SWAMI VIVEKANAND SUBHARTI UNIVERSITY
UGC Approved Meerut
NAAC A
AN ISO 21001: 2018 ORGANIZATION

OFFICE OF THE REGISTRAR
Gp Capt M Yakoob
M-in-D (Retd.), M.Tech.
REGISTRAR
registrar@subharti.org

Ref.No.U-508(i)/SVSU/2025/1579 Date:25.01.2025

NOTIFICATION

It is hereby notified for information of all the concerned that the Academic Council in its 34th meeting held on 25-07-2024 vide resolution No.34(7) has approved the ordinance relating to course curriculum & syllabus of degree of Four Year Degree Program (FYDP) of the following:

Ordinance No.V-126 (B17), relating to B.Sc.-Microbiology

The copies of all above are enclosed and shall be applicable from Academic Session 2024-25 onwards.

This issues with the approval of the Hon'ble Vice Chancellor.

25.01.2025
Registrar

Ref.No.U-508(i)/SVSU/2025/1579 Date: 25.01.2025

Copy forwarded to information of:

1. Hon'ble Vice-Chancellor
2. Controller of Examination
3. Dean-Academics
4. Director-IQAC
5. Dean-Faculty of Science (for compliance please)
6. CTO (with a request to upload the ordinance on University website)
7. Additional Registrar-Academics
8. Guard File

25.01.2025
Registrar

SWAMI VIVEKANAND SUBHARTI UNIVERSITY

MEERUT

Keral Verma Subharti College of Science

Ordinance Number V 126 B-17

Bachelor of Science in Microbiology

MAJOR COURSES

S.NO.	SEMESTER	COURSE CODE	COURSE NAME	CREDITS L+P
1	I		CELL BIOLOGY AND GENETICS	**4+2**
2	II		INTRODUCTION TO MICROBIOLOGY	**4+2**
3	III		MICROBIAL PHYSIOLOGY AND METABOLISM	**4+2**
4			MOLECULAR BIOLOGY	**4+2**
5	IV		BIOANALYTICAL TECHNIQUES	**4+2**
6			BACTERIOLOGY-DIVERSITY AND SYSTEMATIC	**4+2**
7			MICROBIOLOGICAL TECHNIQUES	**4+2**
8	V		MICROBIAL GENETICS	**4+2**
9			MICROBES IN INFECTIOUS DISEASE	**4+2**
10	VI		VIROLOGY	**4+2**
11			ENVIRONMEMNTAL MICROBIOLOGY	**4+2**
12			INDUSTRIAL MICROBIOLOGY	**4+2**
13	VII		BIOETHICS, BIOSAFETY AND IPR	**4+2**
14			COMPUTATIONAL BIOLOGY AND BIOINFORMATICS IN RESEARCH	**4+2**
15			MEDICAL MICROBIOLOGY	**4+2**
16	VIII		RESEARCH METHODOLOGY	**4+2**

MINOR COURSES

S.NO.	SEMESTER	COURSE CODE	COURSE NAME	CREDITS L+P
1.	I		A. MICROORGANISMS FOR HUMAN WELFARE B. BIOTECHNOLOGY AND HUMAN WELFARE C. BIOCHEMISTRY IN HEALTH AND DISEASE	**3+1**
2.	II		BIORESOURCE TECHNOLOGY AND BIOPRODUCTS	**3+1**
3.	III		A. BIOPROCESS ENGINEERING	**3+1**
4.	IV		GENOMICS AND PROTEOMICS	**3+1**
5.	V		1. MICROBIAL ENZYME PRODUCTION AND ITS APPLICATION 2. MICROBIAL REMEDIATION	**3+1** **3+1**
6.	VI		1. STEM CELL BIOLOGY 2. VACCINE DEVELOPMENT	**3+1** **3+1**
7.	VII		LITERATURE REVIEW AND SCIENTIFIC WRITING	**3+1**
8.	VIII		THURST AREA OF MICROBIOLOGY	**3+1**

MULTIDISCIPLINARY COURSES

S.No.	SEMESTER	COURSE CODE	COURSE NAME	CREDITS
1.	**I**		SOIL MICROBIOLOGY	**3+1**
2.	**II**		THRUST AREA OF RESEARCH IN MICROBIOLOGY	**3+1**
3.	**III**		PHARMACEUTICAL MICROBIOLOGY	**3+1**

SKILL ENHANCEMENT COURSES

S.No.	SEMESTER	COURSE CODE	COURSE NAME	CREDITS
1.	**I**		QUALITY ASSURANCE AND QUALITY CONTROL IN	**1+0**

			MICROBIOLOGY	
2.	**II**		PRODUCTION OF MICROGREENS AND MUSHROOM CULTIVATION	**1+0**
3.	**III**		DOMESTIC CULTIVATION OF USEFUL MICROBES	**1+0**

