Marudhar Kesari Jain College for Women (Autonomous)

Vaniyambadi – 635 751

Department of Microbiology

For

Undergraduate Programme

Bachelor of Science in Microbiology

From the Academic Year 2025-2028

LEARNING OUTCOMES BASED CURRICULUM FRAMEWORK FOR UNDERGRADUATE AND POSTGRADUATE EDUCATION

1. Preamble

The Department of Microbiology at Marudhar Kesari Jain College for Women, Vaniyambadi, is proud to introduce the Bachelor of Science (B.Sc.) in Microbiology, a transformative program designed to empower young women with knowledge, skills, and opportunities in the field of life sciences.

Microbiology, the study of microorganisms and their impact on humans, animals, plants, and the environment, is a dynamic and interdisciplinary field with immense relevance in today's world. From combating infectious diseases to advancing biotechnology, food safety, and environmental conservation, microbiology plays a pivotal role in addressing global challenges. This undergraduate program offers a comprehensive curriculum, blending theoretical foundations with practical training in modern laboratories. With a focus on emerging trends such as molecular biology, immunology, and industrial microbiology, the course prepares students for diverse career opportunities in healthcare, research, agriculture, pharmaceuticals, and more.

Guided by a team of experienced faculty and supported by state-of-the-art facilities, the B.Sc. Microbiology program emphasizes holistic education, critical thinking, and innovation. Our commitment is to nurture the scientific temperament, ethical values, and leadership qualities of our students, enabling them to excel as professionals and contribute meaningfully to society. We welcome aspiring microbiologists to embark on this exciting academic journey at Marudhar Kesari Jain College for Women, where tradition meets excellence, and learning empowers lives.

LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK FOR UNDERGRADUATE EDUCATION	
Programme	**B.Sc., Microbiology**
Programme Code	**US14**
Duration	**3 years [UG]**
Programme Outcomes	**PO1: Disciplinary knowledge:** Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate Programme of study. **PO2: Communication Skills:** Ability to express thoughts and ideas effectively in writing and orally; Communicate with others using appropriate media; confidently share one's views and express herself/himself; demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner to different groups. **PO3: Critical thinking:** Capability to apply analytic thought to a body of knowledge; analyse and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development. **PO4: Problem solving: Capacity** to extrapolate from what one has learned and apply their competencies to solve different kinds of non- familiar problems, rather than replicate curriculum content knowledge; and apply one's learning to real life situations. **PO5: Analytical reasoning**: Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples and addressing opposing viewpoints. **PO6: Research-related skills**: A sense of inquiry and capability for asking relevant/appropriate questions, problem arising, synthesizing and articulating; Ability to recognise cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyse, interpret and draw conclusions from data, establish hypotheses, predict cause-and- effect relationships; ability to plan, execute and report the results of an experiment or investigation. **PO7: Cooperation / Teamwork:** Ability to work effectively and respectfully with diverse teams; facilitate cooperative or coordinated effort on the part of a group, and act together as a group or a team in the interests of a common cause and work efficiently as a member of a team. **PO8: Scientific reasoning**: Ability to analyse, interpret and draw conclusions from quantitative/qualitative data; and critically evaluate ideas, evidence, and experiences from an open-minded and reasoned perspective.

	PO9: Reflective thinking: Critical sensibility to lived experiences, with self-awareness and reflexivity of both self and society. **PO10 Information/digital literacy:** Capability to use ICT in a variety of learning situations, demonstrate ability to access, evaluate, and use a variety of relevant information sources; and use appropriate software for analysis of data. **PO11 Self-directed learning**: Ability to work independently, identify appropriate resources required for a project, and manage a project through to completion. **PO12 Multicultural competence:** Possess knowledge of the values and beliefs of multiple cultures and a global perspective; and capability to effectively engage in a multicultural society and interact respectfully with diverse groups. **PO13: Moral and ethical awareness/reasoning**: Ability to embrace moral/ethical values in conducting one's life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work. Capable of demonstrating the ability to identify ethical issues related to one's work, avoid unethical behavior such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights; appreciating environmental and sustainability issues; and adopting objective, unbiased and truthful actions in all aspects of work. **PO14: Leadership readiness/qualities:** Capability for mapping out the tasks of a team or an organization, and setting direction, formulating an inspiring vision, building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination, in a smooth and efficient way. **PO15: Lifelong learning:** Ability to acquire knowledge and skills, including learning how to learn", that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of work place through knowledge/skill development/reskilling.
Programme Specific Outcomes:	**PSO1 – Placement:** To prepare the students who will demonstrate respectful engagement with others' ideas, behaviors, beliefs and apply diverse frames of reference to decisions and actions. **PSO2 - Entrepreneur:** To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skills that will facilitate startups and high potential organizations. **PSO3 – Research and Development:** Design and implement HR systems and practices grounded in research that comply with employment laws, leading the organization towards Growth and development. **PSO4 – Contribution to Business World:** To produce employable, ethical, and innovative professionals to sustain in the dynamic business world. **PSO 5 – Contribution to the Society:** To contribute to the development of the society by collaborating with stakeholders for mutual benefit.

PROGRAM OUTCOMES

PO1	Acquire knowledge in the field of biological sciences.
PO2	Develop critical, analytical thinking and problem-solving skills.
PO3	Develop research related skills in defining the problem, formulate and test the hypothesis, analyse, interpret, and draw conclusion from data.
PO4	Address and develop solutions for societal and environmental needs of local, regional and national development.
PO5	Work independently and engage in lifelong learning and enduring proficient progress.
PO6	Provoke employability and entrepreneurship among students along with ethics and communication skills.
PO7	Understand the importance of ethical behavior in business contexts and be able to recognize and address ethical dilemmas they may encounter in their professional careers.
PO8	Prepared for lifelong learning and professional development, including the ability to adapt to changes in technology, business practices, and economic conditions throughout their careers.

PROGRAM SPECIFIC OUTCOMES

PSO1	**Foundational Knowledge and Skills** Develop a strong understanding of core microbiological concepts, including microbial physiology, genetics, immunology, and biotechnology. Gain hands-on expertise in laboratory techniques such as microbial isolation, culturing, and molecular diagnostics, fostering proficiency in scientific experimentation and analysis.
PSO2	**Application in Multidisciplinary Fields** Apply microbiological knowledge to diverse domains such as healthcare, environmental science, food technology, and pharmaceuticals. Demonstrate the ability to address real-world challenges through innovative solutions, such as developing sustainable practices, combating infectious diseases, and enhancing industrial processes.
PSO3	**Research and Ethical Leadership** Cultivate a scientific temperament and critical thinking skills to conduct research, analyze data, and interpret results effectively. Emphasize ethical practices and environmental consciousness in microbiological studies, preparing graduates to contribute responsibly to advancements in science and technology.

Eligibility for Admission:

The candidate must have successfully completed Higher Secondary (10+2) education from a recognized board. They should have studied **Biology** as a mandatory subject, along with **Physics** and **Chemistry** in their 10+2 curriculum.

