DHANALAKSHMI SRINIVASAN

INSTITUTE OF RESEARCH AND TECHNOLOGY

(Deemed to be University under section 3 of UGC Act, 1956.)
PERAMBALUR – 621 212, TAMIL NADU, INDIA.

SCHOOL OF ARTS AND SCIENCE

CURRICULUM AND SYLLABUS

B.Sc., MICROBIOLOGY

REGULATION 2026

PROGRAMME:

Vision:

To emerge as a leading undergraduate hub in microbiological sciences, inspiring passionate young explorers, competent laboratory professionals, and ethical scientists who harness the power of microorganisms to advance human health, environmental balance, and industrial innovation.

Mission:

- To offer inclusive, flexible, and multidisciplinary undergraduate programs in microbiology that integrate fundamental biology, microbial techniques, biochemistry, and allied sciences, equipping graduates with strong technical, analytical, and critical thinking skills for diverse career paths and lifelong learning.
- To promote foundational research and practical inquiry in microbial genetics, immunology, environmental microbiology, and industrial applications, addressing key challenges in healthcare, agriculture, and ecological management.
- To enhance access to quality microbiology education for rural and underprivileged students by integrating modern scientific methods with indigenous knowledge of microbes and traditional practices, fostering skills that create entrepreneurial opportunities and self-reliant careers.
- To cultivate ethical values, social responsibility, and global awareness through hands-on laboratory training, industry exposure, community projects, and experiential learning that connects classroom knowledge with real-world microbiological applications.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO	PROGRAM EDUCATIONAL OBJECTIVES
PEO1	To provide graduates with a strong foundation in core microbiology concepts, laboratory techniques, microbial identification, and basic research methods, preparing them for entry-level roles in healthcare, food industry, research labs, and higher studies.
PEO2	To develop scientific thinking, experimental skills, and problem-solving abilities so that graduates can investigate, analyze, and apply microbiological principles to address issues in health, agriculture, and environment.
PEO3	To foster professional ethics, effective communication, and teamwork that enable graduates to work collaboratively in scientific environments and contribute responsibly to society.
PEO4	To encourage lifelong learning and adaptability, empowering graduates to stay updated with advancements in microbiology and pursue further education, research, or professional growth in the field.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO	PROGRAM SPECIFIC OUTCOMES
PSO1	Graduates will be proficient in performing microbial culture techniques, staining methods, biochemical tests, and basic molecular biology procedures to isolate, identify, and study microorganisms.
PSO2	Graduates will demonstrate competence in laboratory safety practices, data analysis, environmental monitoring, and quality control techniques, enabling them to contribute effectively to healthcare diagnostics, food microbiology, research, and community health initiatives.

PROGRAM OUTCOMES (POs)

PO	PROGRAM OUTCOMES
PO1	**Disciplinary Knowledge** Demonstrate comprehensive knowledge and understanding of the fundamental concepts, theories, principles, and applications in the chosen discipline and allied fields.
PO2	**Critical Thinking and Problem Solving** Identify, analyze, and solve complex academic, professional, and societal problems using logical reasoning, analytical skills, and evidence-based approaches.
PO3	**Research and Inquiry** Apply scientific methods, research techniques, and investigative skills to conduct studies, analyze data, interpret results, and draw meaningful conclusions.
PO4	**Creativity and Innovation** Develop innovative ideas, creative solutions, and entrepreneurial approaches to address contemporary challenges in academic, professional, and social contexts.
PO5	**Digital and Technological Competence** Utilize appropriate digital technologies, software tools, and information resources effectively and ethically for learning, research, communication, and problem-solving.
PO6	**Environment and Sustainability** Understand environmental issues and sustainable development goals and apply this knowledge to promote ecological balance and responsible resource utilization.
PO7	**Ethics and Social Responsibility** Demonstrate ethical values, integrity, inclusiveness, and social responsibility while contributing positively to society and professional environments.
PO8	**Teamwork and Leadership** Work effectively as an individual and as a member or leader of diverse and multidisciplinary teams, demonstrating leadership, collaboration, and interpersonal skills.
PO9	**Communication Skills** Communicate effectively through oral, written, visual, and digital means with diverse audiences in academic, professional, and societal settings.
PO10	**Employability and Entrepreneurship** Develop professional competencies, managerial abilities, and entrepreneurial skills required for employment, higher education, and self-employment opportunities.
PO11	**Lifelong Learning** Recognize the need for continuous learning, adaptability, and self-development to meet evolving personal, professional, and societal demands in a dynamic global environment.

SEMESTER-I

Semester	Part	Course Category	Title of the Course	Course Code	L	T	P	Credits	Marks		
									CAT	ESE	Total
I	I	AEC	Tamil/Hindi/French-I	TA26C01/ HA26C01/ FA26C01	3	0	0	3	40	60	100
	II		English-I	EN26C01	3	0	0	3	40	60	100
	III	Core	Microbiology and Microbial Diversity	UMB26101	4	0	0	4	40	60	100
			Cell Biology	UMB26102	4	0	0	4	40	60	100
			Practical – Microbiology and Cell Biology	UMB26103	0	0	4	2	40	60	100
		MDC	Multidisciplinary Course - 1		2	1	0	3	40	60	100
	IV	VAC	Human Values	VAC26001	2	0	0	2	40	60	100
								21			**700**

SEMESTER-II

Semester	Part	Course Category	Title of the Course	Course Code	L	T	P	Credits	Marks		
									CAT	ESE	Total
II	I	AEC	Tamil/Hindi/French-II	TA26C02/ HA26C02/ FA26C02	3	0	0	3	40	60	100
	II		English-II	EN26C02	3	0	0	3	40	60	100
	III	Core	Microbial Physiology	UMB26104	4	0	0	4	40	60	100
			Molecular Biology	UMB26105	4	0	0	4	40	60	100
			Practical - Microbial Physiology and Molecular Biology	UMB26106	0	0	4	2	40	60	100
		MDC	Multidisciplinary Course - 2		2	0	2	3	40	60	100
	IV	VAC	Environmental Studies	VAC26002	2	0	0	2	40	60	100
								21			**700**

SEMESTER-III

Semester	Part	Course Category	Title of the Course	Course Code	L	T	P	Credits	Marks		
									CAT	ESE	Total
III	I	AEC	Tamil/Hindi/French-III	TA26C03/ HA26C03/ FA26C03	3	0	0	3	40	60	100
	II		English-II	EN26C03	3	0	0	3	40	60	100
	III	Core	Immunology	UMB26107	3	0	0	3	40	60	100
			Practical - Immunology	UMB26108	0	0	4	2	40	60	100
		MDC	Multidisciplinary Course - 1		2	0	2	3	40	60	100
		DEC	AI in Microbiology	UMB26001	3	1	0	4	40	60	100
			Epidemiology	UMB26002							
			Vaccinology	UMB26003							
	IV	VAC	IKS	VAC26003	3	0	0	3	40	60	100
								21			**700**

