Ordinance No. :- V-126-B-35

(Approved in Academic council meeting held on 11.03.2026

Proposed to be ratified in forthcoming executive council)

Evaluation Scheme and Syllabus

of

B.Sc. Microbiology

FOUR – YEAR UNDER GRADUATE

PROGRAM

(AS PER NEP-2020)

Keral Verma Subharti College of Science

Swami Vivekanand

SUBHARTI UNIVERSITY

Meerut

(Effective from session 2025-26)

K. V. Subharti College of Science
S. V. Subharti University
NH-58 Byepass Road, Meerut

PROGRAMME OBJECTIVES

Aim and Objectives of B.Sc. Microbiology Programme

The primary aim of the B.Sc. Microbiology program is to provide a comprehensive understanding of microorganisms, their structure, physiology, genetics, and interactions with humans, animals, plants, and the environment. The course aims to develop students' theoretical knowledge and practical skills to prepare them for careers in research, industry, healthcare, and applied biological sciences. It also seeks to cultivate scientific curiosity, analytical thinking, and ethical responsibility toward the use of microbiology in societal and environmental contexts.

Programme Objectives

To impart foundational knowledge of microbial diversity, morphology, physiology, metabolism, genetics, and ecology.

1. To train students in standard microbiological techniques, including culturing, staining, microscopy, sterilization, and aseptic handling of microorganisms.
2. To familiarize students with the industrial, agricultural, environmental, and medical applications of microorganisms and their products.
3. To encourage scientific inquiry and develop the ability to design, conduct, and interpret microbiological experiments with precision and accuracy.
4. To provide exposure to interdisciplinary areas such as molecular biology, biotechnology, bioinformatics, and immunology, enhancing understanding of microbial roles at cellular and molecular levels.
5. To promote awareness about microbial diseases, antimicrobial resistance, public health issues, and the role of microorganisms in environmental sustainability.
6. To inculcate scientific integrity, biosafety practices, and ethical responsibility in the handling of microorganisms and data.

To prepare students for employment in microbiology-related industries, research laboratories, and clinical settings, as well as for higher studies in microbiology and allied life sciences.

PROGRAMME OUTCOMES

Upon successful completion of the B.Sc. Microbiology programme, graduates will be able to:

PO1 – Demonstrate comprehensive knowledge of microbial structure, function, diversity, and interactions, including their roles in health, industry, and the environment.

PO2 – Apply microbiological and molecular techniques with accuracy and safety, and analyze experimental data using scientific reasoning to draw meaningful conclusions.

PO3 –Design and conduct research experiments, utilize statistical tools, interpret results, and communicate scientific findings effectively in written, oral, and digital formats.

PO4 – Follow biosafety guidelines, ethical standards, and legal frameworks while recognizing the societal, industrial, and environmental impact of microbiology.

PO5 – Work independently and collaboratively in multidisciplinary teams, demonstrate leadership and adaptability, and engage in lifelong learning to address global challenges such as emerging diseases and sustainability.

CREDIT DISTRIBUTION TABLE

SWAMI VIVEKANAD SUBHARTI UNIVERSITY MEERUT

KERAL VERMA SUBHARTI COLLEGE OF SCIENCE

Department of Life Science

B.Sc Microbiology
(Session 2025-26 onwards)

		I	II	III	IV	V	VI	VII	VIII	Total
1	Major	6	6	9	15	10	14	16	4	80
2	Minor	3	3	3	3	6	6	4	4	32
3	Multi Disciplinary	3	3	3						9
4	Ability Enhancement Course	2	2	2	2					8
5	Skill Enhancement Course	3	3	3						9
6	Value Added Course	3	3							6
7	Internship					4				4
8	Research								12	12
	Total	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**160**

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EVALUATION SCHEME

I YEAR

SWAMI VIVEKANAD SUBHARTI UNIVERSITY MEERUT													
KERAL VERMA SUBHARTI COLLEGE OF SCIENCE													
Department of Life Science													
Course Name - B.Sc. Microbiology													
Batch:2025-26							**SEM:I**						
S. No.	**Course Type**	**Course Code**	**Course Name**	**Teaching Load**			**Credits**		**Internal Assessment**		**External Assessment**	**Total**	**Remark**
				L	**T**	**P**							
THEORY and PRACTICAL SUBJECTS								**Attendance (5)**	**quiz/PPT/Assignment (10)**	**Mid Sem Test (15)**	**End Sem Exam (70)**		
1	Major 1	BSMB-101	Cell Biology and Genetics	4	0	0	4	5	10	15	70	100	
2	Practical I (Based on Major 1)	BSMB-101P	Cell Biology and Genetics Lab	0	0	4	2	5	10	15	70	100	
3	Minor 1		To be chosen	3	0	0	3	5	10	15	70	100	
4	Multi Disciplinary 1		To be chosen	3	0	0	3	5	10	15	70	100	
5	Ability Enhancement Course	AEC-01	English Communication	2	0	0	2	5	10	15	70	100	
6	Skill Enhancement Course		To be chosen	1	0	3	3	5	10	15	70	100	
7	Value Added Course		To be chosen	3	0	0	3	5	10	15	70	100	
8	Qualifying	VAC-RB	Rastra bodh	2	0	0	2	5	5	10	30	50	Qualifying
TOTAL CREDITS / ASSESSMENT							22	**35**	**70**	**105**	**490**	**700**	

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SWAMI VIVEKANAD SUBHARTI UNIVERSITY MEERUT														
KERAL VERMA SUBHARTI COLLEGE OF SCIENCE														
Department of Life Science														
Course Name - B.Sc. Microbiology														
Batch:2025 -26							**SEM:II**							
S. No.	**Course Type**	**Course Code**	**Course**	**Teaching Load**			**Credits**		**Internal Assessment**		**External Assessment**	**Total**	**Remark**
				L	**T**	**P**							
THEORY and PRACTICAL SUBJECTS								**Attendance (5)**	**quiz/PPT/Assignment (10)**	**Mid Sem Test (15)**	**End Sem Exam (70)**		
1	Major 2	BSMB-201	INTRODUCTION TO MICROBIOLOGY	4	0	0	4	5	10	15	70	100	
2	Practical II Major 2	BSMB-201P	Introduction to Microbiology Lab	0	0	4	2	5	10	15	70	100	
3	Minor 2		To be chosen	3	0	0	3	5	10	15	70	100	
4	Multi Disciplinary 2		To be chosen	3	0	0	3	5	10	15	70	100	
5	Ability Enhancement Course 2	AEC-02		2	0	0	2	5	10	15	70	100	
6	Skill Enhancement Course 2		To be chosen	1	0	3	3	5	10	15	70	100	
7	Value Added Course 2		To be chosen	3	0	0	3	5	10	15	70	100	
8	Qualifying	VAC-IKS	IKS	2	0	0	2	5	5	10	30	50	Qualifying
TOTAL CREDITS / ASSESSMENT							22	**35**	**70**	**105**	**490**	**700**	

K. V. Subharti College of Science
S V Subharti University
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Firstyear;Semester-I
CorepaperI Subject Code: BSMB-101
Title of the paper: Cell Biology and Genetics
Theory (4 Credit)

Subject	**Cell Biology and Genetics**
COs	CO1: Describe the structure and function of cellular organelles and explain fundamental cellular processes. CO2: Analyse the principles of cell division, gene organization and inheritance patterns. CO3: Apply Mendelian and non-Mendelian genetic concepts to solve genetics-based problems. CO4: Evaluate the molecular basis of gene expression, mutation and chromosomal abnormalities.
Unit 1	**Total Hours 08** Cell as a basic unit of living systems and cellular organelles: Concept, Historical perspectives. Discovery of cell, cell Theory, Ultra structure of a Prokaryotic and Eukaryotic cell (Both plant and animal cells), Cellular Organelles: Structure and functions of cell organelles – Endoplasmic reticulum, Golgi complex, Mitochondria, Chloroplast, Ribosomes, Lysosomes, Peroxisomes, Nucleus. Vacuole, Cytosol and Cytoskeleton structures (Microtubules, Microfilaments and Intermediate filaments).
Unit 2	**TotalHours:04** Surface Architecture: Structural organization and functions of plasma membrane and cell wall of eukaryotes Ultra structure of plasma membrane – fluid mosaic model, membrane fluidity, Transport across membranes - Symport, antiport, uniport, active and passive transport, Differentiation of cell surface: Basement membrane, tight junction, gap junctions, Desmosomes, hemidesmosomes
Unit 3	**TotalHours**: **12** Chromosomes and cell division: General Introduction, Discovery, Morphology and structural organization – Centromere, Secondary constriction, Telomere, Chromonema, Euchromatin and Heterochromatin, Chemical composition and Karyotype. Genome organization. Cell Division: Cell cycle, phases cell division. Mitosis and meiosis, regulation of cell cycles, cell cycle checkpoints, and enzymes involved in regulation, Significance of cell cycle, mitosis and meiosis interphase nucleus, achromatic apparatus, synaptonemal complex. Cell Senescence and programmed cell death.
Unit 4	**Total Hours: 8** Genetics: Introduction and brief history of genetics. Mendelian theory: Laws of inheritance- dominance, segregation, incomplete dominance, codominance with an example. Law of independent assortment, test cross, back cross. Deviations to Mendelian inheritance, complementary, supplementary and interaction of genes (13:3 ratio), epistasis. Maternal Inheritance: Sex-linked inheritance, Chromosome theory of inheritance. Linkage and crossing over. Gene interaction: Multiple factors–Skin colour in human beings, Epistasis, Multiple allelism: Blood groups in Human beings.
Unit 5	**Total Hours:08** Mutations: Types of mutations, Spontaneous and induced, Mutagens: Physical and chemical. Sex Determination in Plants and animals: Concept of allosomes and autosomes.

	Non-Mendelian Inheritance pattern: Mitochondrial inheritance, complex inheritance-genetics and environmental variation heritability, behaviuoral traits, analysis of quantitative and qualitative traits. Population genetics: phenotype, genotype, gene frequency, Hardy Weinberge Law, factor distinguishing Hardy Weinberge equilibrium, mutation selection, migration, gene flow, genetic drift. Inherited disorders – Allosomal (Klinefelter syndrome).