Methods of Evaluation and Assessment

Methods of Evaluation		
Internal Evaluation		25 Marks
External Evaluation	End Semester Examination	75 Marks
	Total	**100 Marks**
Methods of Assessment		
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions	
Understand / Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, short summary or overview	
Application (K3)	Suggest idea/concept with examples, suggest formulae, solve problems, Observe, Explain	
Analyze (K4)	Problem-solving questions, finish a procedure in many steps, Differentiate Between various ideas, Map knowledge	
Evaluate (K5)	Longer essay/Evaluation essay, Critique or justify with pros and cons	
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations	

Semester – I						
Code	Course Title	Hours Distribution				C
		L	T	P	S	
24UFTA11	Tamil – 1	4	1	0	0	3
24UFEN11	English – 1	4	1	0	0	3
25UMBC11	CC – 1 Fundamentals of Microbiology and Microbial Diversity	3	1	2	0	5
25UMBC12P	CC – 2 Core Practical I Fundamentals of Microbiology and Microbial Diversity	0	0	4	0	3
24UBCA11	EC - 1 Allied Biochemistry I	3	1	0	0	3
25UBCS11	SEC – 1 Social and Preventive medicine	1	0	1	0	2
24UBCS12P	SEC – 2 Allied Biochemistry Practical I	1	0	1	0	2
25UMBF11	FC- Introduction to microbial world	1	1	0	0	2
					30	**23**

Semester - II						
Code	Course Title	Hours Distribution				C
		L	T	P	S	
24UFTA21	Tamil – 2	4	1	0	0	3
24UFEN21	English – 2	4	1	0	0	3
25UMBC21	CC – 3 Microbial Physiology and Metabolism	3	1	2	0	5
25UMBC21P	CC - 4 Core Practical II Microbial Physiology and Metabolism	0	0	3	0	2
24UBCA21	EC – 2 Allied Biochemistry II	3	1	0	0	4
24UBCA21P	EC – 3 Allied Biochemistry Practical II	2	0	1	0	2
25UMBS21	SEC – 3 Bioinstrumentation	1	0	1	0	2
24UAEC21	AEC – 1 Life skill through yoga	1	1	0	0	2
					30	**23**

Semester – III						
24UFTA31	Tamil – 3	4	1	0	0	3
24UFEN31	English – 3	4	1	0	0	3
25UMBC31	CC – 5 Molecular Biology and Microbial Genetics	3	1	2	0	5
25UMBC32P	CC - 6 Practical III - Molecular Biology and Microbial Genetics	0	0	3	0	2
25UMBA31	EC – 4 Clinical Laboratory Technology	3	1	0	0	4
25UMBA32	EC 5 - Microalgal Technology	3	0	0	0	2
25UMBS31	SEC – 4 Organic Farming & Biofertilizer Technology	1	0	1	0	2
25UAEC31	AEC – 2 Human Values and professional ethics	1	1	0	0	2
					30	**23**

Semester - IV						
24UFTA41	Tamil – 4	4	1	0	0	3
24UFEN41	English – 4	4	1	0	0	3
25UMBC41	CC – 7 Immunology and Immunotechnology	3	1	2	0	5
25UMBC42P	CC - 8 Practical IV Immunology and Immunotechnology	0	0	3	0	2
25UMBA41	EC - 6 Food Processing Technology	3	1	0	0	4
25UMBA42	EC – 7 Vermitechnology	3	0	0	0	2
25UMBS41	SEC - 5 Mushroom Technology	1	0	1	0	2
25UAEC41	AEC – 3 Environmental Studies	1	1	0	0	2
					30	**23**

Semester – V						
	CC -9 Bacteriology and Mycology	4	1	0	0	4
	CC- 10 Practical V Medical Microbiology	0	0	3	0	2
	CC - 11 Virology and Parasitology	3	1	1	0	4
	CC - 12 Project with Viva- voce	0	0	3	0	2
	EC – 8 Recombinant DNA Technology	4	1	0	0	4
	EC – 9 Biosafety and Bioethics	4	1	0	0	4
	AEC – 4 Value Education	1	1	0	0	2
	Internship				2	2
					30	**24**

Semester - VI						
	CC – 13 Environmental and Agricultural Microbiology	4	1	0	0	4
	CC - 14 Practical VI Environmental, Agriculture, Food, Dairy and Probiotic Microbiology	0	0	5	0	4
	CC - 15 Food, Dairy and Probiotic Microbiology	0	0	0	5	5
	EC –10 Pharmaceutical Microbiology	4	1	0	0	4
	EC – 11 Entrepreneurship and Bio business	4	1	0	0	4
	PEC – 1 – Sericulture	1	1	0	0	2
	SLC – 1 Microbial Quality control and Testing				3	2
					30	**25**
					141+2*	

Students must complete at least one online course (MOOC) from platforms like SWAYAM, NPTEL, or Nanmudalvan within the fifth semester. Additionally, engaging in a specified Self-learning Course is mandatory to qualify for the degree, and successful participation will be acknowledged with an extra credit of 2*.

Part – 1 & 2	Tamil & English	8	SEC	Skill Elective Course (ME /NME)	5
CC	Core Course	15	FC	Foundation Course	1
EC-AL	Elective Course – Allied / Generic	7	AEC	Ability Enhancement Course	4
EC	Elective Course – Major	4	SLC	Self-Learning Course	1

I[ST] YEAR FIRST SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
25UMBC11	**FUNDAMENTALS OF MICROBIOLOGY AND MICROBIAL DIVERSITY**	Core CC-1	3	1	2	0	5	6	25	75	100

Learning Objectives	
LO1	Learn the fundamental principles about different aspects of Microbiology including recent developments in the area.
LO2	Describe the structural organization, morphology and reproduction of microbes.
LO3	Explain the methods of cultivation of microbes and measurement of growth.
LO4	Understand the microscopy and other basic laboratory techniques – culturing, disinfection and sterilization in Microbiology.
LO5	Compare and contrast the different methods of sterilization.

Unit	**Content**	**Hours**
1	**Evolution, Classification, and Biodiversity of Microorganisms:** History and evolution of microbiology, contributions of key scientists, theories on the origin of microorganisms. Classification – Three-kingdom, five-kingdom, six-kingdom, and eight-kingdom systems, modern molecular approaches to microbial taxonomy. Microbial biodiversity – Introduction to microbial diversity, ecological niches, and microbial roles in biogeochemical cycles. Basic concepts of prokaryotes and eukaryotes, characteristics and significance of Bacteria, Archaea (Archaebacteria), and eukaryotic microorganisms (Protozoa, Fungi, Algae).	18
2	**Characteristics and Structure of Microorganisms** General characteristics of cellular microorganisms (Bacteria, Algae, Fungi, and Protozoa) and acellular microorganisms (Viruses, Viroids, and Prions). Differences between prokaryotic and eukaryotic microorganisms. Structure of bacterial cell wall, cell membrane, capsule, flagella, pili, mesosomes, chlorosomes, phycobilisomes, spores, and gas vesicles.	18
3	**Microbial nutrition** Nutritional requirements of microorganisms - Macronutrients, micronutrients and growth factors. Nutritional types of microorganisms: Autotrophs and heterotrophs, phototrophs and chemotrophs. Physical factors affecting growth of microorganisms: Temperature, pH and Oxygen. Culture media: Components of media, Synthetic or defined media, Complex media, enriched media, selective media, differential media, enrichment culture media.	18
4	**Bacterial Growth** Concept of growth of microorganisms; measurement of growth; Culture	18

	system: concept of batch and continuous culture, growth kinetics in batch system emphasizing different phases of bacterial growth, specific growth rate, growth curve, diauxic growth. Counting of bacteria -Viable count, Total count and turbidimetric estimation.	
5	**Sterilization and Disinfection** Sterilization – moist heat (autoclaving), dry heat (hot air oven), radiation (UV, ionization), filtration (membrane filter). Disinfection and antiseptics. Antimicrobial agents.	18

CO	**Course Outcomes**
CO1	Study the historical events that led to the discoveries and inventions and understand the Classification of microorganisms.
CO2	Gain Knowledge of detailed structure and functions of prokaryotic cell organelles.
CO3	Understand the various microbiological techniques, different types of media, and techniques involved in culturing microorganisms
CO4	Explain the principles and working mechanism of different microscopes/Microscope, their function and scope of application.
CO5	Understand the concept of asepsis and modes of sterilization and disinfectants.