VALUE ADDED COURSE

S.No.	SEMESTER	COURSE CODE	COURSE NAME	CREDITS
1.	**I**		AI FOR MICROBIOLOGY	**1+0**
2.	**II**		DIGITAL AND FINANCIAL LITERACY	**1+0**

SWAMI VIVEKANAD SUBHARTI UNIVERSITY MEERUT

KERAL VERMA SUBHARTI COLLEGE OF SCIENCE

Department of Botany

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		Cell Biology and Genetics	4	1	0	4	5	10	15	70	100	
2	Practical I (Based on Major 1)		Cell Biology and Genetics Lab	0	0	4	2	5	10	15	70	100	
3	Minor 1		A. Micro organisms for human welfare B. Biotechnology and Human Welfare C. Biochemistry in health and disease	3	1	0	3	5	10	15	70	100	
4	Multi Disciplinary		Soil Microbiology	3	1	0	3	5	10	15	70	100	
5	Ability Enhancement Course		English Communication	2	1	0	2	5	10	15	70	100	
6	Skill Enhancement Course		Quality Assurance and Quality Control in Microbiology	1	0	3	3	5	10	15	70	100	

7	Value Added Course			3	1	0	3	5	10	15	70	100	
8	Qualifying		IKS / Rastra bodh	2	1	0	2	5	5	10	30	50	Qualifying
TOTAL CREDITS / ASSESSMENT							**20**	**35**	**70**	**105**	**490**	**700**	

SWAMI VIVEKANAD SUBHARTI UNIVERSITY MEERUT

KERAL VERMA SUBHARTI COLLEGE OF SCIENCE

Department of Botany

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		INTRODUCTION TO MICROBIOLOGY	4	1	0	4	5	10	15	70	100	
2	Practical II Major 2		Introduction to Microbiology Lab	0	0	4	2	5	10	15	70	100	
3	Minor 2		Bioresource Technology and Bioproducts	3	1	0	3	5	10	15	70	100	
4	Multi Disciplinary 2		Thrust Areas of Research in Microbiology	3	1	0	3	5	10	15	70	100	
5	Ability Enhancement Course 2			2	1	0	2	5	10	15	70	100	

6	Skill Enhancement Course 2		Production of Microgreens and Mushroom Cultivation	1	0	3	3	5	10	15	70	100	
7	Value Added Course 2		Digital and Financial Literacy	3	1	0	3	5	10	15	70	100	
8	Qualifying		IKS / Rastra bodh	2	1	0	2	5	5	10	30	50	Qualifying
TOTAL CREDITS / ASSESSMENT							**20**	**35**	**70**	**105**	**490**	**700**	

SWAMI VIVEKANAD SUBHARTI UNIVERSITY MEERUT

KERAL VERMA SUBHARTI COLLEGE OF SCIENCE

Department of Botany

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		Molecular Biology	4	1	0	3	5	10	15	70	100	
2	Practical III (Based on Major 3+4)		Molecular Biology Lab	0	0	4	3	5	10	15	70	100	
3	Major 4		MICROBIAL PHYSIOLOGY AND METABOLISM	4	1	0	3	5	10	15	70	100	

4	Minor 3		A. Bioprocess Engineering B. Gene Therapy C. Drug Designing	3	1	0	3	5	10	15	70	100	
5	Multi Disciplinary 3		Pharmaceutical Microbiology	3	1	0	3	5	10	15	70	100	
6	Ability Enhancement Course 3 (Disaster Risk Management)		Disaster Risk Management	2	1	0	2	5	10	15	70	100	
7	Skill Enhancement Course 3		Domestic Cultivation of Useful Microbes	1	0	3	3	5	10	15	70	100	
TOTAL CREDITS / ASSESSMENT							**20**	**35**	**70**	**105**	**490**	**700**	

SWAMI VIVEKANAD SUBHARTI UNIVERSITY MEERUT

KERAL VERMA SUBHARTI COLLEGE OF SCIENCE

Department of Botany

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		Bioanalytical Techniques	4	1	0	4	5	10	15	70	100	

