mouse, Cow, Fish, Sheep **Introduction to Fermentation processes** **Screening**: Definition Primary screening and its methods Secondary screening and its methods **Basics of Fermentation and Fermentation media**	**15**

References:

1. A Textbook of Biotechnology by R Chaubey 4th edition
2. Advanced Biotechnology by R C Dubey 1st edition
3. Biotechnology, Expanding Horizons by B D Singh, 4th edition
4. Microbial Technology Microbial Process Volume I Peppler Periman Second Edition
5. Springer Book of Marine Biotechnology
6. Stanbury and whitaker 3rd ed
7. Screening- Casida
8. Fermenter Design- Nduka Okafor 1sted

Course Code	MAJOR-II SEM – I	Credits	Lectures/ Week
26BIOTECHMJ112	**Molecular Biology and Genetics**	**2**	**2**

Course Objectives(CO):

CO1. To Recall structure, composition, and organization of DNA, RNA, chromosomes, and basic genetic concepts.

CO2. To Explain DNA replication, mutation, repair mechanisms, and principles of Mendelian genetics.

CO3. To Apply genetic principles to solve problems related to inheritance patterns and molecular processes.
CO4. To Analyse chromosomal organization, genetic variations, and deviations from Mendelian inheritance.

Course Outcomes (OC):
After successful completion of this course, students would be able to
OC1. Identify and define key concepts related to DNA/RNA structure, chromosomes, and genetics.
OC2. Describe mechanisms of DNA replication, mutation, and Mendelian and non-Mendelian inheritance.
OC3. Apply genetic concepts to interpret inheritance patterns such as monohybrid, dihybrid crosses, and blood groups.
OC4. Analyse genetic variations, chromosomal organization, and molecular mechanisms of mutation and repair.

Unit	Topics	No of Lectures
I	**DNA Composition, Chromosome, DNA structure and packing:** **The Composition and structure of DNA and RNA:** Nucleotide and Nucleoside, Structure of nucleotides. Structure of DNA. DNA double helix – Watson and Crick's Model. Structure of RNA. Types of RNA. **Organization of DNA in chromosome:** Prokaryotic Chromosomes.Eukaryotic Chromosomes. Histone and Non-histone proteins. Nucleosome Structure. **DNA replication** DNA Replication in Prokaryotes Evidence of Semi-conservative DNA replication- Meselson and Stahl's experiment DNA Replication in Eukaryotes	15
II	**Genetics:** Basic Terminologies in genetics **Mendelian Genetics:** Monohybrid Crosses and Mendel's Principle of Segregation. Representing crosses with a Branch Diagram. Principle of Segregation: The use of Test crosses. Dihybrid crosses and Mendel's Principle of IndependentAssortment. **Extensions of and Deviations from Mendelian Genetic**	15

	Principles: Multiple Alleles - ABO Blood groups Modifications of Dominance Relationships: Incomplete Dominance and Codominance.	

References:

1. Genetics – A molecular approach Peter J Russell 3rd edition
2. Biochemistry - U SatyanarayanaU.Chakrapani, (2013) 4th edition
3. Principles of Genetics. E J Gardner, M J Simmons & D Peter Snustad. 8th edition
4. A Textbook of Biotechnology By R.C. Dube
5. Genetics – A molecular approach Peter J Russell 3rd edition.
6. Cell and Molecular Biology 5th edition by Gerald Karp (John Wiley and sons publications)
7. Genetics, (2006) Strickberger MW - (Prentice Hall, India) (recombination repair)

Course Code	Practical of Major Sem I	Credits	Lectures /Week
26BIOTECHMJP11	Practical (Fundamentals of Biotechnology+Molecular Biology and genetics)	2	2

Course Objectives(CO):

CO1. To Recall principles of sterilization, media preparation, microscopy, and basic genetic and molecular techniques.
CO2. To Explain methods of microbial isolation, biochemical estimation, aseptic techniques, and genetic analysis.
CO3. To Apply laboratory techniques for sterilization, media preparation, microbial study, DNA/RNA estimation, and genetics.
CO4. To Analyse experimental results from microbiological, molecular, and genetic studies including pedigree and blood group analysis.