Textbooks:	
1	Pelczar. M. J., Chan E.C.S. and Noel. R.K. (2007). Microbiology. 7thEdition., McGraw – Hill, New York.
2	Willey J., Sherwood L., and Woolverton C. J., (2017). Prescott's Microbiology. 10th Edition., McGraw-Hill International edition.
3	Salle. A.J (1992). Fundamental Principles of Bacteriology. 7thEdition., McGraw Hill Inc. New York.
4	Boyd, R.F. (1998). General Microbiology,2ndEdition., Times Mirror, Mosby College Publishing, St Louis.
5	Madigan M.T., Martinko J.M., Stahl D.A, and Clark D. P. (2010). Brock - Biology of Microorganisms, 13th Edition Benjamin-Cummings Pub Co
6	Sarma, S., & Paniker, C. K. J. (2023). *Ananthanarayan and Paniker's Textbook of Microbiology* (13th ed.). Universities Press.

Reference Books:

1	Jeffrey C. Pommerville., Alcamo's Fundamentals of Microbiology (9thEdition). Jones &Bartlett learning 2010.
2	Stanier R.Y, Ingraham J. L., Wheelis M. L., and Painter R. R. (2010). General Microbiology, 5thEdition., MacMillan Press Ltd
3	Tortora, G.J., Funke, B.R. and, Case, C.L (2013). Microbiology-An Introduction, 11thEdition., Benjamin Cummings.
4	Nester E., Anderson D., Roberts C. E., and Nester M. (2006). Microbiology-A Human Perspective, 5thEdition., McGraw Hill Publications.
5	Madigan M.T., Martinko J.M., Stahl D.A, and Clark D. P. (2010). Brock - Biology of Microorganisms, 13th Edition Benjamin-Cummings Pub Co

Web resources:	
1	https://www.cliffsnotes.com/study-guides/biology/microbiology/introduction-to-microbiology/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/

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	2	2	2	3	3	3	3	3
CO2	3	2	3	3	2	2	2	3	1	3	2
CO3	3	3	3	1	2	2	2	3	3	1	3
CO4	3	3	2	3	2	2	2	2	3	3	2
CO5	3	2	2	3	3	2	3	3	3	3	2
Total	15	13	13	12	11	10	12	14	13	13	12
Average	3	2.6	2.6	2.4	2.2	2.0	2.4	2.8	2.6	2.6	2.4

3 – Strong, 2- Medium, 1- Low

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
25UMBC12P	**Practical I - Fundamentals of Microbiology and Microbial Diversity**	Core CC-2	0	0	4	0	3	4	25	75	100

Learning Objectives	
LO1	Understand and apply proper cleaning, sterilization, and safety techniques to maintain aseptic conditions in a microbiology laboratory..
LO2	Gain knowledge of microbiological media preparation, types, and quality control to support microbial growth and identification.
LO3	Develop fundamental microbiological skills for isolating, culturing, and quantifying bacteria using standard laboratory techniques..
LO4	Understand the principles and applications of microbiological instrumentation and quantification techniques for microbial analysis.
LO5	Learn and apply staining, observation, and enumeration techniques to study microbial morphology, and diversity.

Unit	Content	Hours
1	**Laboratory Practices, Sterilization, and Safety in Microbiology** • **Cleaning of Glassware:** Proper methods for washing, decontaminating, and preparing glassware for microbiological use. • **Microbiological Good Laboratory Practices (GLP) and Safety:** Essential guidelines for maintaining aseptic conditions, handling microorganisms, and ensuring laboratory safety. • **Sterilization Techniques:** Methods including autoclaving, hot air oven sterilization, and membrane filtration for ensuring sterility. • **Assessment of Sterility:** Verification procedures to confirm the effectiveness of sterilization techniques.	12
2	**Media Preparation and Quality Control in Microbiology** • **Types of Microbiological Media:** Preparation and applications of liquid, solid, and semi-solid media. • **Agar-Based Media Formats:** Preparation of agar slants, agar deeps, and agar plates for microbial cultivation. • **Specialized Culture Media:** Formulation and usage of basal, differential, enriched, enrichment, transport, and selective media. • **Quality Control of Culture Media:** Assessment of growth-supporting properties, sterility checks, and validation of media performance.	12
3	**Fundamental Microbiological Techniques and Bacterial Enumeration** • **Pure Culture Techniques:** Methods including streak plate, pour plate, and decimal dilution for isolating and maintaining	12

	pure bacterial cultures. • **Bacterial Growth on Different Media:** Observing microbial growth characteristics and describing colony morphology on various culture media. • **Pigment Production in Bacteria:** Demonstrating and analyzing the production of pigments by different bacterial species. • **Enumeration of Bacteria from Environmental Samples:** Quantitative estimation of bacterial populations from soil, water, and air using standard microbiological techniques.	
4	**Microbiological Instrumentation and Quantification Techniques** • **Microscopy Techniques:** Principles and applications of light microscopy and bright-field microscopy for microbial observation. • **Colorimeter:** Usage and significance of a colorimeter in microbiological and biochemical assays. • **pH Meter:** Measurement and importance of pH in microbial growth and culture media preparation. • **Microbial Enumeration Methods:** Determination of microorganisms using direct count and viable count techniques.	12
5	**Microbial Staining, Observation, and Diversity Studies** • **Staining Techniques:** Smear preparation and staining methods, including simple staining, Gram's staining, and endospore staining, for bacterial identification. • **Microbial Diversity Analysis:** Examination of microbial communities using Hay Infusion Broth.	12

CO	**Course Outcomes**
CO1	Demonstrate proficiency in laboratory best practices, including glassware cleaning, sterilization methods, and sterility assessment, ensuring compliance with microbiological safety standards.
CO2	Demonstrate competence in preparing various culture media, ensuring their quality through sterility checks and performance validation for reliable microbiological analyses.
CO3	Demonstrate proficiency in pure culture techniques, bacterial enumeration, and analysis of microbial growth characteristics for accurate microbiological investigations.
CO4	Demonstrate proficiency in using microscopy, colorimetry, pH measurement, and microbial enumeration methods for accurate microbial assessment.
CO5	Demonstrate competency in microbial staining, and diversity analysis to identify and characterize microorganisms accurately.

Textbooks:	
1	James G Cappucino and N. Sherman MB(1996). A lab manual Benjamin Cummins, New York 1996.
2	Kannan. N (1996). Laboratory manual in General Microbiology. Palani Publications.
3	Sundararaj T (2005). Microbiology Lab Manual (1st edition) publications.