2	Practical IV (Based on Major 5+6+7)		Bioanalytical Techniques Lab	0	0	4	3	5	10	15	70	100	
3	Major 6		BACTERIOLOGY-DIVERSITY AND SYSTEMATIC	4	1	0	4	5	10	15	70	100	
4	Major 7		Microbiological Techniques	4	1	0	4	5	10	15	70	100	
5	Minor 4		Genomics and Proteomics	3	1	0	3	5	10	15	70	100	
6	Ability Enhancement Course 3 (Course on NCC/NSS/NGO,s/ Scout Guide / Sports)		Course on NCC/NSS/NGO,s/ Scout Guide / Sports)	2	1	0	2	5	10	15	70	100	
TOTAL CREDITS / ASSESSMENT							**20**	**30**	**60**	**90**	**420**	**600**	

SWAMI VIVEKANAD SUBHARTI UNIVERSITY MEERUT

KERAL VERMA SUBHARTI COLLEGE OF SCIENCE

Department of Botany

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		MICROBIAL GENETICS	4	1	0	4	5	10	15	70	100	
2	Practical V (Based on Major 8+9)		MICROBIAL GENETICS Lab		0	4	2	5	10	15	70	100	
3	Major 9		MICROBES IN INFECTIOUS DISEASE	4	1	0	4	5	10	15	70	100	
4	Minor 5		Microbial Remediation	3	1	0	3	5	10	15	70	100	
5	Minor 6		A. Microbial Enzyme production and its application B. Microbial remediation C. Plant Microbe Interaction	3	1	0	3	5	10	15	70	100	
6	Internship		Internship	2	1	0	4	5	10	15	70	100	
TOTAL CREDITS / ASSESSMENT							**20**	**30**	**60**	**90**	**420**	**600**	

SWAMI VIVEKANAD SUBHARTI UNIVERSITY MEERUT

KERAL VERMA SUBHARTI COLLEGE OF SCIENCE

Department of Botany

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		VIROLOGY	4	1	0	4	5	10	15	70	100	
2	Practical VI		INDUSTRIAL	0	0	4	2	5	10	15	70	100	

	(Based on Major 10+11+12)		MICROBIOLOGY Lab										
3	Major 11		ENVIRONMEMNTAL MICROBIOLOGY	4	1	0	4	5	10	15	70	100	
4	Major 12		INDUSTRIAL MICROBIOLOGY	4	1	0	4	5	10	15	70	100	
5	Minor 7		A. Stem Cell Biology B. Vaccine Development	3	1	0	3	5	10	15	70	100	
6	Minor 8		A. Stem Cell Biology B.	3	1	0	3	5	10	15	70	100	
TOTAL CREDITS / ASSESSMENT							**20**	**30**	**60**	**90**	**420**	**600**	

SWAMI VIVEKANAD SUBHARTI UNIVERSITY MEERUT

KERAL VERMA SUBHARTI COLLEGE OF SCIENCE

Department of Botany

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		Bioethics, Biosafety and IPR	4	1	0	4	5	10	15	70	100	
2	Practical VII (Based on		MEDICAL MICROBIOLOGY Lab	0	0	4	2	5	10	15	70	100	

	Major (13+14)												
3	Major 14		Computational biology and bioinformatics in research	4	1	0	4	5	10	15	70	100	
4	Practical VIII (Based on Major 15)		Computational biology and bioinformatics in research Lab	0	0	4	2	5	10	15	70	100	
5	Major 15		MEDICAL MICROBIOLOGY	4	1	0	4	5	10	15	70	100	
6	Minor 9		Literature review and Scientific writing	3	1	0	4	5	10	15	70	100	
TOTAL CREDITS / ASSESSMENT							**20**	**30**	**60**	**90**	**420**	**600**	

SWAMI VIVEKANAD SUBHARTI UNIVERSITY MEERUT

KERAL VERMA SUBHARTI COLLEGE OF SCIENCE

Department of Botany

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**
								Attendance (5)	**Quiz/PPT/ Assignment (10)**	**Mid Sem Test (15)**	**End Sem Exam (70)**		
	THEORY and PRACTICAL SUBJECTS			**L**	**T**	**P**							
1	Major 16		Research Methodology in Microbiology	4	1	0	4	5	10	15	70	100	
2	Minor 10		Thurst Area of Microbiology	3	1	0	4	5	10	15	70	100	
4	Research		Research Project / Dissertation	2	1	0	12				300	300	

	Project / Dissertation												
TOTAL CREDITS / ASSESSMENT						**20**	**60**				**440**	**500**	