SEMESTER-IV

Semester	Part	Course Category	Title of the Course	Course Code	L	T	P	Credits	Marks		
									CAT	ESE	Total
IV	I	AEC	Tamil/Hindi/French-IV	TA26C04/ HA26C04/ FA26C04	3	0	0	3	40	60	100
	II		English-II	EN26C04	3	0	0	3	40	60	100
	III	Core	Bacteriology and Mycology	UMB26109	3	0	0	3	40	60	100
			Practical - Bacteriology and Mycology	UMB26110	0	0	4	2	40	60	100
		MDC	Multidisciplinary Course - 4		2	0	2	3	40	60	100
		DEC	Virology and Parasitology	UMB26004	3	1	0	4	40	60	100
			Microalgal Technology	UMB26005							
			Bio-safety and Bio-ethics	UMB26006							
	IV	VAC	Ethics in AI	VAC26004	3	0	0	3	40	60	100
	V	EAA	Extra Academic Activity **(NSS, NCC, YRC, etc.,)**	-	-	-	-	1*			
								21			**700**

SEMESTER-V

Semester	Part	Course Category	Title of the Course	Course Code	L	T	P	Credits	Marks		
									CAT	ESE	Total
V	III	Core	Soil, Agricultural and Environmental Microbiology	UMB26111	3	1	0	4	40	60	100
			Food Microbiology	UMB26112	3	1	0	4	40	60	100
			Practical - Agricultural and Environmental, Food Microbiology	UMB26113	0	0	4	2	40	60	100
		Core	Pharmaceutical Microbiology	UMB26114	3	0	0	3	40	60	100
		DEC	Aquatic Microbiology	UMB26007	3	1	0	4	40	60	100
			Microbial Innoculants	UMB26008							
			Bioremediation	UMB26009							
		SEC	Drug Design and Discovery	UMB26S01	3	0	0	3	40	60	100
			Nanotechnology Applications in Microbiology	UMB26S02	3	0	0	3	40	60	100
		EE	Experiential Elective	UMBEE01	*	*	*	2	*	*	100
								25			**800**

SEMESTER-VI

Semester	Part	Course Category	Title of the Course	Course Code	L	T	P	Credits	Marks		
									CAT	ESE	Total
VI	III	Core	Microbial Genetics	UMB26115	3	1	0	4	40	60	100
			Industrial Microbiology	UMB26116	3	1	0	4	40	60	100
			Practical - Microbial Genetics and Industrial Microbiology	UMB26117	0	0	4	2	40	60	100
		Core	Project	UMB26118	0	0	12	6	40	60	100
		DEC	Microbial Biotechnology	UMB26010	3	1	0	4	40	60	100
			Microbial Genomics and Proteomics	UMB26011							
			Next Generation Sequencing Techniques	UMB26012							
		SEC	Recombinant DNA Technology	UMB26S03	3	0	0	3	40	60	100
			Entrepreneurship in Microbiology	UMB26S04	3	0	0	3	40	60	100
	V	VAC	Gender Studies	VAC26005	2	0	0	2	40	60	100
								28			**800**

Multidisciplinary Course (MDC) Offered to Other Department:

Course Code	Title of the Course
UMB26901	Host Microbe Biology
UMB26902	General Microbiology
UMB26903	Microbiological Techniques
UMB26904	Commercial Microbiology

Disciplinary Elective Course (DEC) Offered by the Department:

Course Code	Title of the Course
UMB26001	AI in Microbiology
UMB26002	Epidemiology
UMB26003	Vaccinology
UMB26004	Virology and Parasitology
UMB26005	Microalgal Technology
UMB26006	Bio-safety and Bio-ethics
UMB26007	Aquatic Microbiology
UMB26008	Microbial Innoculants
UMB26009	Bioremediation
UMB26010	Microbial Biotechnology
UMB26011	Microbial Genomics and Proteomics
UMB26012	Next Generation Sequencing Techniques

Semester-wise Categorization of Courses

COURSE CATEGORY	Semester						No of Courses	Total Credits
	I	II	III	IV	V	VI		
AEC–Ability Enhancement Courses	2	2	2	2	-	-	8	24
MSC–Core Courses (Theory & Practicals)	3	3	2	2	4	4	18	59
MDC–Multi Disciplinary Course	1	1	1	1	-	-	4	12
DEC–Disciplinary Elective Course	-	-	1	1	1	1	4	16
SEC–Skill Enhancement Course	-	-	-	-	2	2	4	12
VAC – Value Added Courses	1	1	1	1	-	1	5	12
EE–Experiential Elective	-	-	-	-	1	-	1	2
EAA–Extra Academic Activity	-	-	-	1	-	-	1	
Total Courses Per Semester	7	7	7	8	7	7	**45(Courses)**	
Total Credits	21	21	21	21	25	28	**137(Credits)**	

Sem	Course Code	Title of the Course	Course Category	L	T	P	Credits
I	UMB26101	MICROBIOLOGY AND MICROBIAL DIVERSITY	Core	4	0	0	4

Pre-Requisite: Students should have basic knowledge of Biology in 12th Standard

Co- Requisite: Practical – Microbiology and Cell Biology

Progressive Course: Semester II – Microbial Physiology, Molecular Biology

Course Objectives:

1. To understand the basic concepts, history, and classification of microorganisms.
2. To learn the principles of microscopy, staining, sterilization, and laboratory safety.
3. To study the structure and diversity of prokaryotic microorganisms.
4. To understand the structure, diversity, and importance of eukaryotic microorganisms.
5. To learn microbial growth, culture methods, and preservation techniques.

Course Outcomes:

CO1: Recall the basic concepts, history, classification, and taxonomy of microorganisms. **(K1)**

CO2: Explain the principles of microscopy, staining, sterilization, and laboratory safety practices. **(K2)**

CO3: Describe the structure and diversity of prokaryotic and eukaryotic microorganisms. **(K2)**

CO4: Apply appropriate culture media, staining, and aseptic techniques for microbial cultivation and identification. **(K3)**

CO5: Demonstrate microbial culture, isolation, and preservation techniques in laboratory practices. **(K3)**

K1 – Remember	*K2 – Understand*	*K3 – Apply*

Unit-I	Basic concepts in Microbiology	12 Hrs.

History, scope and concepts of microbiology. Major contributions of microbiologists. Classification and taxonomy of microorganisms. Taxonomic hierarchy and taxonomic ranks. Three-kingdom, five-kingdom and three-domain systems of classification. Differences between prokaryotic and eukaryotic cells.

Unit-II	Microscopy, Sterilization and Laboratory Techniques	12 Hrs.

Principles and applications of microscopy. Types of microscopes: simple, compound, phase-contrast, fluorescence and electron microscopes. Staining techniques: simple, differential and special staining methods. Sterilization and disinfection: physical and chemical methods, aseptic techniques and laboratory safety practices.

Unit-III	Prokaryotic Microbial diversity and Conservation	12 Hrs.

Introduction to prokaryotic biodiversity. General characteristics, classification and diversity of prokaryotes: archaebacteria, eubacteria, cyanobacteria, and actinobacteria. Structure, size, shape and arrangement of prokaryotic cells. Cell organization: plasma membrane, cytoplasmic matrix, ribosomes, inclusion bodies and nucleoid. Gram-positive and Gram-negative cell walls, capsules, slime layers, pili, fimbriae, flagella and bacterial motility.

Unit-IV	Eukaryotic Microbial diversity and Conservation	12 Hrs.