Course Outcomes (OC):

After successful completion of this course, students would be able to

OC1. Identify laboratory techniques, equipment, and basic microbiological and genetic procedures.
OC2. Describe methods of media preparation, microbial isolation, aseptic techniques, and biochemical estimation.
OC3. Apply practical skills in DNA/RNA estimation, microscopy, and genetic problem-solving.
OC4. Analyse and interpret experimental data from microbial studies, blood group analysis, and pedigree charts.

Topics

1. Study of Microscope
2. Sterilization of Laboratory Glassware and Media using Autoclave and Hot air oven
3. Preparation of media- Nutrient broth and Agar, MacConkey Agar, Sabouraud's Agar.
4. Study of aseptic techniques.
5. Isolation of Yeasts from the natural environment.
6. Extraction of DNA from plant material.
7. Qualitative analysis of DNA.
8. Estimation of RNA by Orcinol method
9. Study of Blood groups ABO in humans.
10. Construction of Pedigree charts and Analysis of Human Genetic traits using Pedigree analysis.
11. Problems based on Mendelian genetics.
12. Study of Karyotype - Normal male and Normal female.

References:

1. "Bergey's Manual of Systematic Bacteriology" (Multiple Volumes).
2. "Manual of Methods for General Bacteriology" by Gerhardt et al.
3. "Microbiology: A Laboratory Manual" by Cappuccino and Welsh.
4. "Industrial Microbiology" by L.E. Casida.
5. "Plant Molecular Biology — A Laboratory Manual" by M.S. Clark.
6. "Human Genetics: Concepts and Applications" by Ricki Lewis.
7. "Benson's Microbiological Applications" by Alfred Brown.

Course Code	OPEN ELECTIVE SEM – I	Credits	Lectures /Week
26BIOTECHOE131	**Basics of Food Science**	**2**	**2**

Course Objectives(CO):

CO1. To Remember the concepts of nutrition, malnutrition, diet and health, food spoilage, preservation methods, and food safety standards (FSSAI, FDA).
CO2. To Explain the role of diet in health, causes of malnutrition, and processes of food spoilage, contamination, and preservation.
CO3. To Apply principles of balanced diet, safe food practices, and preservation methods using food quality and safety guidelines.
CO4. To Analyse food spoilage, quality control, and regulatory aspects of food safety.

Course Outcomes (OC):

After successful completion of this course, students would be able to

OC1. Recall key concepts of nutrition, malnutrition, diet and health, food spoilage, preservation methods, and food safety standards (FSSAI, FDA).
OC2. Explain the role of diet in health, causes of malnutrition, and mechanisms of food spoilage, contamination, and preservation.
OC3. Apply principles of balanced nutrition, safe food practices, and preservation methods in accordance with food quality and safety guidelines.
OC4. Analyze food spoilage, quality control measures, and regulatory frameworks related to food safety.

Unit	Topics	No of Lectures
I	**Nutrition:** Intake and use of food for energy, growth, and health **Malnutrition:** **Undernutrition:** Not enough nutrients **Overnutrition:** Too much food → obesity, lifestyle diseases **Diet and Health:** Vital role of Diet in Physical health, immunity, and disease prevention Junk food vs Balanced diet	**15**
II	**Food spoilage, Food Preservation, Quality and safety** Food spoilage, food deterioration and contamination. Methods of food preservation Indicators of Food Microbial Quality & Safety, FSSAI & FDA	**15**

References:

1. Food Microbiology, 5 th edition, William C. Frazier, Dennis C. Westhoff, N.M. Vanitha, McGraw Hill Education, India.

2. Fundamentals of Food Biotechnology, 2 nd edition, Byong H. Lee, Wiley Blackwell
3. Modern Food Microbiology, 7 th edition, James M. Jay, Martin J. Loessner, David A. Golden, Food Science Texts Series
4. Prescott's Microbiology, 9 th edition, Joanne M. Willey, Linda M. Sherwood, Christopher J.Woolverton, McGraw-Hill, USA.
5. Industrial Microbiology, A. H. Patel

Course Code	VOCATIONAL SKILL COURSE SEM – I - Fermentation Technology	Credits	Lectures /Week
26BIOTECHVSC141	**Fermentation Technology Practical**	2	2

Course Objectives(CO):

CO1. To familiarize students with basic concepts, terminology, and equipment used in fermentation.
CO2. To explain principles of microbial growth and fermentation processes.
CO3. To perform basic fermentation techniques under aseptic conditions. .
CO4. To develop analytical skills for interpretation of fermentation processes.