B.Sc. (Honors) Microbiology

DETAILED SYLLABUS

Semester - I

DEPARTMENT OF BOTANY

KERAL VERMA SUBHARTI COLLEGE OF SCIENCE

SWAMI VIVEKANAND SUBHARTI UNIVERSITY

MEERUT

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		Cell Biology and Genetics	4	1	0	4	5	10	15	70	100	
2	Practical I (Based on Major 1)		Cell Biology and Genetics Lab	0	0	4	2	5	10	15	70	100	
3	Minor 1		A. Micro organisms for human welfare B. Biotechnology and Human Welfare C. Biochemistry in health and disease	3	1	0	3	5	10	15	70	100	
4	Multi Disciplinary		Soil Microbiology	3	1	0	3	5	10	15	70	100	
5	Ability Enhancement Course		English Communication	2	1	0	2	5	10	15	70	100	
6	Skill Enhancement Course		Quality Assurance and Quality Control in Microbiology	1	0	3	3	5	10	15	70	100	
7	Value Added Course			3	1	0	3	5	10	15	70	100	
8	Qualifying		IKS / Rastra bodh	2	1	0	2	5	5	10	30	50	Qualifying
TOTAL CREDITS / ASSESSMENT							**20**	**35**	**70**	**105**	**490**	**700**	

Firstyear;Semester-I

CorepaperI Subject Code:

Title of the paper: Cell Biology and Genetics

Theory (4 Credit)

Units	Cell Biology and Genetics
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 and Turner's syndrome), Autosomal (Down's syndrome).

First year;Semester- I

Minor Paper: 1 Subject Code:

Title of the paper: MICROORGANISMS FOR HUMAN WELFARE
Theory (3 Credit)

Subject:	**MICROORGANISMS FOR HUMAN WELFARE**
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
Minor Paper: 2 Subject Code:
Title of the paper: BIOTECHNOLOGY FOR HUMAN WELFARE
Theory (3 Credit)

Subject:	BIOTECHNOLOGY FOR HUMAN WELFARE
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
Minor Paper: 3 Subject Code:
Title of the paper: Biochemistry in Health and Disease
Theory (3 Credit)

Subject:	Biochemistry in Health and Disease
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
Title of the paper:Soil Microbiology
Theory (3 Credit)

Subject:	**Soil Microbiology**
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.
Unit V	**Hours: 6** Applied Soil Microbiology and Environmental Concerns Soil Pollution and Microbial Degradation: Pesticides, hydrocarbons, heavy metals. Bioremediation and rhizoremediation of contaminated soils. Role of soil microbes in sustainable agriculture. Microbial biocontrol agents and soil-borne pathogens

First year;Semester- I
SEC Paper: 1 Subject Code
Title of the paper:Quality Assurance and Quality Control in Microbiology
Theory (3 Credit)

Subject:	**Quality Assurance and Quality Control in Microbiology**
Unit I	**Hours: 4** **Introduction to QA and QC**

	Definitions and differences between QA and QC. Importance inmicrobiological and pharmaceutical settings. Roles of microbiologists in QA/QC teams. Regulatory standards: GMP, GLP, ISO 17025
Unit II	**Hours: 4** **Quality Control of Microbial Media and Reagents** Media preparation and sterility checks. Growth promotion testing. Reagent standardization and documentation. Calibration and validation of instruments (autoclave, incubator)
Unit III	**Hours: 4** **Microbiological Testing Methods** Sterility testing. Microbial limit tests (MLT), Environmental monitoring (air, surface, personnel), Water quality testing (TVC, coliforms)
Unit IV	**Hours: 4** **Documentation and Audit Practices** Standard Operating Procedures (SOPs), Good Documentation Practices (GDP), Logbooks, batch records, test reports, Internal audits and non-conformity reporting
Unit V	**Hours: 4** **Validation and Risk Management** Method validation in microbiology, Equipment qualification (IQ, OQ, PQ) Root cause analysis (RCA) and CAPA, Risk analysis in microbiological processes (HACCP basics).

B.Sc. (Honors) Microbiology

DETAILED SYLLABUS

Semester - II

DEPARTMENT OF BOTANY

KERAL VERMA SUBHARTI COLLEGE OF SCIENCE

SWAMI VIVEKANAND SUBHARTI UNIVERSITY

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KERAL VERMA SUBHARTI COLLEGE OF SCIENCE													
Department of Botany													
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		INTRODUCTION TO MICROBIOLOGY	4	1	0	4	5	10	15	70	100	
2	Practical II Major 2		Introduction to Microbiology Lab	0	0	4	2	5	10	15	70	100	
3	Minor 2		Bioresource Technology and Bioproducts	3	1	0	3	5	10	15	70	100	
4	Multi Disciplinary 2		Thrust Areas of Research in Microbiology	3	1	0	3	5	10	15	70	100	
5	Ability Enhancement Course 2			2	1	0	2	5	10	15	70	100	
6	Skill Enhancement Course 2		Production of Microgreens and Mushroom Cultivation	1	0	3	3	5	10	15	70	100	
7	Value Added Course 2		Digital and Financial Literacy	3	1	0	3	5	10	15	70	100	
8	Qualifying		IKS / Rastra bodh	2	1	0	2	5	5	10	30	50	Qualifying
TOTAL CREDITS / ASSESSMENT							**20**	**35**	**70**	**105**	**490**	**700**	