Introduction to eukaryotic biodiversity. General characteristics, classification and diversity of eukaryotic microorganisms – algae, fungi and protozoa – structure and organization. Nutrition, metabolism, sexual and asexual reproduction, ecological significance and commercially important products.

Unit-V	Microbial Growth and Culture Techniques	12 Hrs.

Culture media: types and classification of media – simple, enriched, enrichment, selective, differential and transport media. Pure culture techniques: serial dilution, pour plate, spread plate and streak plate methods. Aerobic and anaerobic culture techniques. Preservation of microorganisms.

Text Book(s):

1. Pelczar.M. J., Chan E.C.S. and Noel. R.K. (2007). Microbiology. 7th Edition, McGraw –Hill, New York.
2. Willey J., Sherwood L., and Woolverton C. J., (2017). Prescott's Microbiology. 10th Edition, McGraw-Hill International edition.
3. Tortora, G.J., Funke, B.R., Case, C.L. (2013). Microbiology. An Introduction 11thEdition., A La Carte Pearson
4. Jeffrey C. Pommerville., Alcamo's Fundamentals of Microbiology (9thEdition). Jones & Bartlett learning 2010.
5. Stanier R.Y, Ingraham J. L., Wheelis M. L., and Painter R. R. (2010). General Microbiology, 5thEdition., MacMillan Press Ltd.

Reference Book(s):

1. Tortora, G.J., Funke, B.R. and, Case, C.L (2013). Microbiology-An Introduction, 11th Edition, Benjamin Cummings.
2. Nester E., Anderson D., Roberts C. E., and Nester M. (2006). Microbiology-A Human Perspective, 5th Edition, McGraw Hill Publications.
3. Black, J. G. (2018). *Microbiology: Principles and Explorations* (10th Ed.). Wiley, Hoboken, New Jersey. ISBN: 978-1119392897.
4. Talaro, K. P., & Chess, B. (2017) *F*
5. Singleton, P. (2012). *Bacteria in Biology, Biotechnology and Medicine* (7th Ed.). Wiley-Blackwell.

e Resources:

1. https://www.cliffsnotes.com/study-guides/biology/microbiology/introductiontomicrobiology/a-brief-history-of-microbiology
2. https://www.keyence.com/ss/products/microscope/bz-x/study/principle/structure.jsp
3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6604941/#
4. https://bio.libretexts.org/@go/page/9188
5. https://courses.lumenlearning.com/boundless-microbiology/chapter/microbial- nutrition/

Relationship Matrix for COs, POs and PSOs

Semester	Course code	Title of the course	Hours	Credits
I	UMB26101	Microbiology and Microbial Diversity	4	4

Course Outcomes (COs)	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)		Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	
CO1	3	1	-	-	-	-	-	-	-	-	2	3	-	**1.5**
CO2	3	2	-	-	2	-	2	-	-	-	2	3	2	**1.75**
CO3	3	2	1	-	-	2	-	-	-	-	2	3	3	**1.75**
CO4	3	3	3	-	2		2	-	-	2	2	3	3	**2.15**
CO5	3	3	3	-	2	2	2	-	-	3	2	3	3	**2.3**
Mean Overall Score	**3**	**2.2**	**1.4**	**-**	**1.2**	**1.2**	**1.2**	**-**	**-**	**1**	**2**	**3**	**2.2**	

Sem	Course Code	Title of the Course	Course Category	L	T	P	Credits
I	UMB26102	CELL BIOLOGY	Core	4	0	0	4

Pre-Requisite: Students should have basic knowledge of Biology in 12th Standard

Co- Requisite: Practical – Microbiology and Cell Biology

Progressive Course: Semester II – Microbial Physiology, Molecular Biology

Course Objectives:

1. To understand the fundamental concepts of cell biology, cell cycle, and cytoskeleton.
2. To explain the structure and functions of cell membranes, cell walls, and membrane transport mechanisms.
3. To acquire knowledge of cellular organelles and intracellular transport processes.
4. To understand cellular energy metabolism and the mechanisms of photosynthesis.
5. To develop an understanding of cell signaling, communication, and programmed cell death.

Course Outcomes:

CO1: Identify the structure and functions of cells, cytoskeleton, and stages of the cell cycle. **(K1)**

CO2: Explain the structure and transport mechanisms of cell membranes and the functions of major cellular organelles. **(K2)**

CO3: Describe the pathways of intracellular transport, endocytosis, and membrane trafficking. **(K2)**

CO4: Illustrate the processes of cellular respiration and photosynthesis in energy production. **(K3)**

CO5: Interpret the mechanisms of cell signaling, cell communication, and programmed cell death in maintaining cellular homeostasis. **(K3)**

K1 – Remember	*K2 – Understand*	*K3 – Apply*

Unit-I	Fundamentals of Cell Biology and Cytoskeleton	12 Hrs.

Cell theory and protoplasm theory. Diversity of cell size and shape. Basic properties of cells. Isolation and growth of cells. Cell division and cell cycle: mitosis and meiosis, stages, regulation and control of the cell cycle. Cytoskeleton: structure and functions.

Unit-II	Cell Wall and Cellular Membranes	12 Hrs.

Structure, chemical composition and biological function of cell wall and cell membranes. Lipid bilayer and membrane proteins. Dynamic nature of membranes and membrane potential. Transport across the cell membrane: diffusion, osmosis, ion channels, active-transport and membrane pumps. Mechanisms of intracellular transport and sorting.

Unit-III	Cellular Organelles and Intracellular Transport	12 Hrs.

Structure and functions of endoplasmic reticulum (smooth and rough ER), Golgi complex and ribosomes. Morphology and functions of peroxisomes, glyoxysomes and plant cell vacuoles. Endocytic pathways: endocytosis and phagocytosis. Membrane trafficking and intracellular transport.

Unit-IV	Energy Metabolism and Photosynthesis	12 Hrs.

Mitochondria: morphology, structural variations, chemical composition and functions. Enzyme systems of mitochondria. Energy production: glycolysis, oxidative decarboxylation, Krebs cycle, respiratory chain and oxidative phosphorylation. Chloroplast: structure, function and protein import. Photosynthesis: photosystems I and II, cyclic electron flow and ATP synthesis.

Unit-V	**Cell Signaling, Cell Communication and Cell Death**	**12 Hrs.**

Principles of cell signaling and cell communication. Types of signaling: autocrine, paracrine, endocrine and juxtacrine signaling. Signal transduction pathways and receptors. Cell junctions: tight junctions, gap junctions and desmosomes. Programmed cell death (apoptosis) and necrosis. Role of cell signaling in growth, differentiation and maintenance of cellular homeostasis.

Text Book(s):

1. Cooper, G.M. and Hausman, RE. 2009. The Cell. A Molecular Approach. (5th ed) Sunderland.
2. Krebs.JE, Kilpatrick.S.T and Goldstein. E.S, 2013, Lewin GENES XI, JONES & Bartlett Learning, Burlington, Massachusetts.
3. Lodish.H,.A , Berk.C.A, Kaiser.M, Krieger.MP, Scott.A Bretscher.H, Ploegh and p. Matsudaira, 2007, Molecular Cell Biology, 6th Edition, WH. Freeman Publishers, New York, USA.
4. PS Verma and VK Agarwal 2004 Cell Biology, Genetics, Molecular Biology Evolution and Ecology (14" ed), S.Chand and Company Ltd.
5. Watson. JD, TA.Basker and Sp.Bell, 2008, Molecular Biology of the Gene, 5th Edition. Dorling Kindersley Pvt., Ltd., New Delhi.