First year;Semester- I
Minor Paper: 1 Subject Code: BSMB-102
Title of the paper: MICROORGANISMS FOR HUMAN WELFARE
Theory (3 Credit)

Subject:	**MICROORGANISMS FOR HUMAN WELFARE**
COs	**CO1: Describe the beneficial roles of microorganisms in food, agriculture, environment, and industry.** **CO2: Explain microbial interactions that contribute to human welfare, including probiotics and biocontrol agents.** **CO3: Analyze the role of microbes in biogeochemical cycles and ecosystem maintenance.** **CO4: Evaluate microbial applications in sustainable development and biotechnology.**
Unit I	**Hours: 8** Food and Fermentation Microbial Technology: Fermented Foods – Types, Nutritional Values, Advantages and Health Benefits Prebiotics, Probiotics, Synbiotics and Nutraceutical Foods Fermented Products – Alcoholic and nonalcoholic beverages, fermented dairy products, Fruit fermented drinks,
Unit II	**Hours: 8** **Biofertilizers:** Nitrogen fixers: Rhizobium, Azospirillum, Azotobacter. Phosphate-solubilizing and potassium-mobilizing microbes. Biopesticides:Bacillus thuringiensis (Bt), Trichoderma spp.Viral and fungal biocontrol agents.Microbial inoculants and formulations. Role in composting and vermicomposting. Microbial enhancement of plant growth (PGPR)
Unit III	**Hours: 6** Food Industry: Fermented foods (curd, cheese, bread, sauerkraut, soy products). Probiotics and functional foods. Microbial Biofuels: Biogas, bioethanol, biodiesel from microbes.
Unit IV	**Hours: 12** Microorganisms in Environmental Management Sewage and Wastewater Treatment: Primary, secondary, tertiary treatment. Activated sludge process, trickling filters. Solid Waste Management: Microbial composting, landfill leachattreatment. Bioremediation: Microbial degradation of pesticides, hydrocarbons, plastics, dyes, and heavy metals. Microbes as biosensors and bioindicators. Microbial mining (bioleaching)

First year;Semester- I **(Choice 1 of Minor)**
Minor Paper: 2 Subject Code: BSMB-102
Title of the paper: BIOTECHNOLOGY FOR HUMAN WELFARE
Theory (3 Credit)

Subject:	**BIOTECHNOLOGY FOR HUMAN WELFARE**
COs	CO1: Describe basic principles and applications of biotechnology in medicine, agriculture, and industry. CO2: Explain the development of transgenic organisms and their societal impact. CO3: Analyze biotechnological innovations for disease diagnosis and therapeutic development. CO4: Evaluate ethical, biosafety and regulatory concerns associated with biotechnology.
Unit I	**Hours: 8** Definition and Historical Background. Scope and Interdisciplinary Nature Branches of Biotechnology: Red, Green, White, Blue biotechnology Biotechnology in Developing Countries. Biotechnology for Sustainable Development Goals (SDGs)
Unit II	**Hours: 8** Biotechnology in Agriculture Transgenic Plants: Bt Cotton, Golden Rice, Flavr Savr Tomato. Crop Improvement using Genetic Engineering: Insect and pest resistance Herbicide tolerance; Stress tolerance (drought, salinity) Biofertilizers and Biopesticides. Molecular Farming: Edible vaccines and nutraceuticals. Controversies and biosafety concerns of GMOs
Unit III	**Hours: 6** Biotechnology in Medicine and Health Care: Recombinant DNA Technology in Medicine: Insulin, Growth Hormone, Interferons. Gene Therapy: Somatic and germline therapy. Monoclonal Antibodies: Hybridoma technology and diagnostics. Vaccines: Conventional and recombinant (e.g., Hepatitis B, COVID-19 mRNA vaccines). Pharmacogenomics and Personalized Medicine Ethical and regulatory issues
Unit IV	**Hours: 12** Industrial Applications: Production of enzymes, organic acids, bioethanol, and bioplastics. Fermentation processes and bioreactor basics Microbial Biotechnology in Industry. Environmental Applications: Bioremediation and Bioaugmentation. Treatment of industrial effluents and solid waste, Bioindicators and Biosensors. Biotechnology for pollution control and biodiversity conservation

First year;Semester- I **(Choice 2 of Minor)**
Minor Paper: 3 Subject Code: BSMB- 102
Title of the paper: Biochemistry in Health and Disease
Theory (3 Credit)

Subject:	**Biochemistry in Health and Disease**
COs	**CO1:** Describe biochemical pathways and their relevance to normal human physiology. **CO2:** Explain molecular basis of metabolic disorders and enzymatic deficiencies. **CO3:**Analyze biomarkers and biochemical tests used in clinical diagnosis. **CO4:** Evaluate biochemical approaches in disease prevention and treatment.
Unit I	**Hours: 8** Fundamentals of Clinical Biochemistry Review of Basic Biochemistry: Biomolecules (carbohydrates, lipids, proteins, nucleic acids). Enzyme functions, kinetics, and clinical relevance Homeostasis and Biochemical Regulation. Biochemical Composition of Blood and Urine. Specimen Collection and Clinical Significance. Acid-Base Balance and Buffer Systems in the Human Body
Unit II	**Hours: 8** Carbohydrate, Lipid & Protein Metabolism in Health and Disease Carbohydrate Metabolism: Glycolysis, Gluconeogenesis, Glycogen metabolism. Disorders: Diabetes mellitus (Type 1 and 2), Hypoglycemia Lipid Metabolism: β-Oxidation, Ketogenesis, Cholesterol biosynthesis Disorders: Obesity, Atherosclerosis, Fatty liver disease. Protein and Amino Acid Metabolism: Urea cycle, Transamination, Deamination Disorders: PKU, Maple syrup urine disease, Liver cirrhosis
Unit III	**Hours: 6** Biochemistry of Hormones and Endocrine Disorders Classification and Mechanism of Hormone Action: Peptide and steroid hormones. Hormones of the Pituitary, Thyroid, Adrenal, and Pancreas Endocrine Disorders: Hypo-/Hyperthyroidism. Addison's disease, Cushing's syndrome. Insulin resistance and Metabolic Syndrome. Diagnostic Biomarkers and Hormone Assays
Unit IV	**Hours: 12** Clinical Enzymology and Diagnostic Biochemistry. Plasma Enzymes as Disease Markers: Liver: ALT, AST, ALP, GGT. Heart: CK-MB, LDH, Troponins. Pancreas: Amylase, Lipase. Tumor Markers and Cancer Biochemistry: PSA, CEA, AFP. Biochemical Basis of Jaundice, Myocardial Infarction, Renal Failure. Diagnostic Techniques: Colorimetry, ELISA, Electrophoresis

First year;Semester- I
MTD Paper: 1 Subject Code – M-DIS-SM
Title of the paper: Soil Microbiology
Theory (3 Credit)

Subject:	**Soil Microbiology**
COs	**CO1:** Describe the diversity, physiology and ecological roles of soil microorganisms. **CO2:** Explain microbial processes involved in nutrient cycling, soil fertility and plant–microbe interactions. **CO3:**Analyze the impact of environmental factors, pollutants and agricultural practices on soil microbial communities. **CO4:** Evaluate applications of soil microorganisms in biofertilizer production, biocontrol and sustainable agriculture.
Unit I	**Hours: 6** Introduction to Soil and Microbial Diversity: Soil as a Habitat: Composition, structure, and types of soil. Soil Microbial Communities: Bacteria, fungi, actinomycetes, algae, protozoa, viruses Methods for studying soil microbes: Cultivation and non-cultivation techniques. Soil Microbial Biomass and Activity Indicators. Factors influencing soil microbial populations: Ph, moisture, temperature, organic matter
Unit II	**Hours: 6** Soil Microbial Ecology and Interactions. Microbial succession and colonization in soil. Soil microbial food web and trophic levels. Rhizosphere and phyllosphere interactions. Allelopathy and microbial competition. Microbe–microbe and plant–microbe interactions
Unit III	**Hours: 6** Nutrient Cycling and Biogeochemical Transformations Carbon Cycle: Decomposition, humus formation, lignocellulose degradation Nitrogen Cycle: Nitrogen fixation (symbiotic and free-living microbes), Nitrification, ammonification, denitrification Phosphorus and Sulfur Cycles: Solubilization and mineralization by microbes Role of microbes in micronutrient transformation (Zn, Fe, Mn), Importance of microbial enzymes in nutrient turnover
Unit IV	**Hours: 6** Soil Health, Fertility & Biofertilizers: Concept of Soil Health and Quality Microbial indicators of soil fertility. Types of Biofertilizers: Rhizobium, Azotobacter, Azospirillum, Cyanobacteria, Phosphate-solubilizing microbes, Mycorrhizae.

First year;Semester- I
SEC Paper: 1 Subject Code- SEC-IF
Title of the paper: Industrial Application of Fermentation
Theory (3 Credit)

Subject:	**Industrial Application of Fermentation**
COs	**CO1:** Describe types and principles of microbial fermentation and their industrial significance. **CO2:** Explain fermentation processes for producing enzymes, antibiotics, organic acids, biofuels and fermented foods. **CO3:** Analyze fermentation parameters, media optimization and scale-up strategies. **CO4:** Evaluate downstream processing, quality control and industrial bioprocess management.
Unit I	**Hours: 4** **Fundamentals of Fermentation Technology** • Introduction to fermentation: definition, history, scope and applications • Types of fermentation: submerged, solid-state, batch, fed-batch, continuous • Microbial strain selection, maintenance and improvement • Bioreactors: types, design, components and operation • Aseptic operations in fermentation industries
Unit II	**Hours: 4** **Industrial Fermentation Processes:** Production of primary metabolites: alcohols, organic acids, amino acids • Secondary metabolite production: antibiotics, vitamins, enzymes • Industrial production of fermented foods and beverages • Fermentation media: formulation, raw materials, optimization • Scale-up of fermentation processes
Unit III	**Hours: 4** **Downstream Processing** • Cell separation: filtration, centrifugation, sedimentation • Product recovery: precipitation, extraction, distillation • Purification techniques: chromatography, membrane processes • Drying techniques: spray drying, freeze drying • Quality control and regulatory standards (GMP, GLP)
Unit IV	**Hours: 4** **Modern and Emerging Applications** • Fermentation in biopharmaceuticals: hormones, vaccines, recombinant proteins • Biofuel production: ethanol, biogas, biodiesel, hydrogen • Fermentation in environmental applications: composting,

	bioremediation • Role of biotechnology in improving fermentation efficiency • Industrial case studies

First year;Semester- I
VAC Paper: 1 Subject Code- VAC–AILS
Title of the paper: AI for Life science
Theory (3 Credit)

Subject:	**AI for Lifesciences**
COs	**CO1 – Artificial Intelligence Applications:** Students will be able to explain the principles of AI and machine learning and apply AI-based tools for biological data analysis, prediction, automation, and problem-solving in life science research. **CO2 – Ethical, Safe, and Responsible Use of Technology:** Students will evaluate the ethical, legal, and safety aspects of digital tools, data privacy, online security, and AI applications in scientific research, healthcare, and biotechnology.
Unit I	**Hours: 10** **Fundamentals of Artificial Intelligence and Data Science in Biology** Introduction to Artificial Intelligence, Machine Learning, and Deep Learning, Types of learning: supervised, unsupervised, and reinforcement learning, Overview of data science workflow: data collection, cleaning, and preprocessing. Biological data types: genomic, proteomic, metabolic, and imaging data.
Unit II	**Hours: 10** **AI Applications in Microbiology** AI in microbial taxonomy and identification. Machine learning for microbial image analysis (colony recognition, morphology detection). AI-based diagnostics and disease surveillance. Prediction of antimicrobial resistance (AMR) using AI models. AI in metagenomics and microbiome analysis. Role of AI in vaccine development and epidemiology. Industrial and environmental microbiology: predictive models for fermentation, bioremediation, and wastewater microbiology
Unit III	**Hours: 10** **Ethical, Computational, and Future Perspectives** Ethical issues, biosafety, and data privacy in AI applications. AI and automation in microbiology laboratories. Limitations and challenges in AI adoption in life sciences. Integration of AI with omics technologies (genomics, transcriptomics, proteomics). Role of AI in global health and pandemic prediction. Future of AI-driven microbiological research and careers in computational microbiology