Firstyear;Semester-II

Corepaper2 Subject Code:
Title of the paper: Introduction to Microbiology
Theory (4 Credit)

Units	Introduction to Microbiology
Unit 1	**History ofMicrobiologyTotal Hours 08** Discovery of microorganisms; Spontaneous generation vs. biogenesis; Historicalaccountsof modern Microbiology; from Leeuwenhoek to Craig Venter including thecontributions of Antonvon Leeuwenhoek, Louis Pasteur, Robert Koch,

	Joseph Lister, Martinus W. Beijerinck, Sergei N. Winogradsky, Alexander Fleming, Selman, A. Waksman, Paul Ehrlich, Elie Metchnikoff, 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,cytoplasmicinclusionsandendospore;Fungi:Generalcharacteristics, Ultrastructure andreproduction;Protozoa:Generalcharacteristicswith special referencetoAmoeba 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, Typesofenvelopes,Types andstructureofgenome;Cultivationofvirusesandbacteriophage;Multiplicationofviruses;Lyticand lysogenycycleof λphage.
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:
Title of the paper: Bioresource Technology and Bioproducts
Theory (3 Credit)

Subject:	**Bioresource Technology and 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 basicsBioreactor 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
Title of the paper: Thrust Areas of Research in Microbiology
Theory (3 Credit)

Subject:	**Thrust Areas of Research in Microbiology**
Unit I	**Hours: 6** Microbiome Research & Host InteractionsHuman and animal microbiomes: gut, skin, oral, urogenital. Role in immunity, development, and disease. Microbiome engineering and microbial therapeutics. Meta-omics approaches (metagenomics, metatranscriptomics). Microbiome-based diagnostics and probiotics. *Research Thrust*: Personalized medicine, microbiota modulation, microbial-host crosstalk
Unit II	**Hours: 6** Antimicrobial Resistance (AMR) & Novel Antimicrobials Mechanisms of antibiotic resistance in bacteria. Genetic basis of AMR: plasmids, transposons, integrons. Surveillance and One Health approachNovel antibiotics from extremophiles and uncultured microbes. Phage therapy, antimicrobial peptides (AMPs), quorum sensing inhibitors

Unit III	**Hours: 6** **Extremophiles and Environmental Microbiology** Life in extreme environments: thermophiles, acidophiles, halophiles, psychrophiles. Enzymes from extremophiles and their industrial significance Microbial biogeochemistry and climate change. Microbial fuel cells, bio-electrochemical systems. Microbial remediation of polluted environments (heavy metals, plastics, oil)
Unit IV	**Hours: 6** **Synthetic Biology & Microbial Genomics** Principles of synthetic biology: gene circuits, biosystems design. Genome editing tools: CRISPR-Cas, recombineering. Whole-genome sequencing and annotation. Functional genomics and gene expression analysis. Synthetic microbial consortia for bioengineering
Unit V	**Hours: 6** **Industrial and Translational Microbiology** Microbial production of value-added bioproducts: enzymes, pigments, biopolymers. Bioprocess optimization and scale-up. Microbial biosensors for environmental monitoring. Startups and translational research in microbiology. Ethical, regulatory, and patent considerations in microbial innovation

First year;Semester- II
SEC Paper: 2 Subject Code
Title of the paper:Production of Microgreens and Mushroom Cultivation
Theory (1 Credit)

Subject:	**Production of Microgreens and Mushroom Cultivation**
Unit I	**Hours: 4** **Introduction to Microgreens and Mushrooms** Overview and significance of microgreens and mushrooms. Nutritional and medicinal value. Market potential and scope for entrepreneurship
Unit II	**Hours: 4** **Production of Microgreens** Selection of seeds (wheatgrass, mustard, radish, fenugreek, etc.). Growing media: soil, cocopeat, hydroponics. Light, water, and temperature management. Harvesting, packaging, and shelf-life. Pest and fungal contamination control
Unit III	**Hours: 4** **Basics of Mushroom Biology** Types of edible mushrooms: button, oyster, shiitake, milky. Life cycle and nutritional requirements of mushrooms. Overview of spawn and substrate
Unit IV	**Hours: 4** **Mushroom Cultivation Techniques** Preparation of substrate (wheat straw, paddy straw, etc.)Pasteurization and inoculation. Incubation and fruiting conditions. Harvesting, drying, and

	preservation methods. Common contaminants and their control
Unit V	**Hours: 4** **Post-Harvest and Entrepreneurship** Packaging, storage, and marketing of microgreens and mushrooms. Economics of small-scale production. Value-added products: mushroom pickles, powders. Government schemes and startup opportunities (e.g., Agri-clinics, FPOs)