4	Gunasekaran, P. (1996). Laboratory manual in Microbiology. New Age International Ld., Publishers, New Delhi.
5	R C Dubey and D K Maheswari (2002). Practical Microbiology. S. Chand Publishing.
Reference Books:	
1	Atlas.R (1997). Principles of Microbiology, 2nd Edition, Wm.C.Brown publishers.
2	Amita J, Jyotsna A and Vimala V (2018). Microbiology Practical Manual. (1st Edition). Elsevier India
3	Talib VH (2019). Handbook Medical Laboratory Technology. (2nd Edition). CBS.
4	Wheelis M, (2010). Principles of Modern Microbiology, 1st Edition. Jones and Bartlett Publication.
5	Lim D. (1998). Microbiology, 2ndEdition, WCB McGraw Hill Publications
Web resources:	
1	http://www.biologydiscussion.com/micro-biology/sterilisation-and-disinfectionmethods-and-principles-microbiology/24403.
2	https://www.ebooks.cambridge.org/ebook.jsf?bid=CBO9781139170635
3	https://www.grsmu.by/files/file/university/cafedry//files/essential_microbiology.pdf
4	https://microbiologyinfo.com/top-and-best-microbiology-books/
5	https://www.cliffsnotes.com/studyguides/biology/microbiology/introduction-tomicrobiology/a-brief-history-of-microbiology

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	2	3	3	3	2	3	1	3	3	3	3
CO2	3	2	3	3	3	3	1	3	3	3	3
CO3	3	3	3	3	2	3	1	3	3	3	3
CO4	3	3	2	2	3	3	1	3	3	3	3
CO5	3	3	3	3	2	3	1	3	3	3	3
Total	15	15	15	15	12	15	5	15	15	15	15
Average	3	3	3	3	3	3	1	3	3	3	3

3 – Strong, 2- Medium, 1- Low

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
25UBCS11	**SEC – 1 NME** **Social and Preventive Medicine**	**NME**	**1**	**0**	**1**	**0**	**2**	**2**	**25**	**75**	**100**

Learning Objectives	
LO1	Describe the concepts of health and disease and their social determinants
LO2	Summarize the health management system
LO3	Know about the various health care services
LO4	Outline the goals of preventive medicine
LO5	Gain knowledge about alternate medicine

Unit	Content	Hours
1	**Social Medicine and Public Health** History of social medicine, concepts of health and disease, social determinants of health and disease. Health and quality of life, health information systems, measures of population health, and health policies.	**6**
2	**Health Management and Disease Prevention** Applications of behavioral sciences and psychology in health management. Nutritional programs for health management. Water and sanitation in human health. National programs for communicable and non-communicable diseases. Environmental and occupational hazards and their control.	**6**
3	**Community Health and Health Education** Health care of the community – information, education, communication, and training in health. Maternal and child health. School health services.	**6**
4	**Preventive Medicine and Disease Control** Introduction to preventive medicine, role of preventive medicine, levels of prevention. Surveillance, monitoring, and reporting of disease outbreaks. Forecasting and control measures in community settings. Early detection methods.	**6**
5	**Traditional Medicine and Global Health Regulations in Epidemics** Unani, Ayurveda, Homeopathy, and Naturopathy systems in epidemic and pandemic outbreaks. International health regulations. Infectious disease outbreak case studies and precautionary responses during SARS, MERS coronavirus, Ebola, and novel SARS-CoV-2 outbreaks.	**6**

CO	Course Outcomes
CO1	Identify the health information system
CO2	Associate various factors with health management system
CO3	Choose the appropriate health care services
CO4	Appraise the role of preventive medicine in community setting
CO5	Recommend the usage of alternate medicine during outbreaks
Textbooks:	
1	Park.K (2021). Textbook of preventive and social medicine, 26th edition. Banarsidas Bhanot publishers.
2	Mahajan& Gupta (2013). Text book of preventive and social medicine, 4thedition. Jaypee brothers medical publishers.
3	Chun-Su Yuan, Eric J. Bieber, Brent Bauer (2006). Textbook of Complementary and Alternative Medicine. Second Edition. Routledge publishers
4	Vivek Jain (2020). Review of Preventive and Social Medicine: Including Biostatics. 12th edition, Jaypee Brothers Medical Publishers.
5	Lal Adarsh Pankaj Sunder (2011). Textbook of Community Medicine: Preventive and Social Medicine, CBS publisher
Reference Books:	
1	Howard Waitzkin, Alina Pérez, Matt Anderson (2021). Social Medicine and the coming Transformation. First Edition. Routledge publishers.
2	GN Prabhakara (2010). Short Textbook of Preventive and Social Medicine. Second Edition. Jaypee publishers
3	Jerry M. Suls, Karina W. Davidson, Robert M. Kaplan (2010).Handbook of Health Psychology and BehavioralMedicine.Guilford Press..
4	Marie Eloïse Muller, Marie Muller, MarthieBezuidenhout, KarienJooste (2006).Health Care Service Management. Juta and Company Ltd.
5	Geoffrey Rose (2008).Rose's Strategy of Preventive Medicine: The Complete.OUP Oxford.
Web resources:	
1	https://www.omicsonline.org/scholarly/social--preventive-medicine-journals-articlesppts-list.php
2	https://www.teacheron.com/online-md_preventive_and_social_medicine-tutors
3	https://www.futurelearn.com
4	https://www.healthcare-management-degree.net
5	https://www.conestogac.on.health-care-administration-and-service-management

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	1	3	3	3	2	3	2	3	1
CO2	3	3	2	2	3	3	3	2	3	2	3
CO3	3	1	3	3	3	3	2	1	2	2	3
CO4	3	3	1	3	3	3	2	3	1	3	2
CO5	3	3	2	2	3	2	1	3	2	1	2
Total	15	13	09	13	15	14	10	12	10	11	11
Average	3.0	2.6	1.8	2.6	3.0	2.8	2.0	2.4	2.0	2.2	2.2

3 – Strony, 2 - Medium, 1 - Low

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
25UMBF11	**FC – 1 Introduction to microbial world**	**FC**	**1**	**1**	**0**	**0**	**2**	**2**	**25**	**75**	**100**

Learning Objectives	
LO1	Describe the discovery of microbial world and development of pure culture techniques.
LO2	Learn about distribution of microorganism in nature, diversity and types of Microorganisms
LO3	Know about the impact of microorganism in environment- Branches of microbiology
LO4	Outline the goals of pure culture techniques
LO5	Gain knowledge about microscopy and staining techniques

Unit	Content	Hours
1	**Foundations of Microbiology and Medical Advances** Establishment of the theory of biogenesis. Discovery of viruses. Developments in pure culture techniques. Establishment of the germ theory of disease and fermentation. Work of Lister and principles of aseptic surgery. Discovery and development of vaccines and modern chemotherapy. Contributions of Winogradsky and Beijerinck. Discovery of microorganisms as plant pathogens.	**6**
2	**Microbial Diversity and Classification** Diversity in microbial habitats. Types of microorganisms. Introduction to the prokaryotic world, eukaryotic microorganisms, viruses, and other acellular microorganisms.	**6**
3	**Microorganisms and Their Significance** Impact of microorganisms on the environment and human life. Branches of microbiology. Thrust areas of microbiology – genetic engineering and biotechnology.	**6**
4	**Pure Culture Techniques and Preservation** Definition of pure culture and axenic culture. Principles and methods of obtaining pure culture. Preservation of pure culture. Culture collection centers.	**6**
5	**Microscopy and Staining Techniques** Principles of microscopy, magnification, and resolving power. Light microscopy–simple and compound microscopes. Bright-field and dark-field microscopy. Principles and applications of phase-contrast and fluorescent microscopy. Electron microscopy–general principles, types, working mechanisms, and limitations. Staining – Nature of dyes. – Staining techniques; principle, procedure and applications: i) Simple staining ii) Differential staining-Grams and acid fast staining, iii) Structural staining- endospore, flagella, capsular and granular staining.	**6**