Firstyear;Semester-II
Corepaper2 Subject Code: MSMB-201
Title of the paper: Introduction to Microbiology
Theory (4 Credit)

Subject	**Introduction to Microbiology**
Cos	**CO1:** Explain the historical development, scope and significance of microbiology. **CO2:** Classify microorganisms based on structure, morphology, nutrition and physiology. **CO3:** Apply aseptic techniques and fundamental microbiological principles in laboratory settings. **CO4:** Analyze microbial growth, control methods and their applications in health and industry.
Unit 1	**History ofMicrobiology** **Total Hours 08** Discovery of microorganisms; Spontaneous generation vs. biogenesis; Historical accounts of modern Microbiology; from Leeuwenhoek to Craig Venter including the contributions of Antonvon Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Martinus W. Beijerinck, Sergei N. Winogradsky, Alexander Fleming, Selman, A. Waksman, Paul Ehrlich, Elie Metchni koff, Edward Jenner, Falkow, Ross and Chakravarty. Golden era of microbiology; Scope of microbiology.
Unit 2	**Classification of Micro-organism** **TotalHours:04** Kingdom classification of microorganisms: Haeckel's three kingdom concept, Whittaker's five kingdom concept, Six kingdom classification, Eight kingdom classification, Three domain concepts of Carl Woeser. Definition of microorganisms, Numerical and chemical taxonomy and Introduction to Bergey's manual
	Cellular Microorganisms **TotalHours**: **12**Bacteria: Morphology of bacteria, Structure and functions of cell wall, cell membrane, flagella, pili, ribosome, nucleoid, cytoplasmic inclusions and endospore; Fungi: General characteristics, Ultrastructure and reproduction; Protozoa: General characteristics with special reference to Amoeba and Paramaecium; Algae: General characteristics. History of phycology with emphasis on contributions of Indian scientists;
Unit 4	**AcellularMicroorganisms** **Total Hours: 8** Characteristic features of viruses, prions and bacteriophage; Ultrastructure: Capsids, Types of envelopes, Types and structure of genome; Cultivation of viruses and bacteriophage; Multiplication of viruses; Lytic and lysogeny cycle of λ phage.
Unit 5	**MicrobesinExtremeEnvironment** **Total Hours:08** Nature, special features of the thermophilic, methanogenic and halophilic Archaea; photosyntheticbacteria,CyanobacteriasomeArchaeawholiveinextremeconditions like cold, and space.

First year;Semester- II
Minor Paper: 4 Subject Code: MSMB-202
Title of the paper: Bioresource Technology and Bioproducts
Theory (3 Credit)

Subject:	**Bioresource Technology and Bioproducts**
COs	CO1: Describe various biological resources and their industrial importance. CO2: Explain principles and methods involved in converting biomaterials into useful bioproducts. CO3: Analyze the bioprocessing strategies used in the production of biofuels, bioplastics, and biosurfactants. CO4: Evaluate the sustainability, environmental impact, and commercialization of bioproducts.
Unit I	**Hours: 8** Definition and Classification: Renewable vs. Non-renewable biological resources. Terrestrial and aquatic bioresources. Types of Bioresources: Plants, animals, microbes, agro-industrial residues, Importance in Food, Energy, Health, and Industry. Biodiversity as a Source of Novel Bioproducts Conservation and Sustainable Use of Bioresources
Unit II	**Hours: 8** Biomass Conversion and Bioprocess Technologies Biomass Composition: Cellulose, hemicellulose, lignin, starch, lipids, proteins. Pre-treatment and Conversion Technologies: Physical, chemical, biological methods. Fermentation Technology: Submerged and solid-state fermentation. Downstream processing basics Bioreactor Design and Scale-up. Waste-to-Wealth Technologies
Unit III	**Hours: 6** Bioenergy and Biofuels. Types of Biofuels: First-, second-, and third-generation biofuels. Production of Bioethanol, Biodiesel, Biogas, Biohydrogen. Microalgae for Biofuel Production. Comparative Efficiency and Sustainability. Integrated Biorefineries
Unit IV	**Hours: 12** Bioproducts from Bioresources Industrial Bioproducts: Enzymes, Organic Acids (e.g., Citric, Lactic acid), Bioplastics (PHA, PLA). Pharmaceutical and Nutraceutical Products: Antibiotics, vitamins, pigments, antioxidants. Food and Feed Additives: Probiotics, bio-emulsifiers, flavoring agents. Green Chemistry and Biodegradable Materials. Applications in Agriculture, Environment, and Industry

First year;Semester- II
MTD Paper: 2 Subject Code – M-DIS-MD
Title of the paper: Microbiology for Daily Life
Theory (3 Credit)

Subject:	**Microbiology for Daily Life**
COs	**CO1:** Describe the role of microorganisms in food, health, environment and everyday household practices. **CO2:** Explain the importance of hygiene, sanitation and disease prevention in daily life. **CO3:** Analyze the beneficial and harmful effects of microbes in food preservation, digestion, probiotics and spoilage. **CO4:** Evaluate practical microbial applications in disease management, waste handling and personal/community health.
Unit I	**Hours: Principles and Processes of Bioremediation** • Definition and types: bioremediation, bioaugmentation, bio stimulation • Microorganisms and metabolic pathways involved in pollutant breakdown. • Ex-situ vs. in-situ remediation; intrinsic and engineered approaches.
Unit II	**Microbes in Environmental Cleanup** **Hours: 8** Major pollutants: oil spills, heavy metals, pesticides, organic wastes. Applications in soil, water, and industrial waste management. Case studies: oil spill cleanup, agricultural runoff treatment, wastewater enhancement.
Unit III	**Hours: 8** **Microbial Inoculants and Advances** Production and application of microbial inoculants: Rhizobium, Azotobacter, PGPR, mycorrhiza. Recent advances: genetic engineering, increased efficiency, legal and regulatory aspects. Quality control of bio-inoculants and measuring remediation effectiveness.
Unit IV	**Hours: 8** **Industrial Applications of Microbes** • Role of microbes in the production of food and beverages: bread, cheese, yogurt, wine, and beer • Industrial manufacturing of enzymes, vitamins, antibiotics, and vaccines with the help of microbes. • Use of microorganisms in biotechnology and genetic engineering for producing biofuels, pharmaceuticals, and bioplastics. • Applications in waste management, water treatment, and agriculture (biofertilizers, biopesticides)

First year;Semester- II
SEC Paper: 2 Subject Code- SEC-OF
Title of the paper: Organic Fertilizers
Theory (3 Credit)

Subject:	**Organic Fertilizers**
	CO1: Describe the composition, types and functions of organic fertilizers in soil health management. **CO2:** Explain the role of microbes in composting, vermicomposting and nutrient mineralization. **CO3:** Analyze production technologies, quality standards and applications of organic fertilizers in agriculture. **CO4:** Evaluate the environmental benefits, sustainability aspects and limitations of organic fertilizer use.
Unit I	**Hours: 8** **Introduction to Organic Fertilizers** • Definition, scope and importance of organic fertilizers • Comparison of organic vs. inorganic fertilizers • Chemical, physical and biological properties of soil influenced by organic matter • Microbial activity and nutrient cycling
Unit II	**Hours: 4** **Types of Organic Fertilizers** • Compost, vermicompost, farmyard manure, green manure • Biofertilizers: Rhizobium, Azotobacter, Azospirillum, mycorrhizae • Plant- and animal-based organic fertilizers: bone meal, blood meal, fish emulsion • Agro-industrial waste–based fertilizers
Unit III	**Hours: 6** **Production and Processing Techniques** • Composting methods: aerobic, anaerobic, windrow, pit, mechanical composting • Vermicomposting techniques and earthworm species • Preservation, packaging and storage of organic fertilizers • Quality control, maturity indices, and standards for organic fertilizers
Unit IV	**Hours: 6** Mode of application in agriculture, horticulture and forestry. Release patterns and nutrient availability. Organic fertilizers in sustainable agriculture and soil restoration, Environmental benefits: carbon sequestration, reduced pollution. Government policies, certifications and case studies.

First year;Semester- II
VAC Paper: 2 Subject Code- VAC–DFL
Title of the paper: Digital and Financial Literacy
Theory (3 Credit)

Subject:	**Digital and Financial Literacy**
	CO1 – Digital Literacy: Students will be able to effectively use digital tools, online platforms, scientific databases, and productivity software for academic, research, and professional activities in life sciences. **CO2 – Financial Literacy:** Students will demonstrate understanding of basic financial concepts including budgeting, banking, digital payments, taxation, savings, insurance, and responsible financial decision-making in personal and professional contexts.
Unit I	**Hours: 10** **Digital Literacy and Communication** Basics of computer systems and operating environments (Windows/Linux) Internet fundamentals: browsers, search engines, and online resources Email etiquette, online communication, and collaboration tools. Digital citizenship and responsible online behavior. Cloud computing and data storage (Google Drive, OneDrive, Dropbox). Cybersecurity basics: passwords, phishing, malware, and safe browsing. Social media awareness and digital footprint management
Unit II	**Hours: 10** **Financial Literacy Fundamentals:** Introduction to financial literacy and personal finance. Sources of income and types of expenditures. Importance of savings, budgeting, and financial planning. Banking system overview: types of accounts, ATM, cheque, passbook. Digital banking tools: NEFT, RTGS, UPI, BHIM, and mobile banking. Introduction to insurance, pension, and tax basics. Role of RBI, SEBI, and other financial regulators in India
Unit III	**Hours: 10** **Digital Finance, Cyber Ethics, and Entrepreneurship** E-commerce and digital marketing basics. Digital payment systems: Paytm, Google Pay, PhonePe, Amazon Pay. FinTech innovations and startups in India. Cyber laws and online fraud prevention. Data privacy, consent, and online grievance redressal mechanisms. Digital inclusion and government initiatives: Digital India, PMGDISHA, Jan Dhan Yojana. Basics of entrepreneurship, digital startups, and freelancing opportunities