B.Sc. (Honors) Microbiology

DETAILED SYLLABUS

Semester - III

DEPARTMENT OF BOTANY

KERAL VERMA SUBHARTI COLLEGE OF SCIENCE
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KERAL VERMA SUBHARTI COLLEGE OF SCIENCE

Department of Botany

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
				L	T	P						
THEORY and PRACTICAL SUBJECTS								Attendance (5)	quiz/PPT/Assignment (10)	Mid Sem Test (15)	End Sem Exam (70)	
1	Major 3		Molecular Biology	4	1	0	3	5	10	15	70	100
2	Practical III (Based on Major 3+4)		Molecular Biology Lab	0	0	4	3	5	10	15	70	100
3	Major 4		MICROBIAL PHYSIOLOGY AND METABOLISM	4	1	0	3	5	10	15	70	100
4	Minor 3		A. Bioprocess Engineering B. Gene Therapy C. Drug Designing	3	1	0	3	5	10	15	70	100
5	Multi Disciplinary 3		Pharmaceutical Microbiology	3	1	0	3	5	10	15	70	100
6	Ability Enhancement Course 3 (Disaster Risk Management)		Disaster Risk Management	2	1	0	2	5	10	15	70	100
7	Skill Enhancement Course 3		Domestic Cultivation of Useful Microbes	1	0	3	3	5	10	15	70	100
TOTAL CREDITS / ASSESSMENT							**20**	**35**	**70**	**105**	**490**	**700**

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

Units	**Microbial physiology and Metabolism**
Unit 1	**MicrobialGrowthand EffectofEnvironmentonMicrobialGrowth 12 Hours** Definitionsofgrowth;Batchculture;Continuousculture;Generationtimeand specific growthrate;TemperatureandpHrangesofgrowth;Effectofsoluteandwater activity ongrowth;Effectofoxygenconcentrationongrowth;Nutritionalcategoriesof microorganisms.
Unit 2	**NutrientUptakeandTransportHours: 06** Passive and facilitated diffusion; Primary and secondary active transport; Concept of uniport,symportandantiport; Group translocation;Ironuptake
Unit 3	**Phototropy and Autotropy Hours: 08** Phototrophic metabolism: Introduction, Groupsofphototrophicmicroorganisms, 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,Comparisonofmitochondrialandbacterial ETC, Electron transport phosphorylation, Uncouplers and inhibitors. Fermentation: Alcohol and Lactate fermentation,
Unit 5	**NitrogenMetabolismNo.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:
Title of the paper: Molecular Biology
Theory (4 Credit)

Units	Molecular Biology
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:
Title of the paper: Bioprocess Engineering
Theory (3 Credit)

Subject:	**Bioprocess Engineering**
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 Continuousprocesses. 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:
Title of the paper:Pharmaceutical Microbiology
Theory (3 Credit)

Subject:	**Pharmaceutical Microbiology**
Unit I	**Hours: 6** **Introduction to Pharmaceutical Microbiology** History and scope of pharmaceutical microbiology. Types of microorganisms relevant to pharmaceutical industry. Microbial contamination sources and control in pharmaceutical settings. Good Manufacturing Practices (GMP) and GLP overview.
Unit II	**Hours: 6** **Sterilization and Disinfection** Principles and methods of sterilization:Physical: moist heat, dry heat, filtration, radiationChemical: gases (ethylene oxide), liquids (alcohols, phenols). Validation and quality control of sterilization techniques Sterility testing methods
Unit III	**Hours: 6** **Microbial Contamination and Control in Pharmaceuticals** Microbial contamination in raw materials, manufacturing, and packaging Endotoxins: sources, effects, and testing (LAL test). Preservation of pharmaceutical products: preservatives and their efficacy. Biofilms in pharmaceutical environments and their control
Unit IV	**Hours: 6** **Antibiotics and Antimicrobial Agents** Classification and mechanism of action of antibiotics. Antibiotic susceptibility testing (disk diffusion, MIC, MBC). Resistance mechanisms and control of antibiotic resistance. Microbial production of antibiotics (e.g., penicillin, streptomycin). Synthetic and semi-synthetic antibiotics
Unit V	**Hours: 6** **Pharmaceutical Products and Quality Assurance** Microbial quality of non-sterile pharmaceutical products. Microbiology of parenterals, ophthalmic and topical products. Vaccine production and QC testing (bacterial & viral vaccines). Probiotics and their applications in health Regulatory bodies and guidelines: WHO, FDA, ICH, Pharmacopeias (USP, IP, BP)