Reference Book(s):

1. Bruce Alberts and Dennis Bray 2013, Essential Cell Biology. (4th ed). Gar land Science, New York.
2. De Robertis, EDP, and De Robertis, EM.F. 2010, Cell and Molecular Biology (8thed). Lippincott Williams and Wilkins, Philadelphia.
3. Geoffrey M. Cooper and Robert. E. Hausman, 2009. The Cell: A Molecular Approach, Sinauer Associates, 5th Ed, USA.
4. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiment (6th ed) John Wiley & Sons, Inc, United Kingdom.
5. Wayne M. Baker, 2008. The World of the Cell. (7th ed). Pearson Benjamin Cummings Publishing, San Francisco.

e Resources:

1. https://www.pdfdrive.com/biochemistry-books.html
2. https://drive.google.com/file/d/1tghNWPyuqPiqKlrlllZzUrFwcoMiuoMa/
3. https://www.freebookcentre.net/biology-books-download/BASIS-ON MOLECULAR-BIOLOGY-(PDF-52P).html

4. https://www.freebookcentre.net/biology-books-download/Basis ofmolecular-cell-biology-(PDF-36P).html
5. https://agrilif.org/gold/files/2012/09/Lecture-26.pdf

Relationship Matrix for COs, POs and PSOs

Semester	Course code			Title of the course							Hours		Credits
I	UMB26102			Cell Biology							4		4
Course Outcomes (COs)	Programme Outcomes (POs)										Programme Specific Outcomes (PSOs)		Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	
CO1	3	1	-	-	-	-	-	-	-	-	2	3	2	1.75
CO2	3	2	1	-	-	1	-	-	-	-	2	3	3	1.88
CO3	3	2	2	-	-	-	-	-	-	-	2	3	3	1.88
CO4	3	3	2	1	2	2	-	-	-	1	2	3	3	2
CO5	3	3	2	1	-	2	2	-	1	1	2	3	3	2
Mean Overall Score	3	2.2	1.4	0.4	0.4	1	0.4	-	0.2	0.4	2	3	2.8	

Sem	Course Code	Title of the Course	Course Category	L	T	P	Credits
I	UMB26103	PRACTICAL – MICROBIOLOGY AND CELL BIOLOGY	Core	0	0	4	2

Pre-Requisite: Students should have basic knowledge of Biology in 12th Standard

Co- Requisite: Microbiology, Cell Biology

Progressive Course: Semester II – Microbial Physiology, Molecular Biology

Course Objectives:

1. To familiarize students with microbiology laboratory instruments and safety practices.
2. To develop skills in sterilization, culture media preparation, and microbial cultivation techniques.
3. To perform basic staining methods and observe microbial morphology using a microscope.
4. To understand fundamental cell biology experiments and cellular processes.
5. To apply basic laboratory techniques such as chromatography and cell counting for biological analysis.

Course Outcomes:

CO1: Identify microbiology laboratory instruments, safety practices, and sterilization methods. **(K1)**

CO2: Explain the principles of culture media preparation, microbial cultivation, and preservation techniques. **(K1)**

CO3: Perform serial dilution, plating methods, and staining techniques for microbial analysis. **(K3)**

CO4: Demonstrate the use of a compound microscope and carry out basic cell biology experiments. **(K3)**

CO5: Apply chromatography and haemocytometer techniques for pigment separation and cell counting. **(K3)**

K1 – Remember	*K2 – Understand*	*K3 – Apply*

Unit-I	Introduction to Microbiology Laboratory	12 Hrs.

1. Familiarization with microbiology laboratory instruments and safety practices.
2. Demonstration of physical and chemical methods of sterilization.
3. Handling and operation of compound microscope.

Unit-II	Media Preparation and Microbial Cultivation	16 Hrs.

4. Preparation and sterilization of glassware and culture media.
5. Serial dilution technique, pour plate, spread plate and streak plate methods.
6. Aerobic and anaerobic culture techniques.
7. Preservation of microbial cultures.

Unit-III	Staining Techniques	12 Hrs.

8. Observation of microbial morphology using prepared slides.
9. Staining: Simple staining of bacteria, Gram staining, Spore, Negative staining techniques.
10. Demonstration of bacterial motility.

Unit-IV	Cell Biology	12 Hrs.

11. Examination of mitosis in onion root tip.
12. Examination of plasmolysis and deplasmolysis.
13. Observation of endocytosis (demonstration).

Unit-V	Chromatography and Cell Counting	08 Hrs.

14. Separation of photosynthetic pigments by paper chromatography.
15. Cell counting using a haemocytometer.

Text Book(s):

1. Bruce Alberts and Dennis Bray. 2013, Essential Cell Biology. (4th ed). Garland Science.
2. Cooper, G.M. and Hausman, R.E. 2009. The Cell. A Molecular Approach. (5" ed) Sunderland.
3. Ganesh M.K. and Shivashankara A.R. 2012. Laboratory Manual for Practical Biochemistry Jaypee publications, 2ndEdn.
4. Atlas.R (1997). Principles of Microbiology, 2nd Edition, Wm.C.Brown publishers.
5. Amita J, Jyotsna A and Vimala V (2018). Microbiology Practical Manual. (1st Edition). Elsevier India

Reference Book(s):

1. Lodish.H,.A , Berk.C.A, Kaiser.M, Krieger.MP, Scott.Abretscher.H, Ploegh and p. Matsudaira, 2007. Molecular Cell Biology, 6th Edition, WH. Freeman Publishers, New York, USA.
2. Watson. JD, TA.Basker and Sp.Bell, 2008, Molecular Biology of the Gene, 5th Edition. Dorling Kindersley Pvt., Ltd., New Delhi.
3. Kannan. N (1996). Laboratory manual in General Microbiology. Palani Publications.
4. R C Dubey and D K Maheswari (2002). Practical Microbiology. S. Chand Publishing.
5. Gunasekaran, P. (1996). Laboratory manual in Microbiology. New Age International Ld., Publishers, New Delhi

e Resources:

1. http://amrita.olabs.edu.in/?sub=79&brch=18&sim=237&cnt=1
2. https://www.microscopemaster.com/organelles.html
3. https://www.pdfdrive.com/biochemistry-books.html

Relationship Matrix for COs, POs and PSOs

Semester	Course code			Title of the course								Hours	Credits
I	UMB26103			Practical – Microbiology and Cell biology								4	2
Course Outcomes (COs)	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)	Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	
CO1	3	1	-	-	2	-	3	-	-	-	2	3	2	1.75
CO2	3	2	1	-	2	1	2	-	-	1	2	3	3	2.00
CO3	3	3	3	1	2	-	2	-	-	2	2	3	3	2.25
CO4	3	2	2	1	2	1	1	-	-	1	2	3	3	1.92
CO5	3	3	3	2	3	1	-	-	-	2	2	3	3	2.25
Mean Overall Score	3	2.2	1.8	0.8	2.2	0.6	1.6	-	-	1.2	2	3	2.8	

Sem	Course Code	Title of the Course	Course Category	L	T	P	Credits
II	**UMB26104**	**MICROBIAL PHYSIOLOGY**	**Core**	**4**	**0**	**0**	**4**

Pre-Requisite: Students should have basic knowledge of Biology in 12th Standard

Co- Requisite: Practical – Microbial Physiology and Molecular Biology

Progressive Course: Semester III – Immunology

Course Objectives:

1. To understand the nutritional requirements and growth patterns of microorganisms.
2. To explain microbial growth, differentiation, and endospore formation.
3. To describe the major metabolic pathways involved in energy production and nutrient utilization.
4. To illustrate the biosynthetic pathways for fatty acids, nucleotides, amino acids, and the bacterial cell wall.
5. To compare different microbial energy-generating processes, including respiration, photosynthesis, methanogenesis, and fermentation.