II YEAR

SWAMI VIVEKANAD SUBHARTI UNIVERSITY MEERUT													
KERAL VERMA SUBHARTI COLLEGE OF SCIENCE													
Department of Life Science													
Course Name - B.Sc. Microbiology													
Batch:2025 -26							**SEM:III**						
S. No.	**Course Type**	**Course Code**	**Course**	**Teaching Load**			**Credits**		**Internal Assessment**		**External Assessment**	**Total**	**Remark**
				L	**T**	**P**							
THEORY and PRACTICAL SUBJECTS								**Attendance (5)**	**quiz/PPT/Assignment (10)**	**Mid Sem Test (15)**	**End Sem Exam (70)**		
1	Major 3	BSMB -301	Molecular Biology	4	0	0	4	5	10	15	70	100	
2	Practical III (Based on Major 3+4)	BSMB -303P	Molecular Biology Lab	0	0	4	2	5	10	15	70	100	
3	Major 4	BSMB -302,	MICROBIAL PHYSIOLOGY AND METABOLISM	4	0	0	4	5	10	15	70	100	
4	Minor 3		To be chosen	3	0	0	3	5	10	15	70	100	
5	Multi Disciplinary 3		To be chosen	3	0	0	3	5	10	15	70	100	
6	Ability Enhancement Course 3 (Disaster Risk Management)	AEC-03	Disaster Risk Management	2	0	0	2	5	10	15	70	100	
7	Skill Enhancement Course 3		To be chosen	1	0	3	3	5	10	15	70	100	
TOTAL CREDITS / ASSESSMENT							21	**35**	**70**	**105**	**490**	**700**	

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Department of Life Science													
Course Name - B.Sc. Microbiology													
Batch:2025 -26							**SEM:IV**						
S. No.	**Course Type**	**Course Code**	**Course**	**Teaching Load**			**Credits**		**Internal Assessment**		**External Assessment**	**Total**	**Remark**
				L	**T**	**P**							
THEORY and PRACTICAL SUBJECTS								**Attendance (5)**	**quiz/PPT/Assignment (10)**	**Mid Sem Test (15)**	**End Sem Exam (70)**		
1	Major 5	BSMB-401	Bioanalytical Techniques	4	0	0	4	5	10	15	70	100	
2	Practical IV (Based on Major 5+6+7)	BSMB-405P	Bioanalytical Techniques Lab	0	0	4	2	5	10	15	70	100	
3	Major 6	BSMB-402	BACTERIOLOGY-DIVERSITY AND SYSTEMATIC	4	0	0	4	5	10	15	70	100	
4	Major 7	BSMB-403	Microbiological Techniques	4	0	0	4	5	10	15	70	100	
5	Minor 4		To be chosen	3	0	0	3	5	10	15	70	100	
6	Ability Enhancement Course 3 (Course on NCC/NSS /NGO,s/ Scout Guide / Sports)	AEC-04	Course on NCC/NSS/ NGO,s/ Scout Guide / Sports)	2	0	0	2	5	10	15	70	100	
TOTAL CREDITS / ASSESSMENT							19	**30**	**60**	**90**	**420**	**600**	

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Secondyear;Semester-III
Core Paper: 3 Subject Code: MSMB-301
Title of the paper: Microbial physiology and Metabolism
Theory (4 Credit)

Subject	Microbial physiology and Metabolism
COs	**CO1**: Describe microbial cell structure, nutrient uptake mechanisms and metabolic pathways. **CO2:** Explain principles of energy generation, biosynthesis and regulation in microorganisms. **CO3:** Analyze microbial growth kinetics under different environmental and nutritional conditions. **CO4:** Evaluate the role of enzymes and metabolic pathways in industrial and environmental processes.
Unit 1	**Microbial Growth and** **Effect of Environment on Microbial Growth 12 Hours** Definitions of growth; Batch culture; Continuous culture; Generation time and specific growthrate;TemperatureandpHrangesofgrowth;Effectofsoluteandwater activity on growth; Effect of oxygen concentration on growth; Nutritional categories of microorganisms.
Unit 2	**Nutrient Uptake and Transport Hours: 06** Passive and facilitated diffusion; Primary and secondary active transport; Concept of uniport, symport and antiport; Group translocation; Iron uptake
Unit 3	**Phototropy and Autotropy Hours: 08** Phototrophic metabolism: Introduction, Groups of phototrophic microorganisms, Photosynthetic and accessory pigments, aerobic vs. anaerobic photosynthesis with reference to photosynthesis in green bacteria and cyanobacteria. Carbon fixation pathways.
Unit 4	**Carbon catabolism No.ofHours: 10** Concept of aerobic and anaerobic respiration; Sugar degradation pathways: EMP, ED, Pentose phosphate pathway, TCA cycle, Electron transport chain: Componentsofrespiratorychain,ComparisonofmitochondrialandbacterialETC, Electron transport phosphorylation, Uncouplers and inhibitors. Fermentation: Alcohol and Lactate fermentation,
Unit 5	**Nitrogen Metabolism No.of Hours: 04** An overview of Nitrogen cycle, biological nitrogen fixation, Nitrification, Nitrate reduction, Denitrification, and Anammox.

Secondyear;Semester-III
Core Paper: 4 Subject Code: MSMB-302
Title of the paper: Molecular Biology
Theory (4 Credit)

Subject:	Molecular Biology
COs	**CO1:** Explain the structure and function of nucleic acids and mechanisms of DNA replication. **CO2:** Describe transcription, RNA processing and protein synthesis in prokaryotes and eukaryotes. **CO3:** Analyze gene regulation models and molecular mechanisms controlling gene expression. **CO4:** Evaluate molecular tools and techniques used in recombinant DNA technology.
Unit 1	**12 Hours** Introduction to molecular biology, Evolution and Molecular structure of cell and its organelles. Types of cells. Including different kinds of prokaryotic and eukaryotic cells. Cell growth, Cell adhesion, cell junctions and extra cellular matrix organelles, Cell cycle, Cell membrane and its structure (fluid-mosaic model). Factors influencing on membrane fluidity, asymmetry of membrane and membrane transport (active and passive).
Unit 2	**12 Hours** Molecular Nature of the Genetic Material in Prokaryotic and Eukaryotic Cells: Molecular biology of Genes, DNA: Molecular structure, types: Primary, secondary and tertiary, Double helix, types, Transferring information from DNA to RNA, Synthesis of RNA, Translation RNA: Molecular structure, types. Evolution of DNA and RNA, Gene and genetic codes.
Unit 3	**12 Hours** General Concept on Regulation of the Gene Expression, Regulating the Metabolism: The Lac- Operon system, Catabolic repression, Trp Operon system: regulating the biosynthesis of the tryptophan, Gene expression in Eukaryotic cells, Plasmids: types, maintenance and functions. DNA Replication and Gene Expression: DNA Replication: Semi conservative Nature of DNA Replication, DNA Replication in prokaryotic Cells, DNA Replication in Eukaryotic cell, Enzymes involved in DNA Replication: DNA polymerases, Proofreading, post-replication Modification of DNA.
Unit 4	**12 Hours** Transferring information from DNA to RNA, Synthesis of RNA(Transcription), RNA polymerase, Initiation and Termination of Transcription, Post and co-transcription modification of the RNA.
Unit 5	**12 Hours** Protein Biosynthesis: Translation of the genetic code, Translation of m RNA, Role of r-RNA in protein synthesis, Forming the polypeptides- elongation, Termination of the protein biosynthesis

Second year;Semester- III
Minor Paper: 5 Subject Code: BSMB-304
Title of the paper: Bioprocess Engineering
Theory (3 Credit)

Subject:	Bioprocess Engineering
COs	**CO1:** Describe the concepts of bioreactors, mass transfer, and kinetics of microbial growth. **CO2:** Explain design, operation, and control of bioprocess systems. **CO3:** Analyze scale-up processes, upstream and downstream operations. **CO4:** Evaluate industrial bioprocess optimization and quality control measures.
Unit I	**Hours: 8** Introduction to Bioprocess Engineering. Overview of Bioprocess Technology. Historical development and scope. Fermentation vs. chemical processes. Types of Bioprocesses: Batch, Fed-batch, and Continuous processes. Microbial Growth Kinetics: Growth curve, Monod kinetics Substrate utilization and product formation
Unit II	**Hours: 8** Bioreactor Design and Operation Basic Components of a Bioreactor: Types: Stirred tank, airlift, packed bed, fluidized bed. Design Considerations: Aeration and agitation, pH, temperature, and foam control. Sterilization: Media and reactor sterilization Scale-up Principles: Oxygen transfer rate (OTR), Kla. Mixing time and shear stress.
Unit III	**Hours: 6** Upstream Processing Microbial Strain Improvement: Mutagenesis and selection. Recombinant strains and overproducers. Media Formulation: Carbon, nitrogen, and trace element sources. Optimization techniques. Inoculum Preparation and Development. Sterile Techniques in Bioprocesses. Monitoring of Parameters: DO, pH, foam, etc.
Unit IV	**Hours: 8** Downstream Processing. Introduction and Importance. Cell Separation Techniques: Filtration, centrifugation. Product Recovery Methods: Solvent extraction, precipitation. Purification and Polishing Steps: Chromatography (Ion exchange, affinity). Ultrafiltration and dialysis. Final Formulation and Packaging

Second year;Semester- III

MTD Paper: 3 Subject Code: M-DIS-MR
Title of the paper: Microbial Remediation
Theory (3 Credit)

Subject:	**Microbial Remediation**
COs	**CO1:** Describe microbial mechanisms involved in the degradation of pollutants and toxic compounds. **CO2:** Explain bioremediation techniques used in soil, water, industrial effluents and waste management. **CO3:** Analyze environmental and biotechnological factors influencing microbial remediation efficiency. **CO4:** Evaluate bioremediation strategies and their application in environmental restoration and sustainable development.
Unit I	**Hours: 6** **Principles and Processes of Bioremediation** Definition and types: bioremediation, bioaugmentation, biostimulation. Microorganisms and metabolic pathways involved in pollutant breakdown. Ex-situ vs. in-situ remediation; intrinsic and engineered approaches.
Unit II	**Hours: 6** **Microbes in Environmental Cleanup** Major pollutants: oil spills, heavy metals, pesticides, organic wastes. Applications in soil, water, and industrial waste management. Case studies: oil spill cleanup, agricultural runoff treatment, wastewater enhancement.
Unit III	**Hours: 6** **Microbial Inoculants and Advances** Production and application of microbial inoculants: Rhizobium, Azotobacter, PGPR, mycorrhiza. Recent advances: genetic engineering, increased efficiency, legal and regulatory aspects. Quality control of bio-inoculants and measuring remediation effectiveness.
Unit IV	**Hours: 6** **Future Trends and Challenges in Remediation** Recent advancements: use of genetically engineered microbes for targeted pollutant breakdown. Integration of microbial remediation in circular economy and sustainable development. Economic, policy, and societal challenges: cost, scaling, regulations, ecosystem impacts. Frameworks for monitoring and evaluating remediation effectiveness in real-world scenarios.