CO	Course Outcomes
CO1	Study the historical events that led to the discoveries and inventions
CO2	Gain Knowledge of detailed habitat of microbes. Study the prokaryotic and eukaryotic world
CO3	Understand the impacts of microorganism in environment
CO4	Learn about pure culture techniques
CO5	Explain the principles and working mechanism of different microscopes/Microscope, their function and scope of application

Textbooks:	
1	Pelczar MJ, Chan ECS and Kreig NR Tata McGrow Hill.
2	R C Dubey and D K Maheswari (2002). Practical Microbiology. S. Chand Publishing.
3	Willey J., Sherwood L., and Woolverton C. J., (2017). Prescott's Microbiology. 10th Edition., McGraw-Hill International edition
4	Boyd, R.F. (1998). General Microbiology,2ndEdition., Times Mirror, Mosby College Publishing, St Louis
5	Salle. A.J (1992). Fundamental Principles of Bacteriology. 7thEdition., McGraw Hill Inc. New York
Reference Books:	
1	General Microbiology: RY Stanier, Adelberg EA and JL Ingraham, MacMillan PressInc.
2	Introduction to microbiology: In graham JL and In graham CA Thomson Brooks/ Cole.
3	Principles of microbiology: RM Atlas WmC brown Publishers.
4	Brock's biology of Microorganisms: Madigan MT and Martinko JM Pearson Education Inc
5	Willey, J., Sandman, K., & Wood, D. (2020). *Prescott's Microbiology* (11th ed.). McGraw-Hill Education.
Web resources:	
1	https://www.cliffsnotes.com/study-guides/biology/microbiology/introduction-tomicrobiology/a-brief-history-of-microbiology
2	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6604941/#
3	https://www.keyence.com/ss/products/microscope/bz-x/study/principle/structure.jsp
4	https://bio.libretexts.org/@go/page/9188
5	https://courses.lumenlearning.com/boundless-microbiology/chapter/microbialnutrition/

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	1	3	2	1	2	3	2	3	1
CO2	3	3	2	2	3	2	3	2	3	2	3
CO3	3	1	3	2	3	1	2	1	2	2	3
CO4	3	3	1	2	1	3	2	3	1	3	2
CO5	2	3	2	1	3	2	1	3	2	1	2
Total	14	13	09	10	12	09	10	12	10	11	11
Average	2.8	2.6	1.8	2.0	2.4	1.8	2.0	2.4	2.0	2.2	2.2

3 – Strong, 2- Medium, 1- Low

I[ST] YEAR SECOND SEMESTER

Course Code	Course Name	Cate gory	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
25UMBC21	**MICROBIAL PHYSIOLOGY AND METABOLISM**	Core CC-3	3	1	2	0	5	6	25	75	100

Learning Objectives	
LO1	To study the nutritional requirements of microorganisms and their transport mechanisms.
LO2	To study microbial growth influencing factors, and specialized growth patterns.
LO3	To explore key metabolic pathways and energy generation mechanisms in microorganisms.
LO4	To explore anaerobic respiration and fermentation pathways in microorganisms.
LO5	To study photosynthetic prokaryotes and bioluminescence.

Unit	Content	Hours
1	Microbial Nutrition and Transport Mechanisms: Nutritional requirements of Microorganisms - Autotrophs, Heterotrophs, Chemotrophs, Copiotrophs and Oligotrophs. Cell membrane – models, properties and functions. Transport Mechanisms - Diffusion- Facilitated Diffusion, Active transport- Group translocation.	18
2	Microbial Growth and Its Regulation: Definitions of growth – Effect of Environmental factors on growth – pH, temperature, oxygen, osmotic pressure - synchronous growth and continuous cultivation. Diauxic growth, Sporulation – Endospore formation in bacteria.	18
3	Microbial Metabolism and Energy Production: Metabolism - EMP, HMP, ED Pathway - TCA cycle - Electron transport chain, Phosphorylation, Oxidative Phosphorylation, Substrate level Phosphorylation.	18
4	Anaerobic Respiration and Fermentation: Anaerobic respiration - sulphur, nitrogenous compounds and $C0_2$ as a final electron acceptor- Fermentation: Homolactic, heterolactic, alcoholic and mixed acid. Comparative study of aerobic vs anaerobic metabolism.	18
5	Microbial Photosynthesis: Photosynthesis in microorganisms – oxygenic photosynthesis, cyanobacteria structure and functions, light dependent reactions and calvin cycle – anoxygenic photosysnthesis, purple and green photosynthetic bacteria, heliobacteria, chloroflexi and halophilic archaea.	18
	Total	90

CO	Course Outcomes
CO1	Understand microbial nutritional classifications and transport processes.
CO2	Understand growth curves, environmental effects, and microbial growth strategies.
CO3	Understand microbial metabolic pathways and their role in energy production.
CO4	Understand electron acceptors in anaerobic respiration and different types of fermentation.
CO5	Understand oxygenic and anoxygenic photosynthesis and microbial light-based processes.

Textbooks:	
1	Schlegal, H.G. (1993). General Microbiology.,7th Edition, Press syndicate of the University of Cambridge.
2	Rajapandian K. (2010). Microbial Physiology, Chennai: PBS Book Enterprises India.
3	Meena Kumari. 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	S. Ram Reddy, S.M. Reddy (2008). Microbial Physiology. Anmol Publications Pvt Ltd.

Reference Books:

1	Robert K. Poole (2004). Advances in Microbial Physiology, Elsevier Academic Press, New York, Volume 49.
2	Kim B.H., Gadd G.M. (2008). Bacterial Physiology and Metabolism. Cambridge University Press, Cambridge
3	Daniel R. Caldwell. (1995). Microbial Physiology & Metabolism Wm.C. Brown Communications, Inc. USA.
4	Moat, A.G and J.W Foaster (1995). Microbial Physiology, 3rd edition. Wiley – LISS, A John Wiley & Sons. Inc. Publications.
5	Bhanu Shrivastava. (2011). Microbial Physiology and Metabolism: Study of Microbial Physiology and Metabolism. Lambert academic Publication.
Web resources:	
1	https://courses.lumenlearning.com/boundless-microbiology/chapter/microbial-Nutrition
2	https://onlinecourses.swayam2.ac.in/cec20_bt14/preview
3	http://web.iitd.ac.in/~amittal/2007_Addy_Enzymes_Chapter.pdf
4	https://www.frontiersin.org/journals/microbiology/sections/microbial-physiology-and-metabolism

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	2	3	3	3	2	3
CO2	3	2	2	3	2	2	2	3	1	3	2
CO3	3	3	2	1	2	2	2	3	3	1	3
CO4	2	3	2	3	2	2	2	2	3	3	2
CO5	3	2	2	3	3	2	3	3	3	3	2
Total	14	13	10	12	11	10	12	14	13	12	12
Average	2.8	2.6	2.0	2.4	2.2	2.0	2.4	2.8	2.6	2.4	2.4

3 – Strong, 2- Medium, 1- Low

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
25UMBC21P	**Practical II – Microbial Physiology and metabolism**	Core CC-4	0	0	3	0	2	3	25	75	100

Learning Objectives	
LO1	To learn techniques for observing microbial motility and staining methods for bacterial identification.
LO2	To understand methods for quantifying microorganisms using direct and viable counting techniques.
LO3	To understand anaerobic cultivation techniques and methods for assessing microbial antibiotic susceptibility.
LO4	To examine the structural diversity of algae, fungi, and protozoa and learn micrometry techniques for size measurement.
LO5	To study various bacterial identification methods and techniques for maintaining pure cultures.