Course Outcomes:

CO1: Recall the nutritional requirements, transport mechanisms, and growth characteristics of microorganisms. **(K1)**

CO2: Explain the process of microbial growth, differentiation, sporulation, and endospore germination. **(K2)**

CO3: Describe the major metabolic pathways involved in carbohydrate and lipid metabolism in microorganisms. **(K2)**

CO4: Illustrate the biosynthetic pathways of fatty acids, nucleotides, amino acids, and the bacterial cell wall. **(K2)**

CO5: Compare the different microbial energy-generating processes, including photosynthesis, respiration, methanogenesis, and fermentation. **(K3)**

K1 – Remember	*K2 – Understand*	*K3 – Apply*

Unit-I	**Microbial Nutrition and Growth**	**12 Hrs.**

Nutritional requirements of microorganisms: macronutrients, micronutrients and growth factors. Transport of nutrients across the membrane: diffusion, active and passive transport, and group translocation. Microbial growth curve and growth determination methods. Batch, continuous and synchronous cultures.

Unit-II	**Microbial Growth and Differentiation**	**12 Hrs.**

Morphogenesis and development of dormant and resting structures. Sporulation in *Bacillus*. Endospore formation: stages, germination and regulation.

Unit-III	**Microbial Metabolism**	**12 Hrs.**

Carbohydrate metabolism: Embden–Meyerhof pathway, Hexose Monophosphate (HMP) pathway and Tricarboxylic Acid (TCA) cycle. Aerobic respiration, substrate-level phosphorylation and oxidative phosphorylation. Lipid catabolism and β-oxidation.

Unit-IV	**Biosynthetic Pathways**	**12 Hrs.**

Synthesis of fatty acids. Biosynthesis of nucleotides: purines and pyrimidines. Biosynthesis of amino acids: glutamate family. Biosynthesis of the bacterial cell wall.

Unit-V	**Microbial Energy Metabolism**	**12 Hrs.**

Photosynthesis: oxygenic and anoxygenic photosynthesis and the Calvin–Benson cycle. Methanogenesis pathways. Anaerobic respiration using sulfur compounds, nitrate and carbon dioxide as electron acceptors. Fermentation: alcoholic, propionic, lactic, mixed-acid and solvent-producing fermentations.

Text Book(s):

1. Schlegal, H.G. (1993). General Microbiology., 7th Edition.
2. Rajapandian K. (2010). Microbial Physiology, Chennai: PBS Book Enterprises India.
3. MeenaKumari. S. Microbial Physiology, Chennai 1st Edition MJP Publishers 2006.
4. Dubey R.C. and Maheswari, S. (2003). A textbook of Microbiology, New Delhi: S. Chand & Co.
5. Robert K. Poole (2004). Advances in Microbial Physiology, Elsevier Academic Press, New York, Volume 49.

Reference Book(s):

1. Kim B.H., Gadd G.M. (2008). Bacterial Physiology and Metabolism. Cambridge University Press, Cambridge.
2. Moat, A.G and J.W Foaster (1995). Microbial Physiology, 3rd edition. Wiley – LISS, Wiley & Sons. Inc. Publications.
3. Bhan Shrivastava. (2011). Microbial Physiology and Metabolism: Study of Microbial Physiology and Metabolism. Lambert academic Publication.

e Resources:

1. https://sites.google.com/site/microbial physiologyoddsem/teaching-contents
2. https://courses.lumenlearning.com/boundless-microbiology/chapter/microbial-Nutrition
3. https://onlinecourses.swayam2.ac.in/cec20_bt14/preview
4. http://web.iitd.ac.in/~amittal/2007_Addy_Enzymes_Chapter.pdf
5. https://www..frontiersin.org.microbial-physiology-and-metabolism

Relationship Matrix for COs, POs and PSOs

Semester	Course code			Title of the course							Hours		Credits
II	UMB26104			Microbial Physiology							4		4
Course Outcomes (COs)	Programme Outcomes (POs)										Programme Specific Outcomes (PSOs)		Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	
CO1	3	1	-	-	-	-	-	-	-	-	2	3	2	1.75
CO2	3	2	1	-	-	1	-	-	-	-	2	3	3	1.88
CO3	3	2	2	-	-	1	-	-	-	-	2	3	3	1.92
CO4	3	2	2	1	-	-	-	-	-	1	2	3	3	1.75
CO5	3	3	3	1	2	2	-	-	-	2	2	3	3	2.42
Mean Overall Score	3	2	1.6	0.4	0.4	0.8	-	-	-	0.6	2	3	2.8	

Sem	Course Code	Title of the Course	Course Category	L	T	P	Credits
II	**UMB26105**	**MOLECULAR BIOLOGY**	**Core**	**4**	**0**	**0**	**4**

Pre-Requisite: Students should have basic knowledge of Biology in 12th Standard

Co- Requisite: Practical – Microbial Physiology and Molecular Biology

Progressive Course: Semester III – Immunology

Course Objectives:

1. To understand the organization of chromosomes and the mechanisms of DNA replication in prokaryotes and eukaryotes.
2. To learn the causes of DNA damage and the various DNA repair and recombination mechanisms.
3. To understand the processes of transcription, RNA processing, and protein synthesis.
4. To gain knowledge of the genetic code, translation, and post-translational modifications.
5. To understand the mechanisms of regulation of gene expression in prokaryotic and eukaryotic cells.

Course Outcomes:

CO1: Recall the organization of prokaryotic and eukaryotic chromosomes and the mechanisms of DNA replication. **(K1)**

CO2: Explain the causes of DNA damage and the mechanisms of DNA repair and homologous recombination. **(K2)**

CO3: Describe the processes of transcription, RNA processing, and translation in prokaryotic and eukaryotic cells. **(K2)**

CO4: Illustrate the properties of the genetic code and the mechanisms involved in protein synthesis and post-translational modifications. **(K2)**

CO5: Compare the mechanisms of gene regulation in prokaryotes and eukaryotes, including operon models and epigenetic regulation. **(K3)**

K1 – Remember	*K2 – Understand*	*K3 – Apply*

Unit I	**Chromosomal Organization and DNA Replication**	**12 Hrs.**

Chromosome Organization: Structure and characteristics of bacterial and eukaryotic chromosome, packaging of DNA molecule into chromosomes. Replication of DNA in prokaryotes and eukaryotes: Modes of DNA replication, Bi-directional and unidirectional replication, DNA polymerases; The replication complex: pre-primming proteins, primosome, replisome; Rolling circle replication.