Course Outcomes (OC):

After successful completion of this course, students would be able to

OC1..Define and identify types of fermentation and related equipment.
OC2. Explain microbial growth and fermentation processes.
OC3. Perform basic fermentation techniques using standard laboratory methods
OC4. Analyze and interpret results obtained from fermentation experiments..

Topics

1. Study of Fermentation Equipment and Setup (Fermenter, Airlock, Probes)
2. Demonstration of Aerobic and Anaerobic Conditions in Fermentation
3. Preparation and Study of Fermentation Media
4. Aseptic Transfer and Inoculation Techniques in Fermentation
5. Isolation and Characterization of Food Fermenting Microorganisms from Idli Batter (Using Bergey's Manual)
6. Solid-State Fermentation using Food Substrate (Idli/Dhokla Batter)
7. Submerged Fermentation using Yeast Culture
8. Qualitative Analysis of Sugar Fermentation using Indicator and Durham Tube Method
9. Demonstration of Yeast Fermentation by CO_2 Production (Balloon Experiment)
10. Study of the Effect of Substrate (Sugar) Concentration on Fermentation
11. Study of the Effect of Temperature on Fermentation Activity
12. Study of pH Changes during Fermentation using Indicators

References:

1. Stanbury & Whitaker – Principles of Fermentation Technology
2. Crueger & Crueger – Biotechnology
3. Prescott's Microbiology
4. Pelczar, Chan & Krieg – Microbiology
5. Casida – Industrial Microbiology .

Course Code	**SKILL ENHANCEMENT COURSE** **SEM – I - Microbial Culture Techniques**	Credits	
26BTSE151	**Microbial Culture Techniques Practical**	2	

Course Objectives(CO):

CO1. To Explain microbial diversity, colony morphology, staining principles (including Gram Staining), and the influence of environmental factors on microbial growth.
CO2. To Perform core microbiological techniques including serial dilution, CFU enumeration, staining procedures, fungal isolation, and aerogravimetric analysis.
CO3. To Analyze and interpret microbial growth patterns, compare microbial populations from different sources (air, water, food, substrates), and evaluate enumeration methods (direct and indirect).
CO4. To Assess microbial load in environmental and food samples and design experiments for microbial monitoring and quality analysis in real-world applications.

Course Outcomes (OC):

After successful completion of this course, students would be able to

OC1. Describe microbial diversity, colony characteristics, staining techniques (including Gram staining), and the effect of environmental factors on microbial growth.
OC2. Perform fundamental microbiological techniques such as serial dilution, CFU counting, staining methods, fungal isolation, and aerogravimetric analysis.
OC3. Analyze and compare microbial populations from different sources (air, water, food, and substrates) using direct and indirect enumeration methods.
OC4. Evaluate microbial load in environmental and food samples and design basic experiments for microbial monitoring and quality assessment.

Topics

1. Microscopic Examination of Yeast by Staining Techniques
2. Isolation and Comparative Analysis of Fungi from Different Substrates
3. Study of Colony Morphology and Cultural Characteristics of Bacteria
4. Preparation of Serial Dilutions for Microbial Enumeration
5. Determination of Microbial Load by Colony Forming Unit (CFU) Count Method
6. Measurement of Microbial Cell Mass and Enumeration by Direct and Indirect Methods
7. Determination of microbial load by Breed Count method
8. Differential Staining of Bacteria Using the Gram Staining Technique
9. Aerogravimetric Analysis of Airborne Microorganisms

10. Microbial Analysis of Seawater Samples 11. Study of the Effect of Environmental Factors (Temperature, pH, and Salinity) on Microbial Growth 12. Assessment of Microbial Load in Different Food Samples	

References:

1. Ibba, M.P. & Elasky, K. – Basic and Practical Microbiology Lab Manual
2. Ahern, H. – Microbiology: A Laboratory Experience
3. Reddy, S.M. & Reddy, S.R. – Microbiology: A Laboratory Manual
4. Tortora, G.J. et al. – Microbiology: An Introduction
5. Prescott, L.M. et al. – Prescott's Microbiology
6. Bergey's Manual of Determinative Bacteriology (for bacterial identification)
7. Bailey and Scott's Diagnostic Microbiology (for applied microbiology)