First year;Semester- III

SEC Paper: 3 Subject Code
Title of the paper:Domestic Cultivation of Useful Microbes
Theory (1 Credit)

Subject:	**Domestic Cultivation of Useful Microbes**
Unit I	**Hours: 4** **Introduction to Useful Microbes**Concept and scope of domestic microbial use. Categories: probiotics, decomposers, biofertilizers, cleaning microbes Safety and hygiene in home-level microbial handling. Sources of inoculum (commercial, kitchen waste, fermented products)
Unit II	**Hours: 4** **Fermentation and Food Microbes** Preparation of curd, yogurt, fermented rice (kanji), pickles. Cultivation of lactic acid bacteria and yeast at home/ Traditional Indian fermented foods and beverages. Storage and shelf-life of fermented products
Unit III	**Hours: 4** **Probiotic and Health-Promoting Microbes** Overview of probiotics and gut health. DIY probiotic drinks: buttermilk, rice kanji, rejuvelac. Homemade kombucha and kefir (optional advanced topic). Daily use of beneficial microbes for immunity and digestion
Unit IV	**Hours: 4** **Biofertilizers and Composting Microbes** Cultivation of Azotobacter, Rhizobium, PSB in home gardens. Introduction to Trichoderma and its use in disease control. Home composting with decomposer consortia. Bokashi and EM (Effective Microorganisms) techniques
Unit V	**Hours: 4** **Eco-Friendly Domestic Applications** Microbial toilet and drain cleaners (Bacillus-based cleaners). Organic waste digester solutions. Biocleaners and microbial floor wash alternatives. Sustainable packaging of microbial products for household use

B.Sc. (Honors) Microbiology

DETAILED SYLLABUS

Semester - IV

DEPARTMENT OF BOTANY

KERAL VERMA SUBHARTI COLLEGE OF SCIENCE

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KERAL VERMA SUBHARTI COLLEGE OF SCIENCE

Department of Botany

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
				L	T	P						
THEORY and PRACTICAL SUBJECTS								**Attendance (5)**	**quiz/PPT/Assignment (10)**	**Mid Sem Test (15)**	**End Sem Exam (70)**	
1	Major 5		Bioanalytical Techniques	4	1	0	4	5	10	15	70	100
2	Practical IV (Based on Major 5+6+7)		Bioanalytical Techniques Lab	0	0	4	3	5	10	15	70	100
3	Major 6		BACTERIOLOGY-DIVERSITY AND SYSTEMATIC	4	1	0	4	5	10	15	70	100
4	Major 7		Microbiological Techniques	4	1	0	4	5	10	15	70	100
5	Minor 4		Genomics and Proteomics	3	1	0	3	5	10	15	70	100
6	Ability Enhancement Course 3 (Course on NCC/NSS/NGO,s/ Scout Guide / Sports)		Course on NCC/NSS/NGO,s/ Scout Guide / Sports)	2	1	0	2	5	10	15	70	100
TOTAL CREDITS / ASSESSMENT							**20**	**30**	**60**	**90**	**420**	**600**

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

Units	Bioanalytical Techniques
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:
Title of the paper: Bacteriology- diversity and Systematic
Theory (4 Credit)

Units	Bacteriology- diversity and Systematic
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:
Title of the paper: Microbiological techniques
Theory (4 Credit)

Units	Microbiological techniques
Unit 1	**ConceptofSterilizationHours: 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); Maintenanceandpreservation ofpureculture; Cultivationof anaerobicbacteria.
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	**MicroscopyHours: 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:
Title of the paper: Genomics and Proteomics
Theory (3 Credit)

Subject:	Genomics and Proteomics
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

B.Sc. (Honors) Microbiology

DETAILED SYLLABUS

Semester - V

DEPARTMENT OF BOTANY

KERAL VERMA SUBHARTI COLLEGE OF SCIENCE

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KERAL VERMA SUBHARTI COLLEGE OF SCIENCE

Department of Botany

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		MICROBIAL GENETICS	4	1	0	4	5	10	15	70	100	
2	Practical V (Based on Major 8+9)		MICROBIAL GENETICS Lab		0	4	2	5	10	15	70	100	
3	Major 9		MICROBES IN INFECTIOUS DISEASE	4	1	0	4	5	10	15	70	100	
4	Minor 5		Microbial Remediation	3	1	0	3	5	10	15	70	100	
5	Minor 6		A. Microbial Enzyme production and its application B. Microbial remediation C. Plant Microbe Interaction	3	1	0	3	5	10	15	70	100	
6	Internship		Internship	2	1	0	4	5	10	15	70	100	
TOTAL CREDITS / ASSESSMENT							**20**	**30**	**60**	**90**	**420**	**600**	