First year;Semester- III
SEC Paper: 3 Subject Code- SEC-MC
Title of the paper: Mushroom Cultivation
Theory (3 Credit)

Subject:	**Mushroom Cultivation**
	CO1: Describe the taxonomy, life cycle and nutritional value of edible and medicinal mushrooms. **CO2:** Explain substrate preparation, spawn development and environmental conditions required for mushroom cultivation. **CO3:** Analyze cultivation techniques of major mushroom species and methods to manage diseases and pests. **CO4:** Evaluate post-harvest handling, value-added products and commercial/entrepreneurial opportunities in mushroom farming.
Unit I	**Hours: 4** **Basics of Mushrooms and Fungal Biology** • Introduction to mushrooms: diversity, morphology, life cycle • Edible and medicinal mushrooms: Agaricus, Pleurotus, Lentinula, Ganoderma • Nutritional and medicinal value of mushrooms • Mushroom taxonomy and identification
Unit II	**Hours: 4** **Mushroom Cultivation Techniques** • Substrate selection: paddy straw, sawdust, agri-waste • Substrate preparation: composting, pasteurization, sterilization • Spawn production: mother spawn, grain spawn, substrate spawn • Environmental requirements: temperature, humidity, CO_2, light
Unit III	**Hours: 4** **Cultivation of Major Mushrooms** • Button mushroom (Agaricus bisporus): compost preparation, casing soil, cropping • Oyster mushroom (Pleurotus spp.): bag method, shelf method • Milky mushroom (Calocybe indica): substrate preparation, incubation, harvesting • Shiitake mushroom: log and bag cultivation • Disease and pest management in mushroom farms
Unit IV	**Hours: 4** **Post-Harvest and Entrepreneurship:** Harvesting, grading, drying, preservation and packaging. Value-added products: mushroom pickles, powders, nutraceuticals. Economics of mushroom cultivation: cost–benefit analysis. Small-scale and commercial mushroom farming. Government schemes, training centers and marketing strategies

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Secondyear;Semester-IV
Core Paper: 5 Subject Code: BSMB-401
Title of the paper: Bioanalytical Techniques
Theory (4 Credit)

Subject	**Bioanalytical Techniques**
COs	**CO1:** Describe principles of spectroscopy, chromatography, electrophoresis and microscopy. **CO2:** Apply analytical techniques to quantify, separate and characterize biomolecules. **CO3:** Interpret instrument-based data and troubleshoot analytical procedures. **CO4:** Evaluate the applications and limitations of modern bioanalytical tools in research.
Unit 1	**12 Hours** Solutions: Water- Structure and interaction, water as solvent, pH, Bronsted-Lowry concept of acid and bases, ionization, Buffer: Henderson-Hasselbalch equation, biological buffer system (bicarbonate, phosphate buffers and Tris buffers), Determination of molecular weight- molarity, molality, normality, equivalent weight.
Unit 2	**12 Hours** Spectroscopy: Colorimetry, Basic principles, Beer-Lamberts law, instrumentation and application of UV-Vis and IR spectroscopy, Centrifugation – Principle & types, sedimentation co-efficient, sedimentation velocity, ultra centrifugation, separation of macromolecules, subcellular fractionation.
Unit 3	**12 Hours** Chromatography – Basic principle & types – paper chromatography, thin layer chromatography, column chromatography: gel exclusion, adsorption, ion exchange, affinity. Application of chromatographic technique – separation of biomolecules.
Unit 4	**12 Hours** Electrophoresis – Principle, DNA and RNA gel electrophoresis, Protein gel electrophoresis – SDS PAGE, native-PAGE, documentation, 2D-electrophoresis, Isoelectric focusing. Tracer techniques: nature of radioactivity, isotopes, radioactive decay, α, β and γ radiation, Scintillation counter, application of radioisotopes in biological sample.
Unit 5	**12 Hours** Bio-Physical Techniques: Crystallography: basic concepts & laws, symmetry of elements in crystal X–ray crystallography, determination of crystal structure. Fluorescence: concepts, emission, Chemi-luminescence, luminometry. NMR-2D & 3D structure prediction

Secondyear;Semester-IV
Core Paper: 6 Subject Code: BSMB-402
Title of the paper: Bacteriology- diversity and Systematic
Theory (4 Credit)

Subjects	**Bacteriology- diversity and Systematic**
COs	**CO1:** Explain bacterial classification, nomenclature and evolutionary relationships. **CO2:** Describe diversity, morphology, reproduction and ecological roles of bacteria. **CO3:** Analyze biochemical and molecular approaches for bacterial identification. **CO4:** Evaluate bacterial taxonomy and phylogenetic tools for strain differentiation.
Unit 1	**Bacterial diversity based on nutritional and physiological factors: 8 hours** Classification of bacteria based on nutrition: lithotrophs, organotrophs, phototrophs, chemotrophs. Diversity based on physiological factors: solutes, pH, temperature, oxygen, pressure, radiation**.**
Unit 2	**Bacterial systematics: 10 Hours** Definitions: Concepts of systematics, taxonomy, taxa, species, strains. Conventional and modern approaches to classification: Phenetic, phylogenetic, genotypic classification, evolutionary chronometers, rRNA oligonucleotide sequencing (ribotyping) and signature sequences, nucleic acid hybridization, genomic fingerprinting, MLSA, RFLP to study polyphasic bacterial taxonomy, FAME analysis.
Unit 3	**Diversity of Archaea: 8 Hours** General characteristics with reference to genera belonging to Crenarchaeota (Sulfolobus) and Euryarchaeota: Methanogens (Methanobacterium), thermophiles (Pyrococcus), acidophiles (Picrophilus) and halophiles (Halobacterium). Key features of other groups: Thaumarchaeota, Lokiarchaeota, Nanoarchaeota
Unit 4	**Diversity of Eubacteria: 8 Hours** Key features and significance of the following genera: Deeply Branching Bacteria: Thermotoga, Deinococcus. Proteobacteria: Classes and Types. Alphaproteobacteria: Rhizobium, Ricketssia. Betaproteobacteria: Neisseria, Thiobacillus. Gammaproteobacteria: Escherichia, Yersinia. Deltaproteobacteria: Myxococcus and Bdellovibrio. Epsilonproteobacteria: Campylobacter, Helicobacter. Zetaproteobacteria: Mariprofundusferrooxydans.
Unit 5	**Non-Proteobacteria:6 Hours** Chlamydia, Spirochaetes. Gram Positive bacteria having genomes of low GC content: Firmicutes Clostridium, Bacillus.Firmicutes Clostridium, Bacillus. Tenericute Mycoplasma. Gram Positive bacteria having genomes of high GC content: Mycobacterium, Streptomyces

Secondyear;Semester-IV
Core Paper: 7 Subject Code: BSMB-403
Title of the paper: Microbiological techniques
Theory (4 Credit)

	Microbiological techniques
COs	**CO1:** Explain principles of sterilization, culture media preparation and microbial cultivation. **CO2:** Apply staining, isolation and enumeration techniques used in microbiology. **CO3:** Analyze microbial contamination, quality control and biosafety procedures. **CO4:** Evaluate laboratory techniques for microbial characterization and diagnosis.
Unit 1	**Concept of Sterilization** **Hours: 08** Definition of sterilization, dry and moist heat, pasteurization, Tyndalization;radiation, ultrasonication, filtration. Physical and Chemical methods of sterilization; disinfection sanitization, antisepsis sterilant and fumigation. Determination of phenol coefficient of disinfectant.
Unit 2	**Media and Pure Culture Technique** **Hours: 08** Culture media: basic composition, Solid and liquid media, Synthetic and complex media, Inoculation, incubation, cultures and related instruments. Pure culture techniques (Pour plate, Spreading, Streaking and serial dilution); Maintenance and preservation of pure culture; Cultivation of anaerobic bacteria.
Unit 3	**Techniques for enumeration of microorganisms:** **Hours: 08** sample preparation from Aqueous, soluble, insoluble, medical and pasteurized materials. Counting methods: pour plate, spread plate, membrane filtration. Most Probable Number (MPN) and MIC. Turbidimetric methods. Staining techniques for identification bacteria and Fungi.
Unit 4	**Microscopy** **Hours: 06** Concept of magnification, resolution and contrast in microscopy, Introduction to Microscope, Principle, types and application of Bright Field Microscope, Dark Field microscope, fluorescence confocal, SEM and TEM.
Unit 5	**Principles of Centrifugation –** **Hours: 10** Centrifugation techniques – preparative and analytical methods, density gradient centrifugation. General principles and applications of chromatography – Paper, Column, Thin layer, Gas, Ion exchange, Affinity chromatography, HPLC, FPLC, GCMS and Gel filtration. Electrophoresis- moving boundary, zone (Paper Gel) electrophoresis. Immuno electrophoresis. Immuno blotting. Isoelectric focusing, 2-Delectrophoresis, Principles of colorimetry

Second year;Semester- IV
Minor Paper: 6 Subject Code: BSMB-406
Title of the paper: Genomics and Proteomics
Theory (3 Credit)

Subject:	**Genomics and Proteomics**
COs	**CO1:** Describe genome organization, sequencing technologies, and gene annotation. **CO2:** Explain principles of transcriptomics, proteomics, and protein profiling techniques. **CO3:** Analyze genomic and proteomic data for functional and comparative analysis. **CO4:** Evaluate applications of genomics and proteomics in medicine, agriculture, and biotechnology.
Unit I	**Hours: 8** Introduction to Genomics Definition and Scope of Genomics. Genome Organization in Prokaryotes and Eukaryotes. Structural vs. Functional vs. Comparative Genomics DNA Sequencing Technologies: Sanger sequencing. Next-generation sequencing (NGS). Applications of Genomics in Human Health and Agriculture
Unit II	**Hours: 8** Genome Mapping and Functional Genomics Genome Mapping: Genetic, physical, and linkage maps. Genome Annotation and Gene Prediction. Transcriptomics: mRNA sequencing. Microarrays and their analysis. Gene Expression Analysis: qPCR, RNA-seq. Gene Knockout and RNAi Studies
Unit III	**Hours: 6** Proteomics – Basics and Techniques Introduction to Proteomics. Types of Proteomics: Structural, Expression, and Functional Proteomics. Protein Extraction and Separation Techniques: 1D and 2D SDS-PAGE. Western blotting. Protein Identification Techniques: MALDI-TOF, LC-MS/MS. Protein Quantification Methods: ELISA, Spectrophotometry
Unit IV	**Hours: 12** Advanced Tools and Technologies Bioinformatics Tools in Genomics and Proteomics, BLAST, FASTA, Genome browsers (Ensembl, NCBI). Protein structure prediction (SWISS-MODEL). Proteomics Databases: UniProt, PDB, KEGG. Post-Translational Modifications (PTMs), Mass Spectrometry in Proteomics. Protein-Protein Interaction Studies: Co-IP, Yeast two-hybrid system

III YEAR

SWAMI VIVEKANAD SUBHARTI UNIVERSITY MEERUT														
KERAL VERMA SUBHARTI COLLEGE OF SCIENCE														
Department of Life Science														
Course Name - B.Sc. Microbiology														
Batch:2025 -26								**SEM:V**						
S. No.	**Course Type**	**Course Code**	**Course**	**Teaching Load**			**Credits**		**Internal Assessment**			**External Assessment**	**Total**	**Remark**
				L	**T**	**P**								
THEORY and PRACTICAL SUBJECTS								**Attendance (5)**	**quiz/PPT/Assignment (10)**	**Mid Sem Test (15)**		**End Sem Exam (70)**		
1	Major 8	BSMB-501,	MICROBIAL GENETICS	4	0	0	4	5	10	15		70	100	
2	Practical V (Based on Major 8+9)	BSMB-503P	MICROBIAL GENETICS Lab		0	4	2	5	10	15		70	100	
3	Major 9	BSMB-502	MICROBES IN INFECTIOUS DISEASE	4	0	0	4	5	10	15		70	100	
4	Minor 5		To be chosen	3	0	0	3	5	10	15		70	100	
5	Minor 6		To be chosen	3	0	0	3	5	10	15		70	100	
6	Internship	BSMB-506I	Internship	2	0	0	4	5	10	15		70	100	
TOTAL CREDITS / ASSESSMENT							**20**	**30**	**60**	**90**		**420**	**600**	