Unit	Content	Hours
1	Microbial Motility and Staining Techniques: Motility demonstration: hanging drop, wet mount preparation, semi-solid agar. Staining techniques: Smear preparation, Capsular, and Acid-fast staining	09
2	Microbial Enumeration Techniques: spread plate – Direct cell count (Petroff-Hausser counting chamber), Turbidometry. Viable count - pour plate, spread plate.	09
3	Anaerobic Culture and Antibiotic Sensitivity Testing: Anaerobic culture methods – Candle jar method. Antibiotic sensitivity testing: Disc diffusion test.	09
4	Morphological Study of Microorganisms and Micrometry: Morphological variations in algae, fungi and protozoa. Micrometry.	09
5	Biochemical test and Culture Maintenance Techniques: IMViC test, H_2S, TSI, Oxidase, catalase, urease test and Carbohydrate fermentation test. Maintenance of pure culture, paraffin method, stab culture.	09
	Total	45

CO	Course Outcomes
CO1	Gain proficiency in motility assays and differential staining techniques.
CO2	Gain proficiency in direct cell counting,
CO3	Gain proficiency in anaerobic culture methods and antibiotic sensitivity testing using the disc diffusion method.
CO4	Understand morphological variations in microorganisms and accurately measure their dimensions using micrometry.
CO5	Gain proficiency in morphological, physiological, and biochemical bacterial identification and learn culture preservation methods.

Textbooks:	
1	James G Cappucino and N. Sherman MB (1996). A lab manual Benjamin Cummins, New York 1996.
2	Kannan. N (1996). Laboratory manual in General Microbiology. Palani Publications.
3	Sundararaj T (2005). Microbiology Lab Manual (1st edition) publications.
4	Gunasekaran, P. (1996). Laboratory manual in Microbiology. New Age International Ld., Publishers, New Delhi.
5	R C Dubey and D K Maheswari (2002). Practical Microbiology. S. Chand Publishing.
Reference Books:	
1	Elsa Cooper (2018). Microbial Physiology: A Practical Approach. Callisto Reference Publisher.
2	Robert K. Poole (2004). Advances in Microbial Physiology, Elsevier Academic Press, New York, Volume 49.
3	Dawes, I.W and Sutherland L.W (1992). Microbial Physiology (2nd edition), Oxford Blackwell Scientific Publications.
4	Lehninger, Principles of Biochemistry (IE) 7th Edition (2017) by David L.Nelson.
5	Madigan M.T., Martinko J.M., Stahl D.A, and Clark D. P. (2010). Brock - Biology of Microorganisms, 13th Edition Benjamin-Cummings Pub Co
6	Rajan, S and R. Selvi christy. 2015. Experimental procedures in Life Sciences. CBC Publishers and distributors Pvt Ltd.
Web resources:	
1	https://sites.google.com/site/bscmicrobiologycbcs/home/bacterial-physiology-metabolism
2	https://courses.lumenlearning.com/boundless-microbiology/chapter/microbial-Nutrition
3	https://onlinecourses.swayam2.ac.in/cec20_bt14/preview
4	https://www.studocu.com/in/search/Microbial%20physiology?origin=landing

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	2	3	3	3	2	3	1	3	3	3	3
CO2	3	2	3	3	3	3	1	3	3	3	3
CO3	3	3	3	3	2	3	1	3	3	3	3
CO4	3	3	2	2	3	3	1	3	3	3	3
CO5	3	3	3	3	2	3	1	3	3	3	3
Total	14	14	14	14	12	15	5	15	15	15	15
Average	2.8	2.8	2.8	2.8	3	3	1	3	3	3	3

3 – Strong, 2- Medium, 1- Low

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
25UMBS21	**BIO INSTRUMENTATION**	Elective Generic /Discipline Specific Elective II	**1**	**0**	**1**	**0**	**2**	**2**	**25**	**75**	**100**

Course Objectives	
CO1	To introduce fundamental principles and application of instruments used in microbiological research
CO2	To gain knowledge about principles of spectroscopy
CO3	Understand the analytical techniques of Chromatography and electrophoresis
CO4	To understand the principle of different types of scans used in medical diagnosis
CO5	To gain information about the principles of radioactivity and its measurements

Unit	Details	No. of Hours
1	Basic instruments: Definition, scope and importance of bioinstrumentation in microbiology – Calibration of instrument – safety protocols and calibration – Analytical balance, autoclave, hot air oven, incubator, laminar air flow and pH meter.	09
2	Spectroscopic Techniques: Spectroscopic Techniques: Colorimeter, UV-Visible, fluorescence, IR.	09
3	Chromatographic and Electrophoresis Techniques: Chromatographic Techniques: Paper, Thin Layer, Column, HPLC and GC. Electrophoresis Techniques: Agarose and polyacrylamide gel electrophoresis, SDS-PAGE for protein analysis	09
4	Imaging techniques: Principle, Instrumentation and application of ECG, EEG, EMG, MRI, CT and PET scan radioisotopes.	09
5	Fluorescence and radiation based techniques: Spectrofluorometer, Flame photometer, Scintillation counter, Geiger Muller counter, Autoradiography.	09
	Total	45

Course Outcomes	
Course Outcomes	On completion of this course, students will;
CO1	Gain knowledge about the basics of instrumentation.
CO2	Exemplify the structure of atoms and molecules by using the principles of spectroscopy.
CO3	Evaluate by separating and purifying the components.
CO4	Understand the need and applications of imaging techniques.
CO5	Categorize the working principle and applications of fluorescence and radiation.
Text Books	
1.	Jayaraman J (2011). Laboratory Manual in Biochemistry, 2nd Edition. Wiley Eastern Ltd., New Delhi.

2.	Ponmurugan. P and Gangathara PB (2012). Biotechniques.1st Edition. MJP publishers.
3	Veerakumari, L (2009). Bioinstrumentation- 5 th Edition -.MJP publishers.
4	Upadhyay, Upadhyay and Nath (2002). Biophysical chemistry – Principles and techniques 3rd Edition. Himalaya publishing home.
5	Chatwal G and Anand (1989). Instrumental Methods of Chemical Analysis. S.Himalaya Publishing House, Mumbai.
References Books	
1	Rodney.F.Boyer (2000). Modern Experimental Biochemistry, 3rd Edition. Pearson Publication.
2	SkoogA.,WestM (2014). Principles of Instrumental Analysis – 14th Edition W.B.SaundersCo.,Philadephia.
3	N.Gurumani. (2006). Research Methodology for biological sciences- 1st Edition – MJP Publishers .
4	Wilson K, and Walker J (2010). Principles and Techniques of Biochemistry and Molecular Biology.7th Edition. Cambridge University Press .
5	Webster, J.G. (2004). Bioinstrumentation- 4th Edition - John Wiley & Sons (Asia) Pvt.Ltd,Singapore.
Web Resources	
1	http://www.biologydiscussion.com/biochemistry/centrifugation/centrifugeintroduction-types- uses-and-other-details-with-diagram/12489
2	https://www.watelectrical.com/biosensors-types-its-working-and-applications/
3	https://study.com/academy/lesson/what-is-chromatography-definition-typesuses.html
4	http://www.rsc.org/learn-chemistry/collections/spectroscopy/introduction