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

Subject:	**MICROBIAL GENETICS (THEORY)**
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:

Title of the paper: Microbes in Infectious Disease
Theory (4 Credit)

Subject:	**Microbes in Infectious Disease**
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:
Title of the paper: MICROBIAL ENZYME PRODUCTION AND ITS APPLICATION

Theory (3 Credit)

Subject:	**MICROBIAL ENZYME PRODUCTION AND ITS APPLICATION**
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:
Title of the paper: Microbial Remediation
Theory (3 Credit)

Subject:	**Microbial Remediation**
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.

B.Sc. (Honors) Microbiology

DETAILED SYLLABUS

Semester - VI

DEPARTMENT OF BOTANY

KERAL VERMA SUBHARTI COLLEGE OF SCIENCE

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KERAL VERMA SUBHARTI COLLEGE OF SCIENCE

Department of Botany

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		VIROLOGY	4	1	0	4	5	10	15	70	100	
2	Practical VI (Based on Major 10+11+12)		INDUSTRIAL MICROBIOLOGY Lab	0	0	4	2	5	10	15	70	100	
3	Major 11		ENVIRONMEMNTAL MICROBIOLOGY	4	1	0	4	5	10	15	70	100	
4	Major 12		INDUSTRIAL MICROBIOLOGY	4	1	0	4	5	10	15	70	100	
5	Minor 7		A. Stem Cell Biology B. Vaccine Development	3	1	0	3	5	10	15	70	100	
6	Minor 8		A. Stem Cell Biology B.	3	1	0	3	5	10	15	70	100	
TOTAL CREDITS / ASSESSMENT							**20**	**30**	**60**	**90**	**420**	**600**	

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

Subject:	**Virology**
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:
Title of the paper: Environment Microbiology

Theory (4 Credit)

Subject:	**Environment Microbiology**
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:
Title of the paper: Industrial Microbiology
Theory (4 Credit)

Subject:	Industrial Microbiology
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:
Title of the paper: Vaccine Development
Theory (3 Credit)

Subject:	Vaccine Development
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:
Title of the paper:Stem Cell Biology
Theory (3 Credit)

Subject:	**Stem Cell Biology**
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.

B.Sc. (Honors) Microbiology

DETAILED SYLLABUS

Semester - VII

DEPARTMENT OF BOTANY

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KERAL VERMA SUBHARTI COLLEGE OF SCIENCE

Department of Botany

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		Bioethics, Biosafety and IPR	4	1	0	4	5	10	15	70	100	
2	Practical VII (Based on Major (13+14)		MEDICAL MICROBIOLOGY Lab	0	0	4	2	5	10	15	70	100	
3	Major 14		Computational biology and bioinformatics in research	4	1	0	4	5	10	15	70	100	
4	Practical VIII (Based on Major 15)		Computational biology and bioinformatics in research Lab	0	0	4	2	5	10	15	70	100	
5	Major 15		MEDICAL MICROBIOLOGY	4	1	0	4	5	10	15	70	100	
6	Minor 9		Literature review and Scientific writing	3	1	0	4	5	10	15	70	100	
TOTAL CREDITS / ASSESSMENT							**20**	**30**	**60**	**90**	**420**	**600**	

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

Subject:	**BIOETHICS, BIOSAFETY AND IPR**
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.

Thirdyear;Semester-VII
Core Paper: 14 Subject Code:
Title of the paper: Computational Biology and Bioinformatics in research

Theory (4 Credit)

Subject:	**Computational Biology and Bioinformatics in research**
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.

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

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

Subject:	Literature Review and Scientific Writing
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.

B.Sc. (Honors) Microbiology

DETAILED SYLLABUS

Semester - VIII

DEPARTMENT OF BOTANY

KERAL VERMA SUBHARTI COLLEGE OF SCIENCE

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KERAL VERMA SUBHARTI COLLEGE OF SCIENCE

Department of Botany

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		Research Methodology in Microbiology	4	1	0	4	5	10	15	70	100	
2	Minor 10		Thurst Area of Microbiology	3	1	0	4	5	10	15	70	100	
4	Research Project / Dissertation		Research Project / Dissertation	2	1	0	12				300	300	
TOTAL CREDITS / ASSESSMENT							**20**	**60**			**440**	**500**	

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

Subject:	**Research Methodology**
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:
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