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Department of Life Science														
Course Name - B.Sc. Microbiology														
Batch:2025 -26								**SEM:VI**						
S. No.	**Course Type**	**Course Code**	**Course**	**Teaching Load**			**Credits**		**Internal Assessment**		**External Assessment**	**Total**	**Remark**
				L	**T**	**P**							
THEORY and PRACTICAL SUBJECTS								**Attendance (5)**	**quiz/PPT/Assignment (10)**	**Mid Sem Test (15)**	**End Sem Exam (70)**		
1	Major 10	BSMB -601	VIROLOGY	4	0	0	4	5	10	15	70	100	
2	Practical VI (Based on Major 10+11+12)	BSMB -604P	INDUSTRIAL MICROBIOLOGY Lab	0	0	4	2	5	10	15	70	100	
3	Major 11	BSMB -602	ENVIRONMEMNTAL MICROBIOLOGY	4	0	0	4	5	10	15	70	100	
4	Major 12	BSMB -603	INDUSTRIAL MICROBIOLOGY	4	0	0	4	5	10	15	70	100	
5	Minor 7		To be chosen	3	0	0	3	5	10	15	70	100	
6	Minor 8		To be chosen	3	0	0	3	5	10	15	70	100	
TOTAL CREDITS / ASSESSMENT							**20**	**30**	**60**	**90**	**420**	**600**	

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Thirdyear;Semester-Vth
Core Paper: 8 Subject Code: BSMB-501
Title of the paper: Microbial Genetics
Theory (4 Credit)

Subject:	**MICROBIAL GENETICS (THEORY)**
Cos	**CO1:** Explain mechanisms of DNA mutation, repair and horizontal gene transfer. **CO2:** Describe plasmids, transposons and regulatory elements in prokaryotic genetics. **CO3:** Analyze microbial gene expression and genetic recombination. **CO4:** Evaluate genetic engineering strategies and applications in microbial biotechnology.
Unit I	**Genome Organization** **Hours: 10** Experimental evidences for nucleic acid as genetic material, Structure and types of DNA; Genome organization: E. coli, Saccharomyces, Tetrahymena
Unit II	**Plasmids** **Hours: 15** Types of plasmids – F plasmid, R Plasmids, colicine-genic plasmids, Ti plasmids, linear plasmids, yeast- 2 µ plasmid, Plasmid replication and partitioning, Host range, plasmid-incompatibility, plasmid amplification, Regulation of copy number, curing of plasmids
Unit III	**Mechanisms of Genetic Exchange** **Hours: 10** Transformation - Discovery, mechanism of natural competence, Artificial methods: chemical method, electroporation, microinjection, biolistic method (gene gun), liposome and virus mediated and Agrobacterium - mediated delivery Conjugation - Discovery, mechanism, Hfr and F' strains, Interrupted mating technique and time of entry mapping
Unit IV	**Phage Genetics** **Hours: 15** Features of T4 genetics, Genetic basis of lytic versus lysogenic switch of phage lambda, Transduction - Generalized transduction, specialized transduction, LFT & HFT lysates, Mapping by recombination and co-transduction of markers
Unit V	**Transposable elements** **Hours: 10** Prokaryotic transposable elements – Insertion Sequences, composite and non-composite transposons, Replicative and Non replicative transposition, Mu transposon, Uses of transposons and transposition

Thirdyear;Semester-Vth
Core Paper: 9 Subject Code: BSMB-502
Title of the paper: Microbes in Infectious Disease
Theory (4 Credit)

Subject:	**Microbes in Infectious Disease**
COs	**CO1:** Describe pathogenic microorganisms and mechanisms of host–pathogen interactions. **CO2:** Explain disease transmission, epidemiology and immune responses. **CO3:** Analyze diagnostic approaches for bacterial, viral, fungal and parasitic diseases. **CO4:** Evaluate preventive, therapeutic and control strategies for infectious diseases.
Unit I	**Hours: 8** Definition and concept of health, disease, infection, and pathogen. Bacterial, Viral, Fungal and Protozoan Diseases of various human body systems. Disease associated clinical samples for diagnosis - any three diseases of each.
Unit II	**Hours: 8** General account of epidemiology: principles of epidemiology, current epidemics (AIDS, nosocomal, acute respiratory syndromes). Collection of clinical samples (oral cavity, throat, skin, blood, CSF, urine and faeces) and precautions required. Method of transport of clinical samples to laboratory and storage.
Unit III	**Hours: 15** Mechanism of bacterial pathogenicity, colonization and growth, virulence, virulence factors, exotoxins, enterotoxins, endotoxins and neurotoxins. Examination of sample by staining - Gram stain, Ziehl-Neelson staining for tuberculosis, Giemsa-stained thin blood film for malaria. Preparation and use of culture media - Blood agar, Chocolate agar, Lowenstein-Jensen medium, MacConkey agar, Distinct colony properties of various bacterial pathogens.
Unit IV	**Hours: 8** Serological Methods - Agglutination, ELISA, immunofluorescence, Nucleic acid based methods - PCR, Nucleic acid probes. Diagnosis of Typhoid, Dengue and HIV, Swine flu. Role of vectors- biology of vectors. (1) House fly (2) Mosquitoes (3) sand fly.
Unit V	**Hours: 12** Importance, Determination of resistance/sensitivity of bacteria using disc diffusion method, Determination of minimal inhibitory concentration (MIC) of an antibiotic by serial double dilution method. Epidemiological investigations to identify a disease, Problems of drug resistance and drug sensitivity. Drug resistance in bacteria.

Third year;Semester- V
Minor Paper: 7 Subject Code: BSMB-504
Title of the paper: MICROBIAL ENZYME PRODUCTION AND ITS APPLICATION
Theory (3 Credit)

Subject:	**MICROBIAL ENZYME PRODUCTION AND ITS APPLICATION**
COS	**CO1:** Describe microbial sources and pathways for enzyme production. **CO2:** Explain enzyme purification, characterization, and optimization methods. **CO3:** Analyze industrial applications of microbial enzymes in food, pharmaceuticals, and biotechnology. **CO4:** Evaluate strategies for improving enzyme productivity through strain improvement and fermentation.
Unit I	**Hours: 10** Introduction to Microbial Enzymes: Enzymes: Definition, classification (IUB system), and properties, Microorganisms as a source of industrial enzymes (bacteria, fungi, actinomycetes), Advantages of microbial enzymes over plant and animal enzymes, Primary and secondary screening of enzyme-producing microbes.
Unit II	**Hours: 8** Enzyme Production and Fermentation Strategies, Submerged fermentation (SmF) and solid-state fermentation (SSF), Media formulation and optimization for enzyme production, recovery and purification of enzymes, Use of immobilized cells and enzymes in production.
Unit III	**Hours: 6** Characterization and Kinetics of Enzymes, Determination of enzyme activity, units, and specific activity, Enzyme kinetics: Michaelis-Menten equation, Km and Vmax, Factors affecting enzyme activity: pH, temperature, inhibitors, Thermostability and halo stability of microbial enzymes.
Unit IV	**Hours: 10** Applications of Microbial Enzymes, Industrial applications:Food industry: Amylase, protease, lipase, lactase, Detergent industry: Alkaline proteases, cellulases, Textile industry: Laccase, cellulase, Pharmaceuticals: Streptokinase, penicillinase, Environmental: Ligninase, peroxidases in bioremediation, Recent advances: Recombinant enzyme technology, metagenomic enzymes.

Third year;Semester- V
Minor Paper: 8 Subject Code: BSMB-505
Title of the paper: Microbial Remediation
Theory (3 Credit)

Subject:	**Microbial Remediation**
COs	**CO1:** Describe microbial mechanisms involved in biodegradation and bioremediation. **CO2:** Explain applications of microbes for detoxifying pollutants in soil, water and air. **CO3:** Analyze factors affecting biodegradation efficiency and environmental interactions. **CO4:** Evaluate bioremediation technologies used in industrial and environmental cleanup.
Unit I	**Hours: 8** Introduction to Microbial Remediation:Definition, scope, and types of bioremediations**,** Major classes of environmental pollutants: organic and inorganic**,** Microorganisms involved in remediation: bacteria, fungi, algae, and consortia**,** Factors affecting microbial degradation (pH, temperature, moisture, oxygen, etc.)
Unit II	**Hours: 8** Microbial Mechanisms of Biodegradation, Aerobic and anaerobic pathways of degradation, Enzymes involved in degradation of hydrocarbons, pesticides, and plastics, Genetic basis of microbial degradation, Co-metabolism and xenobiotic degradation.
Unit III	**Hours: 6** Microbial Remediation of Contaminated Environments, Soil bioremediation: bioaugmentation, bio stimulation, composting, Water bioremediation: constructed wetlands, activated sludge, phytoremediation with microbes, Marine/oil spill remediation: hydrocarbon clastic bacteria, Industrial waste and heavy metal remediation using microbes.
Unit IV	**Hours: 12** Applied Aspects of Microbial Remediation, Microbial biosurfactants and their role in bioremediation, Immobilized microbial cells and bioreactors for treatment, Biosensors for monitoring pollutants and microbial activity, Case studies: Ganga water bioremediation, Exxon Valdez oil spill, pesticide degradation.

Thirdyear;Semester-VI
Core Paper: 10 Subject Code: BSMB-601
Title of the paper: Virology
Theory (4 Credit)

Subject:	**Virology**
COs	**CO1:** Describe viral structure, classification and replication strategies. **CO2:** Explain virus–host interactions, pathogenesis and antiviral defense mechanisms. **CO3:** Analyze laboratory methods for viral detection, quantification and cultivation. **CO4:** Evaluate applications of virology in vaccines, gene therapy and biotechnology.
Unit I	**Hours: 8** **Introduction of Virology** History and principles of virology, virus taxonomy, introduction to replication strategies. Virus structures, animal and plant viruses.
Unit II	Virus structure and morphology, viruses of veterinary importance and plant viruses. **Hours: 8**
Unit III	**Hours: 15** Mechanism of bacterial pathogenicity, colonization and growth, virulence, virulence factors, exotoxins, enterotoxins, endotoxins and neurotoxins. Examination of sample by staining - Gram stain, Ziehl-Neelson staining for tuberculosis, Giemsa-stained thin blood film for malaria. Preparation and use of culture media - Blood agar, Chocolate agar, Lowenstein-Jensen medium, MacConkey agar, Distinct colony properties of various bacterial pathogens.
Unit IV	**Hours: 8** Serological Methods - Agglutination, ELISA, immunofluorescence, Nucleic acid based methods - PCR, Nucleic acid probes. Diagnosis of Typhoid, Dengue and HIV, Swine flu. Role of vectors- biology of vectors. (1) House fly (2) Mosquitoes (3) sand fly.
Unit V	**Hours: 12** Importance, Determination of resistance/sensitivity of bacteria using disc diffusion method, Determination of minimal inhibitory concentration (MIC) of an antibiotic by serial double dilution method. Epidemiological investigations to identify a disease, Problems of drug resistance and drug sensitivity. Drug resistance in bacteria.