Unit-II	**DNA damage, Repair and Homologous Recombination**	**12 Hrs.**

DNA damage and repair, causes and types of DNA damage, mechanism of DNA repair: base excision repair, nucleotide excision repair, mismatch repair, recombinational repair, nonhomologous end joining. Homologous recombination models and mechanisms.

Unit-III	**Transcription and RNA processing**	**12 Hrs.**

Transcription in prokaryotes: Prokaryotic RNA polymerase, role of sigma factor, promoter, initiation, elongation and termination of RNA chains. Transcription in eukaryotes: Eukaryotic RNA polymerases, transcription factors, promoters, enhancers, mechanism of transcription initiation, elongation; pre mRNA processing: 5’ cap formation,

3’ polyadenylation, Splicing, Editing.		
Unit-IV	**Genetic code and regulation of gene expression**	**12 Hrs.**
Genetic code and its role in protein synthesis - properties of the universal genetic code - wobble hypothesis - variations in the mitochondrial genetic code; process of translation in both prokaryotes and eukaryotes - ribosome structure and assembly, charging of tRNA by aminoacyl-tRNA synthetases, and the mechanisms of initiation, elongation, and termination of polypeptide synthesis. A brief overview of post-translational modifications.		
Unit-V	**Regulation of Gene Expression**	**12 Hrs.**
Regulation of gene expression in prokaryotic and eukaryotic cells; operon concept as the fundamental mechanism of gene regulation in prokaryotes - both inducible and repressible systems through the *lac* and *trp* operons; positive and negative regulation, attenuation, and feedback regulation. An overview of gene regulation in eukaryotes - chromatin remodeling, DNA methylation, histone modification, and transcriptional regulation.		

Text Book(s):

1. David Frifelder Molecular Biology, Narosa publishing house, New Delhi. 2nd edition. 2008.
2. George M Malacinski. Freifelder’s Essentials of Molecular Biology. 4th edition. Narosa Publishing House. 2008.
3. Stanly R Maloy, John E Cronan Jr. and David Freifelder, Microbial Genetics, 2nd edition, Narosa publishing house, New Delhi. 2006.
4. Larry Synder and Wendy Champness. Molecular Genetics of Bacteria, 2nd edition, American Society for Microbiology, Washington. 2003.
5. De Robertis EDP and De Robertis EMF. Cell and Molecular Biology, 8th edition. Lippincott Williams and Wilkins, Philadelphia. 2006.
6. Karp G. Cell and Molecular Biology: Concepts and Experiments, 6th edition, John Wiley and Sons. Inc. 2010.

Reference Book(s):

1. Sambaurthy AVSS. Molecular biology. Narosa publishing house, New Delhi.2 008.
2. Channarayappa A. Cell Biology, Universities Press, (India) Pvt. Ltd, Hyderabad, India. 2010.
3. Channarayappa A. Molecular Biology, Universities Press, (India) Pvt. Ltd, Hyderabad, India. 2010.
4. Watson JD, Tania AB, Stephen PB, Alexander G, Michael L, Richard L (2017) Molecular Biology of the Gene. 7th Edition. Pearson Education.
5. Wilson K, Walker J (2010) Principles and Techniques of Biochemistry and Molecular Biology. Cambridge University Press, Cambridge.

e Resources:

1. https://www.ncbi.nlm.nih.gov/
2. https://pubmed.ncbi.nlm.nih.gov/
3. https://www.ncbi.nlm.nih.gov/books/
4. https://dnalc.cshl.edu/
5. https://nptel.ac.in/

Relationship Matrix for COs, POs and PSOs

Semester	Course code			Title of the course							Hours		Credits
II	UMB26105			Molecular Biology							4		4
Course Outcomes (COs)	Programme Outcomes (POs)										Programme Specific Outcomes (PSOs)		Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	
CO1	3	1	-	-	-	-	-	-	-	-	2	3	2	1.75
CO2	3	2	2	-	-	-	-	-	-	-	2	3	3	2.14
CO3	3	2	2	1	-	-	-	-	-	-	2	3	3	2.00
CO4	3	2	2	1	-	-	-	-	-	1	2	3	3	1.92
CO5	3	3	3	2	1	1	-	-	-	2	2	3	3	2.38
Mean Overall Score	3	2	1.8	0.8	0.2	0.2	-	-	-	0.6	2	3	2.8	

Sem	Course Code	Title of the Course	Course Category	L	T	P	Credits
II	UMB26106	PRACTICAL - MICROBIAL PHYSIOLOGY AND MOLECULAR BIOLOGY	Core	-	-	4	2

Pre-Requisite: Students should have basic knowledge of Biology in 12th Standard

Co- Requisite: Microbial Physiology, Molecular Biology

Progressive Course: Semester III – Immunology

Course Objectives:

1. To understand the principles and techniques involved in studying bacterial growth and environmental factors affecting growth.
2. To develop skills in microbial identification through biochemical tests and observation of microbial characteristics.
3. To learn methods for studying bacterial spores, spore formation, germination, and isolation of spore-forming bacteria.
4. To gain practical knowledge of bacterial DNA isolation, quantification, and molecular analysis techniques.
5. To understand and demonstrate basic molecular biology techniques such as transformation, agarose gel electrophoresis, and restriction digestion.

Course Outcomes:

CO1: Describe bacterial growth patterns, growth kinetics, and the effects of environmental factors on microbial growth. **(K1)**

CO2: Explain microbial metabolic activities and biochemical methods used for identification of bacteria. **(K2)**

CO3: Apply techniques for staining, observation, and isolation of spore-forming bacteria. **(K3)**

CO4: Explain the principles and methods of bacterial DNA isolation, plasmid extraction, and DNA quantification. **(K2)**

CO5: Apply molecular biology techniques such as bacterial transformation, agarose gel electrophoresis, and restriction digestion for DNA analysis. **(K3)**

K1 – Remember	*K2 – Understand*	*K3 – Apply*

Unit I	**Bacterial Growth Studies**	**12 Hrs.**

1. Determination of bacterial growth curve by turbidometric method.
2. Estimation of generation time and growth rate of bacteria.
3. Effect of temperature, pH and salinity on bacterial growth.

Unit-II	**Microbial Metabolism and Identification**	**12 Hrs.**

4. Carbohydrate fermentation tests.
5. Detection of enzymatic activities related to microbial metabolism (catalase, oxidase)
6. Observation of photosynthetic microorganisms.

Unit-III	**Spore Biology and Sporulating Bacteria**	**12 Hrs.**

7. Endospore staining of Bacillus species.
8. Observation of spore germination.
9. Isolation and identification of spore-forming bacteria.

Unit-IV	DNA Isolation and Analysis	12 Hrs.
10. Isolation of chromosomal DNA from bacteria. 11. Isolation of plasmid DNA from bacteria. 12. Quantification of DNA by Spectrophotometric method.		
Unit-V	**Molecular Biology Techniques**	**12 Hrs.**
13. Demonstration of bacterial transformation technique. 14. Demonstration of Agarose gel electrophoresis. 15. Demonstration of Restriction digestion of DNA.		