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2	3	3	3	2	3	2	3	1
CO2	3	3	3	2	3	3	3	2	3	2	3
CO3	3	1	2	3	3	3	2	3	2	2	3
CO4	3	3	2	3	3	3	2	3	1	3	2
CO5	3	3	1	2	3	2	1	2	2	1	2
Total	15	13	10	13	15	14	10	13	10	11	11
Average	3.0	2.6	2.0	2.6	3.0	2.8	2.0	2.6	2.0	2.2	2.2

3 – Strong, 2 - Medium, 1 – Low

SECOND YEAR - III SEMESTER

Course Code	Course Name	Cate gory	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
25UMBC31	**MOLECULAR BIOLOGY AND MICROBIAL GENETICS**	Core course -5	3	1	2	0	5	6	25	75	100

Learning Objectives	
LO1	Provide knowledge on structure and replication of DNA.
LO2	Illustrate the significance and functions of RNA in protein synthesis.
LO3	Explain the cause and types of DNA mutation and DNA repair mechanisms.
LO4	Outline the role of plasmids and phages in genetics.
LO5	Examine mechanisms of gene transfer mechanisms.

Unit	Content	Hours
1	DNA as a genetic material – Salient features, structure, forms. DNA replication - mechanism and types – Semiconservative, conservative and dispersive. Enzymes involved in DNA replication. Replication of DNA in eukaryotes. Fidelity of DNA replication. Inhibitors of DNA replication. RNA – Structure and types	18
2	Transcription in prokaryotes – Concept, mechanism, RNA polymerase and stages; General transcription in eukaryotes. Translation in prokaryotes and eukaryotes – stages and inhibitors of protein synthesis; Regulation of Gene expression – Lac Operon and Trp Operon.	18
3	Mutation - Definition and types. Physical and chemical mutagens. Uses of mutations. DNA Repair Mechanisms - Photoreactivation, Nucleotide Repair, Base Excision Repair, Methyl Directed Mismatch Repair and SOS Repair.	18
4	Plasmid – Structure, characteristics, types, plasmid copy number, plasmid vectors – pBR322, pUC8 and restriction enzymes; Bacteriophages – Structure, characteristics, Lambda phage Lytic and lysogenic cycle. Applications of phages in microbial genetics.	18
5	Gene Transfer Mechanisms – Conjugation, transformation and transduction. Blotting – southern, northern and western. Microinjection and gene gun.	18
	Total	90

CO	Course Outcomes
CO1	Analyze the significance of DNA and elucidate the replication mechanism & structure of RNA
CO2	Illustrate the protein synthesis machinery.
CO3	Infer the causes and types of DNA mutation and summarize the DNA repair mechanisms.
CO4	Evaluate the importance of plasmids and phages in genetics.
CO5	Analyze gene transfer methods.

Textbooks:

1. Malacinski G.M. (2015). Freifelder's Essentials of Molecular Biology. 4th Edition. Narosa Publishing House, New Delhi.
2. Gardner E. J. Simmons M. J. and SnustedD.P.(2006). Principles of Genetics. 8th Edition. Wiley India Pvt. Ltd.
3. Trun N. and Trempy J. (2009). Fundamental Bacterial Genetics. 1st Edition. Blackwell Science Ltd.

4	Brown T. A. (2016). Gene Cloning and DNA Analysis- An Introduction. (7th Edition). John Wiley and Sons, Ltd.
5	Dale J. W., Schantz M.V. and Plant N. (2012). From Gene to Genomes – Concepts and Applications of DNA Technology. (3rd Edition). John Wileys and Sons Ltd.

Reference Books:

1	Glick B. R. and Patten C.L. (2018). Molecular Biotechnology – Principles and Applications of Recombinant DNA. 5th Edition. ASM Press.
2	Russell P.J. (2010). iGenetics - A Molecular Approach, 3rd Edition., Pearson New International edn.
3	Nelson, D.L. and Cox, M.M. Lehninger(2017). Principles of Biochemistry. 7th Edition, W.H. Freeman.
4	Synder L., Peters J. E., Henkin T.M. and Champness W. (2013). Molecular Genetics of Bacteria, 4th Edition, ASM Press Washington-D.C. ASM Press.
5	Primrose S.B. and Twyman R. M. (2006). Principles of Gene Manipulation and Genomics. (7th Edition). Blackwell Publishing
Web resources:	
1	[PDF] Lehninger Principles of Biochemistry (8th Edition) By David L. Nelson and Michael M. Cox Book Free Download - StudyMaterialz.in
2	https://microbenotes.com/gene-cloning-requirements-principle-steps-applications/
3	https://courses.lumenlearning.com/boundless-biology/chapter/dna-replication/
4	Molecular Biology Notes - Microbe Notes
5	https://archive.nptel.ac.in/content/storage2/courses/102103015/module7/lec9/4.html

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	2	3	3	3	2	3
CO2	3	3	3	3	3	2	2	3	1	3	2
CO3	3	3	2	1	2	2	2	3	3	1	3
CO4	3	3	3	3	3	3	2	2	3	3	2
CO5	3	3	3	3	3	3	3	3	3	3	2
Total	15	15	13	12	13	12	12	14	13	12	12
Average	3.0	3.0	2.6	2.4	2.6	2.4	2.4	2.8	2.6	2.4	2.4

3 – Strong, 2- Medium, 1- Low

Course Code	Course Name	Cate gory	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
25UMBC32P	**PRACTICAL III – MOLECULAR BIOLOGY AND MICROBIAL GENETICS**	Core course - 6	0	0	3	0	2	3	25	75	100

Learning Objectives		
LO1	Elucidate the methods of Genomic and Plasmid DNA isolation.	
LO2	Understand the DNA and RNA estimation.	
LO3	Explain method of protein separation.	
LO4	Explain artificial transformation method.	
LO5	Analyze the isolation of phage from sewage.	
Unit	**Content**	**Hours**
1	Isolation of Genomic and Plasmid DNA from *E. coli*	09
2	Estimation of DNA using colorimeter (diphenylamine reagent), RNA (Orcinol method) UV spectrophotometer (A260 measurement).	09
3	Resolution and visualization of proteins by polyacrylamide gel electrophoresis (SDS-PAGE) – Demonstration. Isolation of UV induced auxotrophic mutants by replica plating technique	09
4	Isolation of antibiotic-resistant mutants by gradient plate method.	09
5	Screening and isolation of phages from sewage.	09
	Total	45

CO	Course Outcomes
CO1	Illustrate different types of DNA and RNA.
CO2	Utilize hands-on training in isolation of genomic and plasmid DNA.
CO3	Analyze importance of experimental microbial genetics.
CO4	Apply the knowledge of antibiotic resistant in various fields.
CO5	Investigate the significance of Phages.