SEMESTER II

Course Code	MAJOR I SEM – II	Credits	Lectures /Week
26BIOTECHMJ 211	Fundamentals of Biotechnology-2	2	2

Course Objectives(CO):

CO1. To remember concepts of biomolecules (proteins, amino acids, carbohydrates) and basics of genetic engineering, rDNA technology, enzymes, and vectors.
CO2.To explain properties and functions of biomolecules and the principles of rDNA technology, including enzymes and plasmid vectors.
CO3. To Apply knowledge of biomolecules and demonstrate steps in recombinant DNA construction using enzymes and vectors.
CO4. Analyze biomolecular functions and the processes involved in genetic engineering, including plasmid vectors (pBR322).

Course Outcomes (OC): After successful completion of this course, students would be able to

OC1. Identify and describe biomolecules (proteins, amino acids, carbohydrates) and key components of genetic engineering, including rDNA technology, enzymes, and vectors.
OC2. Explain the structure–function relationships of biomolecules and the working principles of rDNA technology, enzymes, and plasmid vectors.
OC3. Demonstrate the steps involved in recombinant DNA construction and apply biomolecular concepts in relevant biological contexts.
OC4. Analyze biomolecular interactions and evaluate the role of enzymes and plasmid vectors (e.g., pBR322) in genetic engineering processes.

Unit	Topics	No of Lectures
I	**Biomolecules** PROTEINS AND AMINO ACIDS : amino acid classification and properties, peptide bond, classification and functions of proteins, enzymes. CARBOHYDRATES: Structure, functions, classification, chemical and physical properties.	15
II	**Genetic engineering** Introduction to genetic engineering rDNA technology – Definitionanddevelopments How to construct rDNA? **Enzymes in rDNA –** 1. restriction endonuclease; 2. DNA ligase; **Vectors** – Role as agents of transfer Features of plasmid vectors Plasmid vectors - pBR322	15

References:

1. Food Microbiology, 5th edition, William C. Frazier, Dennis C. Westhoff, N.M. Vanitha, McGraw Hill Education, India
2. Fundamentals of Food Biotechnology, 2nd edition, Byong H. Lee, Wiley Blackwell
3. Prescott's Microbiology, 9th edition, Joanne M. Willey, Linda M. Sherwood, Christopher J. Woolverton, McGraw-Hill, USA
4. Industrial Microbiology, A. H. Patel
5. Biotechnology Fundamentals by Dr. FirdosAlam Khan
6. Medical Biotechnology Glick 1st edition

Course Code	MAJOR II SEM – II	Credits	Lectures /Week
26BIOTECHMJ 212	Cell Biology and Immunology	2	2

Course Objectives(CO):

CO1. To Recall ultrastructure and components of prokaryotic and eukaryotic cells and basic immunology concepts.
CO2. To Explain cellular organization and mechanisms of innate and acquired immunity.
CO3. To Apply concepts of cell structure and immunology to understand biological functions and immune responses.
CO4. To Analyse differences between cell types and evaluate immune responses

Course Outcomes (OC):

After successful completion of this course, students would be able to

OC1. Identify structures and functions of prokaryotic and eukaryotic cells and components of the immune system.
OC2. Describe processes and mechanisms of innate and adaptive immunity
OC3. Apply knowledge of cellular and immunological processes to interpret biological functions.
OC4. Analyse cell structure differences and evaluate immune responses .