Thirdyear;Semester-VI
Core Paper: 11 Subject Code: BSMB-602
Title of the paper: Environment Microbiology
Theory (4 Credit)

Subject:	**Environment Microbiology**
COs	**CO1:** Explain microbial diversity in natural environments and their ecological roles. **CO2:** Describe biogeochemical cycles and microbial interactions in soil, water and air. **CO3:** Analyze wastewater treatment, bioremediation and environmental monitoring techniques. **CO4:** Evaluate the impact of microbes on climate, pollution and sustainable development.
Unit I	**Hours: 8** Limnology, factors governing microflora and their distribution in natural water, Microbiology of oceans. Municipal treatment of drinking water. Water pollution and its sources. Role of organic pollutants in water, concepts of C-BOD, N-BOD and COD, Oxygen-sag curve.
Unit II	**Hours: 8** Treatment of waste water by aerobic and anaerobic process-Septic tank, Imhoff tanks, Activated Sludge in detail including process, microbiology, loading parameters, Trickling filters including types of media, microbiology, advantages etc. in detail, Biodiscs, Oxidation ponds, Different types of lagoons. Water borne diseases and pollution, Biomonitors of environmental contamination.
Unit III	**Hours: 15** Air Microbiology-Air borne diseases, Methods for air microflora studies Particulate matters, PAH, Fog and smog, Determination of LD50, Ames test to determine the genotoxicity of toxicants.
Unit IV	**Hours: 8** Degradation of lignocellulosic waste, Biocomposting-different methods, conditions, different types of compost, conditions for production of compost, Leaching of metal from ores-Bioleaching, organisms involved and their usage.
Unit V	**Hours: 12** Biotransformation of Steroids and Antibiotics, pros and cons of biotransformation; Desulphurisation of coal Biodeterioration of wood, paints, pharmaceutical products, leather and leather products

Thirdyear;Semester-VI
Core Paper: 12 Subject Code: BSMB-603
Title of the paper: Industrial Microbiology
Theory (4 Credit)

Subject:	**Industrial Microbiology**
COs	**CO1:** Describe the principles of microbial fermentation and industrial bioprocessing. **CO2:** Explain strain improvement, upstream and downstream processing. **CO3:** Analyze production processes of enzymes, antibiotics, beverages and biofuels. **CO4:** Evaluate quality control, scale-up strategies and industrial biosafety norms.
Unit I	**Hours: 8** Introduction Fermentation processes, Microbial culture selection for fermentation processes. Media formulation and optimization; inoculum development; strain improvement
Unit II	**Hours: 8** Microbial growth kinetics in Batch, fed batch and continuous cultures Design of fermenters Design and operation of Fermenters, Basic concepts for selection of a reactor, Packed bed reactor, Fluidized bed reactor, Trickle bed reactor, Bubble column reactor, Scale up of Bioreactor.
Unit III	**Hours: 15** Food preservation methods High temperatures, drying, food additives and radiation. Preservation of milk, meat, fish, fruits and vegetables; Food hygiene maintenance
Unit IV	**Hours: 8** Biomass based products Biopesticides- Thuricide and Trichoderma; Yeast: SCP, Baker's and Distiller's yeast; Milk products: Cheese and Yogurt; Microbial transformation products: Steroids
Unit V	**Hours: 12** Fermentation products Large scale fermentaion of acetone, butanol and ethanol (ABE) and alcoholic Beverages -Beer and Wines; Vitamins -B12 and Riboflavin; Antibiotics-Penicillin and Streptomycin);Organicacids-Citric acid, Acetic acid and Lactic acid; Amino acid- Glutamic acid; Enzymes-Amylase, Lipases, Esterases and Restriction enzymes; Vaccines – Tetanus, Polio and Rabies.

Third year;Semester- VI
Minor Paper: 9 Subject Code: BSMB-605
Title of the paper: Vaccine Development
Theory (3 Credit)

Subject:	**Vaccine Development**
COs	**CO1:** Explain the immunological principles and mechanisms underlying vaccine-induced protection. **CO2:** Describe major vaccine types and the steps involved in vaccine design and production. **CO3:** Analyze vaccine evaluation, clinical trials, quality control, and regulatory requirements. **CO4:** Evaluate current challenges, global vaccination strategies, and emerging vaccine technologies.
Unit I	**Hours: 8** Basics of Immunology and Vaccinology**:** Innate and adaptive immunity overview**,** Antigens, antibodies, and immune response to infection**,** History and scope of vaccine development**,** Herd immunity and vaccination programs.
Unit II	**Hours: 8** Types of Vaccines:Traditional vaccines:Live attenuated vaccinesand Inactivated (killed) vaccines. Modern vaccine technologies:Subunit and toxoid vaccines, DNA and RNA vaccines**,** Recombinant protein vaccines**,** Viral vector-based vaccines (e.g., adenovirus)**,** Edible vaccines and peptide vaccines.
Unit III	**Hours: 6** Vaccine Development Process: Antigen identification and selection, Preclinical studies (animal models), Clinical trials (Phase I, II, III, IV), Adjuvants and delivery systems (liposomes, nanoparticles), Cold chain and storage considerations.
Unit IV	**Hours: 10** Applications and Case Studies:Pediatric vaccines (e.g., DPT, MMR, polio)**,** Vaccines for emerging diseases: COVID-19, Ebola, Zika**,** Cancer vaccines and therapeutic vaccines**,** Veterinary vaccines**,** Case study: Development of mRNA vaccines for SARS-CoV-2.

Third year;Semester- VI
Minor Paper: 10 Subject Code: BSMB-605 (CHOICE 2)
Title of the paper: Stem Cell Biology
Theory (3 Credit)

Subject:	**Stem Cell Biology**
	CO1: Describe types, characteristics, and developmental potential of stem cells. **CO2:** Explain stem cell culture techniques, differentiation, and applications. **CO3:**Analyze therapeutic uses of stem cells in regenerative medicine. **CO4:** Evaluate ethical, legal, and biosafety concerns in stem cell research
Unit I	**Hours: 8** Introduction to Stem Cells: Definition and historical perspective, Characteristics of stem cells: potency, self-renewal, differentiation, Types of stem cells: embryonic stem cells (ESCs), adult stem cells (ASCs), induced pluripotent stem cells (iPSCs), Niche and microenvironment.
Unit II	**Hours: 8** Molecular and Cellular Biology of Stem Cells: Signaling pathways regulating stem cells (Wnt, Notch, Hedgehog), Transcription factors involved in stemness (Oct4, Sox2, Nanog), Cell cycle and epigenetic regulation in stem cells, Methods for stem cell culture and maintenance
Unit III	**Hours: 6** Stem Cell Differentiation and Applications: Mechanisms of lineage commitment and differentiation, Directed differentiation into specific cell types (neurons, cardiomyocytes, hepatocytes), Stem cells in regenerative medicine, Tissue engineering and organoids
Unit IV	**Hours: 12** Therapeutic Applications and Disease Models:Stem cell therapy in diseases: Parkinson's, diabetes, spinal cord injuries, heart disease**,** Hematopoietic stem cell transplantation**,** Role of stem cells in cancer (cancer stem cells)**,** Stem cells in drug discovery and toxicology testing.

IV YEAR

SWAMI VIVEKANAD SUBHARTI UNIVERSITY MEERUT													
KERAL VERMA SUBHARTI COLLEGE OF SCIENCE													
Department of Life Science													
Course Name - B.Sc. Microbiology													
Batch:2025 -26							**SEM:VII**						
S. No.	**Course Type**	**Course Code**	**Course**	**Teaching Load**			**Credits**		**Internal Assessment**		**External Assessment**	**Total**	**Remark**
				L	**T**	**P**							
THEORY and PRACTICAL SUBJECTS								**Attendance (5)**	**quiz/PPT/Assignment (10)**	**Mid Sem Test (15)**	**End Sem Exam (70)**		
1	Major 13	BSMB-701	Bioethics, Biosafety and IPR	4	0	0	4	5	10	15	70	100	
2	Practical VII (Based on Major (13+14)	BSMB-703P	MEDICAL MICROBIOLOGY Lab	0	0	4	2	5	10	15	70	100	
3	Major 14	BSMB-702	Computational biology and bioinformatics in research	4	0	0	4	5	10	15	70	100	
4	Practical VIII (Based on Major 15)	BSMB-706P	Computational biology and bioinformatics in research Lab	0	0	4	2	5	10	15	70	100	
5	Major 15	BSMB-704	MEDICAL MICROBIOLOGY	4	0	0	4	5	10	15	70	100	
6	Minor 9		To be chosen	3	0	0	3	5	10	15	70	100	
TOTAL CREDITS / ASSESSMENT							19	**30**	**60**	**90**	**420**	**600**	

K. V. Subharti College of Science
S V Subharti University
NH-58 Bypass Road, Meerut

SWAMI VIVEKANAD SUBHARTI UNIVERSITY MEERUT													
KERAL VERMA SUBHARTI COLLEGE OF SCIENCE													
Department of Life Science													
Course Name - B.Sc. Microbiology													
Batch:2025-26							**SEM:VIII**						
S. No.	**Course Type**	**Course Code**	**Course**	**Teaching Load**			**CREDITS**	**Internal Assessment**			**External Assessment**	**Total**	**Remark**
	THEORY and PRACTICAL SUBJECTS			**L**	**T**	**P**		**Attendance (5)**	**Quiz/ PPT/ Assignment (10)**	**Mid Sem Test (15)**	**End Sem Exam (70)**		
1	Major 16	BSMB-801	Research Methodology in Microbiology	4	0	0	4	5	10	15	70	100	
2	Minor 10		To be chosen	3	0	0	3	5	10	15	70	100	
4	Research Project / Dissertation	BSMB-803R	Research Project / Dissertation	12	0	0	12				300	300	
TOTAL CREDITS / ASSESSMENT							**19**	**60**			**440**	**500**	

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Fourthyear;Semester-VII
Core Paper: 13 Subject Code: BSMB-701
Title of the paper: BIOETHICS, BIOSAFETY AND IPR
Theory (4 Credit)

Subject:	**BIOETHICS, BIOSAFETY AND IPR**
COs	**CO1:** Explain principles of bioethics and their relevance in biological research. **CO2:** Describe biosafety levels, regulations and risk assessment methods. **CO3:** Analyze ethical issues associated with biotechnology, GMOs and biomedical research. **CO4:** Evaluate intellectual property rights, patents and legal frameworks in biosciences.
Unit I	**Hours: 8** Biosafety: Introduction, Historical prospective, objectives, risk assessment in biotechnological research and their regulation, physical and biological contaminants, field trial and planned introduction of GMOs, Biosafety guidelines in India, Biosafety levels for plant, animal and microbial researches.
Unit II	**Hours: 8** Bioethics: Introduction, Ethical issues related to biotechnology, legal and socioeconomic impacts of biotechnology, health and safety issues, possible benefits of successful cloning, Ethical concerns of gene cloning, hazards of environmental engineering, Ethical issues in Human Cloning and stem cell research.
Unit III	**Hours: 15** Patents and patent processing: Introduction, Essential requirements, international scenario of patents, patenting of biological materials, significance of patents in India, Patent application, Procedures and granting, protection of biotechnological inventions, Patent Act (1970), Patent (Amendments) Act (2002).
Unit IV	**Hours: 8** Regulatory framework in Biotechnology: Regulation of RDT research, Regulation of food and food ingredients, Regulatory framework in India governing GMOs, Recombinant DNA Guidelines (1990), Revised Guidelines for Research in Transgenic Plants (1998), Prevention Food Adulteration Act (1955), Food Safety and Standards Bill (2005).
Unit V	**Hours: 12** Project management: Search for a business idea, concept of project and classification, project identification, project formulation, project design and network analysis, project report, project appraisal. Financial analysis: Ratio analysis, Investment process, Break even analysis, Profitability analysis, Budget and planning process. Funding of biotech business (Financing alternatives, Venture Capital funding, funding for biotech in India.