Text Book(s):

1. Kim B.H., Gadd G.M. (2008). Bacterial Physiology and Metabolism. Cambridge University Press, Cambridge.
2. Dawes, I.W and Sutherland L.W (1992). Microbial Physiology (2nd edition), Oxford Blackwell Scientific Publications.
3. Moat, A.G and J.W Foaster, (1995). Microbial Physiology, 3rd edition. Wiley – LISS, A John Wiley & Sons. Inc. Publication.
4. Cappuccino, J.G. and Sherman, N., 2012. Microbiology – A Laboratory Manual. 7th Edition, Dorling Kindersley (India) Pvt. Ltd., New Delhi.
5. Rajan S and Selvi Christy R. Experimental Procedures in Life Sciences. Anajanaa Book House, Chennai.

e Resources:

1. https://sites.google.com/site/microbial physiologyoddsem/teaching-contents
2. https://courses.lumenlearning.com/boundless-microbiology/chapter/microbial-Nutrition
3. https://onlinecourses.swayam2.ac.in/cec20_bt14/preview
4. http://web.iitd.ac.in/~amittal/2007_Addy_Enzymes_Chapter.pdf
5. https://www..frontiersin.org.microbial-physiology-and-metabolism

Relationship Matrix for COs, POs and PSOs

Semester	Course code	Title of the course	Hours	Credits
II	UMB26106	Practical - Microbial Physiology and Molecular Biology	4	2

Course Outcomes (COs)	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)		Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	
CO1	3	2	2	-	1	2	-	-	-	-	1	3	2	1.88
CO2	3	2	2	1	1	-	1	-	1	-	1	3	2	1.75
CO3	3	2	3	1	1	1	1	1	-	1	1	3	3	1.71
CO4	3	2	3	1	2	-	1	-	-	1	1	3	3	1.75
CO5	3	2	3	2	3	-	1	1	1	2	2	3	3	2
Mean Overall Score	3	2	2.6	1.2	1.6	0.8	0.8	0.4	0.4	0.8	1.2	3	2.6	

Sem	Course Code	Title of the Course	Course Category	L	T	P	Credits
I	UMB26901	HOST MICROBE BIOLOGY	MDC	2	1	0	3

Pre-Requisite: Students should have basic knowledge of biology

Co- Requisite: Common to all UG discipline

Progressive Course: Semester II

Course Objectives:

1. To understand the fundamentals of host–microbe interactions, including the different types of associations, factors influencing these interactions, and the significance of normal microbiota in human health.
2. To explain the mechanisms of microbial colonization and pathogenesis, including adhesion, biofilm formation, microbial invasion, toxin production, quorum sensing, and immune evasion strategies.
3. To describe the host immune responses to microorganisms, with emphasis on innate and adaptive immunity, antigen presentation, vaccination, mucosal immunity, and immunological memory.
4. To analyze the role of the human microbiome in maintaining health, including its development, functions, colonization resistance, interaction with the immune system, and the gut–brain axis.
5. To evaluate the impact of dysbiosis and emerging microbiome-based therapeutic approaches, including probiotics, prebiotics, fecal microbiota transplantation, phage therapy, host-directed therapy, microbiome analysis techniques, and ethical considerations in microbiome research.

Course Outcomes:

CO1: Define and recall the basic concepts of host–microbe interactions, including mutualism, commensalism, parasitism, pathogenicity, and normal microbiota. **(K1)**

CO2: Explain the mechanisms of microbial adhesion, colonization, biofilm formation, toxin production, and microbial invasion in pathogenesis. **(K2)**

CO3: Describe the components and functions of innate and adaptive immune systems, including pattern recognition receptors, phagocytosis, complement system, and antigen-antibody interactions. **(K2)**

CO4: Apply knowledge of host–microbe interactions to identify the role of microbiota in health, colonization resistance, and immune system modulation in different body sites. **(K3)**

CO5: Illustrate the effects of dysbiosis and apply basic concepts of microbiome-based interventions such as probiotics, prebiotics, and fecal microbiota transplantation in disease contexts. **(K3)**

K1 – Remember	*K2 – Understand*	*K3 – Apply*

Unit-I	Introduction to Host–Microbe Interactions	12 Hrs.

Introduction to host–microbe interactions. Types of interactions: mutualism, commensalism, parasitism, and pathogenicity. Koch's postulates and their significance. Factors affecting host–microbe interactions: host factors, microbial factors, and environmental factors. Normal microbiota and their importance.

Unit-II	Microbial Colonization and Pathogenesis	12 Hrs.

Microbial adhesion: pili, fimbriae, and adhesins. Biofilm formation and its significance. Basic mechanisms of microbial invasion. Bacterial toxins (exotoxins and endotoxins). Introduction to immune evasion mechanisms. Quorum sensing and its role in virulence.

Unit-III	Host Immune Responses	12 Hrs.

Overview of innate immunity. Pattern recognition receptors (TLRs). Phagocytosis and complement system.

Overview of adaptive immunity. Antigen presentation, antibodies, T cells and B cells. Vaccination and immunological memory. Mucosal immunity.		
Unit-IV	**Human Microbiome and Health**	**12 Hrs.**
Human microbiome: gut, skin, oral cavity, respiratory and urogenital tract. Development of the microbiome. Functions of the gut microbiome. Colonization resistance. Microbiome and immune system. Introduction to the gut brain axis.		
Unit-V	**Dysbiosis and Microbiome-Based Therapies**	**12 Hrs.**
Dysbiosis: causes and consequences. Role of dysbiosis in common diseases (IBD, obesity, diabetes). Introduction to microbiome analysis (16S rRNA sequencing and metagenomics). Probiotics, prebiotics, and fecal microbiota transplantation (FMT). Basic concepts of phage therapy and host-directed therapy Ethical issues in microbiome research.		

Text Book(s):

1. Madigan, M. T., Bender, K. S., Buckley, D. H., Sattley, W. M., & Stahl, D. A. (2020). Brock Biology of Microorganisms, 16th Edition. Pearson. USA.
2. Nash, A., Dalziel, R. M., & Mims, C. (2015). Mims' Pathogenesis of Infectious Disease, 6th Edition. Elsevier. UK.
3. Wilson, B. A., Salyers, A. A., Whitt, D. D., & Winkler, M. E. (2011). Bacterial Pathogenesis: A Molecular Approach, 3rd Edition. ASM Press. USA.
4. Cossart, P., & Boquet, P. (2017). Cellular Microbiology, 3rd Edition. ASM Press. USA.
5. Marchesi, J. R. (Ed.). (2014). The Human Microbiota and Microbiome. CABI. UK.
6. Fredricks, D. N. (2013). The Human Microbiota: How Microbial Communities Affect Health and Disease. Wiley. USA.
7. Douglas, A. E. (2018). Fundamentals of Microbiome Science: How Microbes Shape Animal Biology. Princeton University Press. USA.
8. Bordenstein, S. R., & Theis, K. R. (2015). Host Biology in Light of the Microbiome: Ten Principles of Holobionts and Hologenomes. PLoS Biology, 13(8), e1002226.

e Resources:

1. https://hmpdacc.org/
2. https://www.nature.com/subjects/host-microbe-interactions
3. https://www.coursera.org/learn/microbiome
4. https://www.qiime2.org/

Relationship Matrix for COs, POs and PSOs

Semester	Course code			Title of the course								Hours		Credits
I	UMB26901			Host Microbe Biology								3		3
Course Outcomes (COs)	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)		Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	
CO1	3	2	1	-	1	-	2	-	2	-	1	3	2	1.83
CO2	3	3	2	-	1	-	2	-	2	-	1	3	3	2.08
CO3	3	2	2	-	1	-	2	-	2	-	2	3	3	2.17
CO4	3	3	2	1	2	2	2	1	2	1	2	3	3	2.25
CO5	3	3	3	2	2	2	2	2	2	2	2	3	3	2.5
Mean Overall Score	3	2.6	2	1.5	1.4	1	2	1	2	1	1.6	3	2.6	

Sem	Course Code	Title of the Course	Course Category	L	T	P	Credits
II	UMB26902	GENERAL MICROBIOLOGY	MDC	2	0	2	3

Pre-Requisite: Students should have basic knowledge of biology

Co- Requisite: Common to all UG discipline

Progressive Course: Semester III

Course Objectives:

1. To understand the historical development, scope and significance of microbiology and its applications in various fields of life sciences.
2. To acquire knowledge of microscopy and staining techniques used for the observation, identification and characterization of microorganisms.
3. To understand the diversity, classification and general characteristics of major groups of microorganisms and sterilization methods used in microbiology laboratories.
4. To explain the structural organization of bacterial cells and differentiate between prokaryotic and eukaryotic cell systems.
5. To develop practical knowledge of microbial nutrition, culture media, pure culture techniques and methods for cultivation and preservation of microorganisms.

Course Outcomes:

CO1: Recall and define the historical development, scope, and importance of microbiology, including contributions of major pioneers and basic concepts such as germ theory and Koch's postulates. **(K1)**

CO2: Explain the principles, working, and applications of different types of microscopes and staining techniques used for microbial observation and identification. **(K2)**

CO3: Describe the methods of sterilization and classify major groups of microorganisms including viruses, fungi, and algae based on their general characteristics and importance. **(K2)**

CO4: Illustrate the structural organization of bacterial cells and differentiate between prokaryotic and eukaryotic cells, including Gram-positive and Gram-negative bacteria. **(K2)**

CO5: Apply knowledge of microbial nutrition and culture techniques to prepare culture media, perform pure culture methods, and understand microbial growth and preservation techniques. **(K3)**

K1 – Remember	*K2 – Understand*	*K3 – Apply*

Unit-I	History, Scope and Importance of Microbiology	09 Hrs.

Historical development of microbiology and its significance as a modern biological science-Discovery and the contributions of pioneers of Microbiology-germ theory of disease, Koch's and Rivers' postulates-scope of microbiology, including Industrial, Environmental, Medical, Food and Dairy Microbiology, Genetic Engineering and Biotechnology - overview of microorganisms and their beneficial and harmful roles in nature.

Practice: Familiarization with microbiology laboratory instruments and safety practices.

Unit-II	Microscopy and Staining Techniques	09 Hrs.

Principles and applications of Microscope. The principles, construction and applications of compound, dark-field, phase-contrast, fluorescence and electron microscopes - Staining methods used in microbiology- principles and procedures of simple staining, differential staining (Gram and acid-fast staining) and structural staining techniques - endospore and flagella staining.

Practice: Staining methods – Simple, Gram staining.

Unit-III	Sterilization and Diversity of Microorganisms	09 Hrs.

Sterilization techniques used in microbiology laboratories. The general characteristics, structure and importance of major microbial groups; viruses, fungi (including yeasts), and algae.

Practice: Demonstration of physical and chemical methods of sterilization.

Unit-IV	Structural Organization of Bacterial Cells	09 Hrs.

Structure and organization of bacterial cells and the differences between prokaryotic and eukaryotic cells-shape, size and arrangement of bacteria - structure and functions of bacterial components; capsule, cell wall, cytoplasmic membrane, flagella, pili, ribosomes, plasmids, bacterial chromosome and endospores, structural differences between Gram-positive and Gram-negative bacteria.

Practice: Observation of microbial morphology using prepared slides.

Unit-V	**Microbial Nutrition and Pure Culture Techniques**	**09 Hrs.**

Nutritional requirements of microorganisms and the methods used for their cultivation and preservation-sources of carbon, nitrogen, oxygen, phosphorus, sulfur, energy and growth factors - different types of culture media; synthetic, non-synthetic, enriched, selective and differential media. Pure culture techniques-serial dilution, streak plate, pour plate, spread plate techniques - methods for preserving microbial cultures - agar slants, saline suspension, oil overlay and freeze-drying.

Practice: Preparation of nutrient media and culture techniques.

Text Book(s):

1. Pelczar.M. J., Chan E.C.S. and Noel. R.K. (2007). Microbiology. 7th Edition, McGraw –Hill, New York.
2. Willey J., Sherwood L., and Woolverton C. J., (2017). Prescott's Microbiology. 10th Edition, McGraw-Hill International edition.
3. Tortora, G.J., Funke, B.R., Case, C.L. (2013). Microbiology. An Introduction 11th Edition, A La Carte Pearson.
4. Jeffrey C. Pommerville., Alcamo's Fundamentals of Microbiology (9th Edition). Jones & Bartlett learning 2010.
5. Stanier R.Y, Ingraham J. L., Wheelis M. L., and Painter R. R. (2010). General Microbiology, 5th Edition., MacMillan Press Ltd.

Reference Book(s):

1. Tortora, G.J., Funke, B.R. and, Case, C.L (2013). Microbiology-An Introduction, 11th Edition, Benjamin Cummings.
2. Nester E., Anderson D., Roberts C. E., and Nester M. (2006). Microbiology-A Human Perspective, 5th Edition, McGraw Hill Publications.

e Resources:

1. https://www.cliffsnotes.com/study-guides/biology/microbiology/introduction-to- vmicrobiology/a-brief-history-of-microbiology
2. \https://www.keyence.com/ss/products/microscope/bz-x/study/principle/structure.jsp
3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6604941/#
4. https://bio.libretexts.org/@go/page/9188
5. https://courses.lumenlearning.com/boundless-microbiology/chapter/microbial- nutrition/

Relationship Matrix for COs, POs and PSOs

Semester	Course code			Title of the course							Hours		Credits
II	UMB26902			General Microbiology							2L+2P		3
Course Outcomes (COs)	Programme Outcomes (POs)										Programme Specific Outcomes (PSOs)		Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	
CO1	3	2	1	-	1	-	2	-	2	-	1	3	2	**1.83**
CO2	3	2	2	-	2	-	1	-	2	-	1	3	3	**2.08**
CO3	3	2	2	-	2	2	1	-	1	-	1	3	2	**2.00**
CO4	3	3	2	-	1	-	2	-	1	-	1	3	3	**2.17**
CO5	3	3	3	2	2	1	2	2	2	1	2	3	3	**2.38**
Mean Overall Score	**3**	**2.4**	**2**	**1**	**1.6**	**1**	**1.6**	**1**	**1.6**	**0.2**	**1.2**	**3**	**2.4**	