Unit	Topics	No of Lectures
I	**Ultrastructure of Prokaryotic and eukaryotic cells** **Ultrastructure of Prokaryotic Cell:** Concept of Cell shape, size, and arrangement Bacterial structures external to cell wall - Flagella, Pilli, Cell Wall(Gram Positive and Negative); **Ultrastructure of Eukaryotic Cell:** Cell wall; Plasma membrane, Cytoplasmic Matrix, Nucleus –Nuclear Structure, nuclear envelope, nucleoplasm, Nucleolus; cytoplasmic structures – cytoplasmic inclusions, cytoplasmic organelles - Endoplasmic Reticulum; Golgi Apparatus; Mitochondria; Chloroplasts; Ribosomes; Lysosome - **Comparison of Prokaryotic And Eukaryotic Cells**	15
II	**Immunology** **Introduction to Immunology**: Overview of Immune Systems, Introduction of Antigen and Antibody Innate Immunity, Mechanisms of innate immunity, Acquired Immunity, Local and Herd Immunity, Humoral and Cellular Immunity - Factors Influencing and Mechanisms of each.	15

References:

1. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology by Verma and Agarwal
2. Cell and Molecular Biology by Karp, 6th Ed
3. The Cell by Cooper and Hausman, 4th Ed
4. 4.Leininger Principles of Biochemistry, 5th Edition- Nelson D. L., and Cox M. M. (2008) W H Freeman and Company
5. Microbiology Stanier 5th ed
6. Pelczar Ried and Chan

Course Code	MAJOR SEM – II – Practical	Credits	Lectures /Week
26BIOTECHMJP21	Fundamentals of Biotechnology-2 +Cell Biology and Immunology	2	4

Course Objectives(CO):

CO1. To Recall principles of microbial isolation, staining, growth analysis, biochemical techniques, and immunological assays.
CO2. To Explain methods of microbial enumeration, staining techniques, chromatography, and antigen–antibody interactions.
CO3. To Apply laboratory techniques for microbial isolation, staining, growth study, chromatography, and immunological testing.
CO4. To Analyse experimental results from microbiological, biochemical, and immunological studies.

Course Outcomes (OC):

After successful completion of this course, students would be able to

OC1. Identify techniques related to microbial isolation, staining, chromatography, and immunological assays.
OC2. Describe methods of microbial enumeration, growth curve analysis, staining, and antigen–antibody interaction.
OC3. Apply practical skills in isolation, staining, chromatography, and biochemical analysis.
OC4. Analyse and interpret results from microbial, biochemical, and immunological experiments.

Topics

1. Isolation and Enumeration of microorganisms- Surface spread method.
2. Isolation and Enumeration of microorganisms- Serial dilution, Pour plate method.
3. Problems on Restriction digestion.
4. Monochrome staining,
5. Differential Staining,
6. Study of the growth curve of *E.coli.*
7. Isolation techniques: T-streak, polygon method
8. Colony Characteristics of Microorganisms.
9. Solvent extraction of plant pigments and study the absorption spectra of pigments Study of Hill's reaction.
10. Separation of Carotenoids by thin layer chromatography
11. Study of Antigen antibody interaction by Ouchterlony method.
12. Study of mitosis from suitable plant material

References:

1. "Microbiology: A Laboratory Manual" by James G. Cappuccino and Chad T. Welsh.
2. "Laboratory Experiments in Microbiology" by Ted R. Johnson and Christine L. Case.
3. "Prescott's Microbiology" by Joanne Willey, Linda Sherwood, and Christopher J. Woolverton.

Course Code	Minor SEM II - Paper I-Microbiology-I	Credits	Lectures /Week
26BIOTECHMR 221	Microbiology-I	2	2

Course Objectives(CO):

CO1. To Recall fundamental concepts, history, classification, and biochemical aspects of microbiology.
CO2. To Explain principles of microbial cultivation, sterilization, microscopy, staining, and microbial biochemistry.
CO3. To Apply microbiological and biochemical techniques for isolation, staining, and observation of microorganisms.
CO4. To Analyse the role, applications, and biochemical characteristics of microorganisms in various fields.

Course Outcomes (OC):

After successful completion of this course, students would be able to

OC1. Outline the evolution, basic concepts, classification systems, and biochemical features of microorganisms.
OC2. Describe the underlying principles of microbial growth, cultivation methods, sterilization processes, microscopy, staining techniques, and microbial metabolism.
OC3. Demonstrate standard microbiological and biochemical methods for isolation, staining, and microscopic examination of microorganisms.
OC4. Examine and interpret the functional roles, industrial relevance, and biochemical activities of microorganisms across different applications.