Fourthyear;Semester-VII
Core Paper: 14 Subject Code: BSMB-702
Title of the paper: Computational Biology and Bioinformatics in research
Theory (4 Credit)

Subject:	**Computational Biology and Bioinformatics in research**
COs	**CO1:** Describe basic concepts of computational biology, databases and sequence analysis tools. **CO2:** Apply algorithms for genome analysis, alignment and molecular phylogeny. **CO3:** Analyze biological data using bioinformatics software and visualization tools. **CO4:** Evaluate bioinformatics applications in genomics, proteomics and systems biology.
Unit I	**Hours: 8** Introduction to bioinformatics, History of bioinformatics. The notion of Homology. Sequence Information Sources, EMBL, GENBANK, Entrez, Unigene, Understanding the structure of each source and using it on the web, biological databases. Type of databases, Nucleotide sequence databases, Primary nucleotide sequence databases-EMBL, Gene Bank, DDBJ; Secondary nucleotide sequence databases, Unigene.
Unit II	**Hours: 8** Protein Information Sources, PDB, SWISSPROT, TREMBL, Understanding the structure of each source and using it on the web. Introduction of Data Generating Techniques and Bioinformatics and their problems.
Unit III	**Hours: 15** Sequence and Phylogeny analysis, Detecting Open Reading Frames, Outline of sequence Assembly, Mutation/Substitution Matrices, Pairwise Alignments, Introduction to BLAST, using it on the web, Interpreting results, Multiple Sequence Alignment.
Unit IV	**Hours: 8** Searching Databases: SRS, Entrez, Sequence Similarity Searches-BLAST, FASTA, Data Submission. Genome Annotation: Pattern and repeat finding, Gene identification tools.
Unit V	**Hours: 12** Sequence and Phylogeny analysis, Detecting Open Reading Frames, Introduction to BLAST, using it on the web, Outline of sequence Assembly, Pairwise Alignments, Interpreting results, Multiple Sequence Alignment, Phylogenetic Analysis.

Fourthyear;Semester-VII
Core Paper: 15 Subject Code: BSMB-704
Title of the paper: Medical Microbiology
Theory (4 Credit)

Subject:	**Medical Microbiology**
COs	**CO1:** Explain the classification, characteristics and pathogenicity of medically important microbes. **CO2:** Describe mechanisms of infection, immunity and microbial diagnostics. **CO3:** Analyze clinical samples and interpret microbiological laboratory results. **CO4:** Evaluate treatment strategies, antimicrobial resistance and hospital infection control.
Unit I	**Hours: 8** Definitions: Incubation period, Viability, Susceptibility, Pathogenicity, Virulence, Pathogenesis, Lab diagnosis, Epidemic, Sporadic, Endemic, Pandemic
Unit II	**Hours: 8** Study of following pathogens with respect to –Classification, Morphological, Cultural and Biochemical characters, Antigenic structure, Viability characteristics, Pathogenicity, Pathogenesis, Symptoms, Laboratory diagnosis, Epidemiology, Prophylaxis and Chemotherapy: Bacteria: a) Escherichia coli b) Staphylococcus aureus Fungi: a) Candida b) Dermatophytes
Unit III	**Hours: 15** Introduction to Chemotherapy l. Selective toxicity, Bioavailability MIC, MBC, LD 50 ii. Antagonism and synergism in drug administration iii. Antibiotic sensitivity, iv. Antibiotic misuse/antibiotic overuse v. Concept of drug resistance (e.g. MRSA, ESBL).
Unit IV	**Hours: 8** Immunity: Definition, types (Innate and acquired, active and passive, humoral and cell mediated), Formation of blood cells (hematopoiesis) Myeloid and lymphoid lineages and differentiation process Lymphocytes types.
Unit V	**Hours: 12** Antigens and antibodies: definition and concept. Immunohematology a. ABO and Rh blood group systems b. Bombay blood group c. Biochemistry of blood group substances d. Inheritance of ABH antigens e. Medico legal applications of blood groups

Fourth year;Semester- VII
Minor Paper: 11 Subject Code: BSMB-705

Title of the paper: Literature Review and Scientific Writing
Theory (3 Credit)

Subject:	**Literature Review and Scientific Writing**
COs	**CO1:** Describe the structure and components of scientific literature, including research papers and reviews. **CO2:** Apply methods for searching, evaluating, and summarizing scientific articles. **CO3:** Develop research proposals, review articles, and scientific reports with proper citation formats. **CO4:** Evaluate scientific writing for clarity, accuracy, originality, and ethical standards.
Unit I	**Hours: 8** Introduction to Literature Review, Purpose and importance of literature review, Types of literature: primary, secondary, tertiary sources, Review types: narrative vs systematic vs. meta-analysis, identifying research gaps and formulating review questions.
Unit II	**Hours: 8** Searching and Managing Scientific Literature**,** Use of online databases: PubMed, Scopus, Google Scholar, Web of Science**,** Use of keywords, Boolean operators, filters**,** Reference management tools: Mendeley, Zotero, EndNote (basic introduction)**,** Organizing and storing references.
Unit III	**Hours: 6** Principles of Scientific Writing, Structure of a scientific paper: IMRAD (Introduction, Methods, Results, Discussion), Writing styles: clarity, conciseness, coherence, Common errors and how to avoid them, Writing summaries, abstracts, and keywords
Unit IV	**Hours: 12** Referencing and Plagiarism: Citation styles: APA, MLA, Vancouver, Chicago (overview), Paraphrasing and quoting, Avoiding plagiarism: use of plagiarism detection tools, Ethical issues in scientific writing and publication.

Fourthyear;Semester-VIII
Core Paper: 15 Subject Code: BSMB-801
Title of the paper: Research Methodology
Theory (4 Credit)

Subject:	**Research Methodology**
COs	**CO1:** Describe scientific research process, hypothesis development and study design. **CO2:** Apply sampling methods, data collection techniques and statistical tools.

	CO3: Analyze scientific literature, research ethics and plagiarism issues. **CO4:** Develop research proposals, reports and presentations for academic research.
Unit I	**Hours: 8** Introduction to Research Methodology: Definition and objectives of research, Types of research: Basic, Applied, Quantitative, Qualitative, Characteristics of good research, Scientific method and hypothesis formulation, Literature review and identifying research gaps.
Unit II	**Hours: 8** Research Design and Planning:Research problem formulation**,** Variables: Independent, Dependent, Confounding**,** Experimental and control groups**,** Sampling methods: Probability and non-probability**,** Study design: Experimental, observational, case study, cross-sectional, longitudinal.
Unit III	**Hours: 15** Data Collection and Analysis: Types of data: Primary and secondary, Methods: Survey, observation, interviews, experimental methods, Tools: Questionnaires, lab instruments, databases, Data presentation: Tables, graphs, charts, Basics of statistical analysis: Mean, median, mode, SD, t-test, chi-square test (introduction only), Use of software: MS Excel, GraphPad.
Unit IV	**Hours: 8** Scientific Writing and Communication: Structure of scientific reports, thesis, and articles, Abstract, introduction, methodology, results, discussion, and conclusion, Referencing styles: APA, MLA, Vancouver, Use of reference managers (Zotero, Mendeley), Avoiding plagiarism and importance of originality, Oral and poster presentations.
Unit V	**Hours: 12** Ethics in Research and Funding: Research ethics and misconduct, Informed consent and confidentiality, Role of Institutional Ethics Committees (IEC), Biosafety and bioethics in biotechnology, Overview of funding agencies: DBT, DST, UGC, CSIR, ICMR, Preparing research proposals.

Fourth year;Semester- VIII
Minor Paper: 12 Subject Code: BSMB-802
Title of the paper: Thrust Areas of Microbiology
Theory (3 Credit)

Subject:	**Thrust Areas of Microbiology**
Unit I	**Hours: 8** Microbiome Science & Personalized Health: Human microbiome and its role in diagnostics and therapy. Gut-brain-microbiota axis: emerging links in metabolic and mental health. Microbiome in personalized medicine and nutrition. Microbial therapies: Fecal Microbiota Transplantation (FMT). Market landscape: microbiome-based diagnostics, therapeutics, and

	functional foods. Industry Relevance: Precision medicine, probiotics industry, wellness products
Unit II	**Hours: 8** **Industrial & Pharmaceutical Microbiology:** Fermentation technology and microbial cell factories (yeasts, bacteria, fungi). Microbial production of enzymes, organic acids, antibiotics, recombinant proteins. cGMP, GLP, and bioprocess QA/QC in industry. Role of microbes in biosimilars and vaccine production. Industrial-scale bioreactor design basics and tech transfer *Industry Relevance:* Biopharma, enzyme production, fermentation-based industries
Unit III	**Hours: 6** **Agricultural & Environmental Microbial Technologies** Biofertilizers and biopesticides: formulation and field application. Microbial consortia for soil health and carbon capture. Microbes for climate resilience: drought & salt tolerance. Biodegradation and microbial solutions for agro-waste. Biostimulants and sustainable microbial agriculture startups. *Industry Relevance:* Agri-biotech, sustainable farming, climate-smart inputs
Unit IV	**Hours: 12** Clinical Microbiology & Diagnostic Technologies. Rapid diagnostics: LAMP, qPCR, RT-PCR, CRISPR-based kits. Biosensors for pathogen detection. Antibiotic resistance surveillance and AMR management strategies. Role of AI/ML in microbial diagnostics. Microbial forensics and disease outbreak tracing. Industry Relevance: Clinical diagnostics, public health labs, AMR tracking