Unit	Topics	No of Lectures
I	**Introduction to Microbiology, Fundamentals, History and Evolution of Microbiology.** Discovery of Microorganisms, Conflict over spontaneous generation. Role of microorganisms in disease **Classification**: Introduction to Bergey's Manual Groups of Microorganisms Applications of microbiology in various fields **Cultivation and Maintenance of microorganisms,Nutritional categories of microorganisms,** methods of isolation.	15
II	**Sterilization techniques**	15

	Microscopy and stains : Sterilization and Disinfection. **Microscope**- Simple and Compound: General principles of optics; various parts and their functions - objectives – numerical aperture, resolving power, depth of focus, working distance, aberrations; oculars; condensers. Dark Field Microscope; Phase Contrast Microscope **Stains and Staining Solutions** **Chemical composition of stains** Simple Staining, Differential Staining – Gram staining and Acid Fast Staining with specific examples	

References:

1. Microbiology by Prescott 5th edition
2. Microbiology by Pelczar, Reid and Chan 5th Edition
3. Textbook of Microbiology by Ananthanarayan
4. Fundamental Principles of Bacteriology A J Salle 7th
5. Microbiology by Pelczar, Chan and Krieg, 5th Ed

Course Code	Minor Sem II Life Science - I	Credits	Lectures /Week
26BIOTECHMR 222	Life Science-I	2	2

Course Objectives(CO):

CO1. To Recall fundamental concepts of microbial genetics, molecular biology, mutations, and population genetics.
CO2. To Explain mechanisms of genetic transfer, mutation, molecular principles, and population genetics laws.
CO3. To Apply genetic and molecular concepts to analyse bacterial genetics, mutations, and solution chemistry calculations.
CO4. To Analyse genetic variations, evolutionary forces, and molecular mechanisms in microbial and population genetics.

Course Outcomes (OC):

After successful completion of this course, students would be able to

OC1. Identify key concepts related to genetic transfer, mutations, molecular biology, and population genetics.
OC2. Describe mechanisms of conjugation, transformation, transduction, mutation types, and Hardy–Weinberg principles.
OC3. Apply knowledge to interpret genetic processes, mutation effects, and basic biochemical calculations.
OC4. Analyse genetic variation, evolutionary processes, and molecular mechanisms in populations.

Unit	Topics	No of Lectures
I	**Microbial genetics and Molecular Biology** **Genetic analysis in Bacteria:** Prototrophs, Auxotrophs. **Conjugation:** Discovery of Conjugation in E.coli. The sex factor F **Transformation**. **Transduction** Bacteriophages - Lytic and Lysogenic pathway. **Karyotype and Idiogram** Parameters used in Karyotype preparation- Human Karyotype (Normal) - Male and Female. Definition of Mutations- Classification of mutations Types of Point Mutations, Types of Spontaneous and induced mutations	15

	Mutagenesis and types of Mutagens. (Examples of Physical, Chemical and Biological Mutagens)	
II	**Population genetics** **Genetic Structure of Populations** – Hardy- Weinberg Law and its Assumptions Natural Selection. Genetic Drift migration Speciation Genetic Polymorphism	**15**

References:

1. iGenetics – A molecular approach Peter J Russell 3rd edition.
2. Biochemistry - U SatyanarayanaU.Chakrapani, (2013) 4th edition
3. Principles of Genetics. E J Gardner, M J Simmons & D Peter Snustad. 8th edition
4. A Textbook of Biotechnology By R.C. Dube
5. Cell and Molecular Biology 5th edition by Gerald Karp (John Wiley and sons publications)
6. Genetics, (2006) Strickberger MW - (Prentice Hall, India)

Course Code	SKILL ENHANCEMENT COURSE SEM – II	Credits	
26BTSE251	Composting and Solid waste management Practical	2	

Course Objectives(CO):

CO1. To Explain the fundamental concepts of crop improvement, plant growth processes, composting techniques, and solid waste management practices.
CO2. To Apply experimental techniques related to seed germination, biofertilizer use, plant hormones, compost preparation, and biodegradation studies.
CO3. To Analyze the effects of environmental and biological factors on plant growth, compost quality, and waste degradation processes.
CO4. To Evaluate sustainable agricultural and waste management practices and design experiments or strategies for improving crop productivity and environmental sustainability.

Course Outcomes (OC):

After successful completion of this course, students would be able to

OC1. Describe the basic principles of crop improvement, plant growth, composting methods, and solid waste management.
OC2. Perform experiments related to seed germination, biofertilizer application, plant hormones, compost preparation, and biodegradation.
OC3. Analyze the influence of environmental and biological factors on plant growth, compost quality, and waste degradation.
OC4. Evaluate sustainable agricultural and waste management practices and design basic strategies for improving crop productivity and environmental sustainability.

Topics

1. Preparation of compost using kitchen waste and dry leaves, observing decomposition stages over time.
2. Segregation of waste into biodegradable, non-biodegradable, and recyclable categories from sample waste materials.
3. Preparation of a vermicomposting unit using earthworms to study organic waste conversion into nutrient-rich compost.
4. Comparison of decomposition of different organic wastes (fruit peels, paper, leaves) under similar conditions.
5. Study of Hydroponics as a Sustainable Crop Production Technique
6. Study of Composting Methods: Indore and Bangalore Techniques
7. Analysis of Compost Quality Parameters (pH, Moisture Content, and Temperature)
8. To study the effect of organic and chemical fertilizers on plant growth.
9. Estimate moisture content of different waste samples to understand its impact on disposal and treatment methods.

10. Preparation and Application of Bioenzymes for Sustainable Waste Management.
11. Identify recyclable materials (paper, plastic, metal) and demonstrate simple reuse or recycling techniques.
12. Visit to a local waste management site or conduct a survey to study collection, segregation, and disposal practices.

References:

1. Practical Manual of Environmental Science – S. K. Agarwal
2. Laboratory Manual in Plant Biotechnology – H. S. Chawla
3. Integrated Solid Waste Management – George Tchobanoglous (waste management strategies, biodegradation)
4. Environmental Biotechnology – Bruce E. Rittmann & Perry L. McCarty (biodegradation, bioenzyme concepts)

Course Code	VOCATIONAL SKILL COURSE SEM – II - Analytical Instrumentation Techniques	Credits	
26BTSE251	Analytical Instrumentation Techniques Practical	2	

Course Objectives(CO):

CO1. To Recall principles of chromatography, electrophoresis, colorimetry, spectrophotometry, and buffer systems.
CO2. To Explain working principles and applications of analytical and separation techniques and biological buffers.
CO3. To Apply laboratory techniques such as chromatography, electrophoresis, and spectrophotometric analysis.
CO4. To Analyse results obtained from analytical techniques and evaluate the role of buffers in biological systems.

Course Outcomes (OC):

After successful completion of this course, students would be able to

OC1. Identify analytical techniques including chromatography, electrophoresis, and buffer systems.
OC2. Describe principles and working of colorimeter, spectrophotometer, and electrophoretic methods.
OC3. Apply practical skills in chromatography, electrophoresis, and buffer preparation.
OC4. Analyse and interpret results from analytical techniques and understand buffer applications.

Topics

1. Study of Paper chromatography
2. Study the Principle and working of colorimeter
3. Study the principle and working of Spectrophotometer.
4. Study of Electrophoresis
5. Demonstration Agarose Gel electrophoresis .
6. Demonstration of PAGE.
7. Safety in Laboratory: Dress code, Dos and Don't, First Aid
8. Buffer solutions –Concept of Buffers,
9. Titration Titrimetric Analysis
10. Preparation of Normal, Molar, Molal, Percent solution
11. Preparation of solution - PPM and PPB
12. Demonstration of pH meter and digital Balance

References:

1. "Principles and Techniques of Biochemistry and Molecular Biology" by Keith Wilson and John Walker.
2. "Biophysical Chemistry (Principles and Techniques)" by Upadhyay, Upadhyay, and Nath.

3. "Analytical Biochemistry" by David J. Holme and Hazel Peck.
4. "Molecular Cloning: A Laboratory Manual" by Sambrook and Russell.
5. Vogel's Textbook of Quantitative Chemical Analysis" by Mendham et al.
6. "Chromatography: Basic Principles, Sample Preparations and Methods of Analysis" by Leonardo de Sousa Henriques.

Evaluation Scheme for First Year Biotechnology (UG) under NEP 2020 (2 credits)

Evaluation Scheme for First Year (UG) under NEP (2 credits)

I. Internal Evaluation for Theory Courses – 20 Marks

1) Continuous Internal Assessment(CIA)Assignment - Tutorial/ Case Study/ Project / Presentations/ Group Discussion / Ind. Visit. – 10 marks

2) Continuous Internal Assessment(CIA) ONLINE / OFFLINE Unit Test – 10 marks - 15 Minutes

II. External Examination for Theory Courses – 30 Marks

Duration: 1 Hour

Theory question paper pattern:

Question	Based on	Marks
Q.1	Unit I and Unit II	15
Q.2	Unit I and Unit II	15

- All questions shall be compulsory with internal choice within the questions.
- Each Question may be sub-divided into sub questions as a, b, c, d, etc. & the allocation of Marks depends on the weight age of the topic.

NOTE: To pass the examination, attendance is compulsory in both Internal & External (Theory + Practical) Examinations.

FY BSc Biotechnology Evaluation pattern and Question paper pattern for Semester End Practical Examination of Major Course

Internal Continuous Assessment: 40% (20 Marks)	Semester End Examination: 60% (30 Marks)	Duration for End semester examination
Viva/ assignment/ objective question test /Small experiments (15 Marks), Overall performance (5 Marks) = 20 Marks	As per paper pattern	1 hr 30 mins

FY BSc Biotechnology Evaluation pattern and Question paper pattern for Semester End Practical Examination of Vocational Skill Courses and Skill Enhancement Courses

Internal Continuous Assessment: 40% (20 Marks)	Semester End Examination: 60% (30 Marks)	Duration for End semester examination

Viva/ assignment/ objective question test /Small experiments (15 Marks), Overall performance (5 Marks) = 20 Marks	**As per paper pattern**	**1 hr 30 mins**

Signatures of Team Members

SR. No.	Name	Designation	Position	Signatures
1.	Ms Alisha Kadam	Assistant Professor	Chairman	
2.	Ms Pooja kamble	Assistant Professor	Secretary	
3.	Ms Ankita Raul	Assistant Professor	Member	
4.	MsPrajakta Varale	Assistant Professor	Member	
5.	Dr Seema Kokitkar	Assistant Professor and Head Of the Department C.K.T College	V.C Nominee	
6.	Dr Arpita Gupte	Associate Professor School of Biotechnology and Bioinformatics D.Y. Patil University	Subject Experts from other University	
7.	Dr Jacinta Georg	Assistant Professor Somaiya Vidyavihar University	Subject Experts from other University	
8.	Dr Meenakshi Singh	CEO and Founder Sustania Greens	Representative from University	
9.	Ms Prachi Mayekar	Preclinical Researcher Reliance Life Science	Meritorious Alumni	

Letter Grades and Grade Points:

Semester GPA/ Programme CGPA Semester/ Programme	% of Marks	Alpha-Sign/ Letter Grade Result	Grading Point
9.00 - 10.00	90.0 – 100	O (Outstanding)	10
8.00 - < 9.00	80.0 - < 90.0	A+ (Excellent)	9
7.00 - < 8.00	70.0 - < 80.0	A (Very Good)	8
6.00 - < 7.00	60.0 - < 70.0	B+ (Good)	7
5.50 - < 6.00	55.0 - < 60.0	B (Above Average)	6
5.00 - < 5.50	50.0 - < 55.0	C (Average)	5
4.00 - < 5.00	40.0 - < 50.0	P (Pass)	4
Below 4.00	Below 40.0	F (Fail)	0
Ab (Absent)	-	Ab (Absent)	0

Justification for Bachelors in Biotechnology

1.	Necessity for starting the course:	.
2.	Whether the UGC has recommended the course:	**Yes**
3.	Whether all the courses have commenced from the academic year 2023-24.	The course has already commenced in the university and in the academic year 2023-24 it is restructured under NEP 2020
4.	The courses started by the University are self-financed, whether adequate number of eligible permanent faculties are available?:	This course is aided / self-financed based on the sanction given by University of Mumbai to affiliated colleges time to time.
5.	To give details regarding the duration of the Course and is it possible to compress the course?:	The duration of the program is three years (6 semesters). It is not possible to compress the course.
6.	The intake capacity of each course and no. of admissions given in the current academic year:	120 per division

7.	Opportunities of Employability / Employment available after undertaking these courses:	