Textbooks:	
1	Crichton. M. (2014). Essentials of Biotechnology. Scientific International Pvt Ltd.New Delhi.
2	Sambrook J. and Russell D.W. (2001). Molecular Cloning - A Laboratory Manual – 7th Edition. Cold Spring Harbor, N.Y: Cold Spring Harbor Laboratory Press.
3	Dale J. W., Schantz M. V. and Plant N. (2012). From Gene to Genomes – Concepts and Applications of DNA Technology. (3rd Edition). John Wileys and Sons Ltd.
4	Gunasekaran P. (2007). Laboratory Manual in Microbiology. New Age International.
5	James G Cappucino. and Natalie Sherman. (2016). Microbiology – A laboratory manual. (5th Edition). The Benjamin publishing company. New York.
Reference Books:	
1	Glick B. R. and Patten C.L. Molecular Biotechnology – Principles and Applications of Recombinant DNA. 5th Edition. ASM Press. 2018.
2	Russell P.J. (2010). Genetics - A Molecular Approach, 3rd Edition., Pearson New International edn.
3	Nelson, D.L. and Cox, M.M. Lehninger(2017). Principles of Biochemistry. 7th Edition, W.H. Freeman.
4	Synder L., Peters J. E., Henkin T.M. and Champness W. (2013). Molecular Genetics of Bacteria, 4th

	edition, ASM Press Washington-D.C. ASM Press.
5	Brown T.A. (2016). Gene Cloning and DNA Analysis. (7th Edition). John Wiley and Jones, Ltd.
6	Glick B. R. and Patten C.L. Molecular Biotechnology – Principles and Applications of Recombinant DNA. 5th Edition. ASM Press. 2018.
Web resources:	
1	https://www.molbiotools.com/usefullinks.html
2	(PDF) Molecular Biology Laboratory manual (researchgate.net)
3	https://www.molbiotools.com/usefullinks.html
4	https://geneticgenie.org3.
5	http://acl.digimat.in/nptel/courses/video/102103341/L11.html

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	2	3	3	3	2	3	1	3	3	3	3
CO2	3	2	3	3	3	3	1	3	3	3	3
CO3	3	3	3	3	2	3	1	3	3	3	3
CO4	3	3	2	2	3	3	1	3	3	3	3
CO5	3	3	3	3	2	3	1	3	3	3	3
Total	14	14	14	14	12	15	5	15	15	15	15
Average	2.8	2.8	2.8	2.8	2.4	3	1	3	3	3	3

3 – Strong, 2- Medium, 1- Low

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
25UMBA31	**CLINICAL LABORATORY TECHNOLOGY**	Elective course - 4	**3**	**1**	**0**	**0**	**4**	**4**	**25**	**75**	**100**

Course Objectives	
CO1	Understand the fundamental principles, professional code of conduct, and safety protocols within a clinical laboratory setting.
CO2	Explain the procedures for patient assessment, specimen collection, processing, and transportation for various biological samples.
CO3	Describe the basic histological techniques for tissue processing, fixation, and section cutting.
CO4	Identify routine and specialized laboratory methods used in hematology for investigating coagulation disorders.
CO5	Recognize the importance of quality standards and accreditation in the pre-analytical, analytical, and post-analytical phases of testing.

Unit	Details	No. of Hours
1	Introduction to Clinical Laboratory Science: Basic laboratory principles - Code of conduct for medical laboratory personnel. Organization of clinical laboratory and role of medical laboratory technician - Safety measures. Assessment of a patient and brief history of collection. Maintenance of Hygiene & Infection Control Practices.	12
2	Specimen collection and processing - Blood, urine, stool, sputum, CSF, amniotic fluid and bile. Separation of serum and plasma, Handling of specimens for testing, preservation of specimens, transport of specimens and factors affecting the clinical results.	12
3	Introduction to histopathology-Methods of examination of tissues and cells, Fixation of tissues: Classification and properties of fixatives. Tissue processing - Collection of specimens, Labeling and fixation, Dehydration, Clearing, Impregnation, Embedding - Paraffin block making, Section Cutting.	12
4	Introduction to Haematology- Laboratory methods used in the investigation of coagulation disorders - coagulation tests, Routine coagulation tests – Prothrombin time (PT) and Thrombin time (TT), Laboratory diagnosis of bleeding disorders. Estimation of fibrinogen, Assay of coagulation factors.	12
5	Quality Standards in Health Laboratories – Development and implementation of standards, Accreditation Boards – NABCB. NABL, ISO, NABH, CAP, COLA, Performing quality assessment - pre-analytical, analytical and post-analytical phases of testing.	12
	Total	60

CO	Course Outcomes
CO1	Adhere to safety measures and professional ethics while working in a clinical laboratory environment.
CO2	Demonstrate the correct techniques for collecting, handling, and preserving various clinical specimens to ensure accurate results.
CO3	Apply basic principles of histopathology to prepare tissue samples for microscopic examination.
CO4	Perform routine coagulation tests and assist in the laboratory diagnosis of bleeding disorders.
CO5	Implement quality assessment practices in alignment with standards set by accreditation bodies like NABL and ISO.

Text Books	
1.	Mukharji,K.L. (2000). Medical Laboratory Techniques, Vol - I, II & III, 5th Edition. Tata McGrawHill, Delhi.
2.	Ochei,A., Kolhatkar.A. (2000). Medical Laboratory Science: Theory and Practice, McGraw Hill Education.
3	Ramnik Sood (2015) Concise Book of Medical Laboratory Technology: Methods and Interpretation, 2ndEdition, Jaypee Brothers Medical Publishers, NewDelhi.
4	S. Ramakrishnan and K.N. Sulochana. 2012. Manual of Medical Laboratory Techniques,Jaypee Brothers Medical Publishers Pvt. Ltd
5	Talib V.H. (2019).Handbook Medical Laboratory Technology, 2ndEdition, Directorate of health services, Government of India.
References Books	
1	Rutherford, B.H. Gradwohl , A.C. Sonnenwirth L. Jarett. Gradwohls. (2000). Clinical Laboratory Methods and Diagnosis, Vol-I, 8th edition, Mosby.
2	Baker, F.J., Silverton, R.E., and Pallister,.J. (1998). An Introduction to Medical Laboratory Technology, 7thEdition, CBS Publishers and Distributors Pvt. Ltd.
3	Godkar (2021).Textbook of Medical Laboratory Technology, 3rdEdition, Bhalani Publishing House.
4	M.N.Chatterjee and Rana Shinde. (2008). Textbook of Medical Biochemistry, 7thEdition, Jaypee Brothers Medical Publishers Pvt. Limited.
5	James G Cappucino. and Natalie Sherman. (2016). Microbiology – A laboratory manual.(5th Edition).The Benjamin publishing company. New York.
Web Resources	
1	https://www.jaypeedigital.com › book
2	https://www.pdfdrive.com › wintrobes-clinical-hematology
3	https://currentprotocols.onlinelibrary.wiley.com/doi/pdf/10.1002/cpet.5
4	https://gppanchkula.ac.in/e-notes-medical-lab-technology/
5	https://www.scribd.com/doc/24005424/Clinical-Laboratories

Mapping with Programme Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	3	3	3	2	3	2	3	1
CO2	3	3	3	2	3	3	3	2	3	2	3
CO3	3	1	2	3	3	3	2	3	2	2	3
CO4	3	3	2	3	3	3	2	3	1	3	2
CO5	3	3	1	2	3	2	1	2	2	1	2
Total	15	13	10	13	15	14	10	13	10	11	11
Average	3.0	2.6	2.0	2.6	3.0	2.8	2.0	2.6	2.0	2.2	2.2

3 – Strong, 2 - Medium, 1 – Low

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
25UMBA32	**MICROALGAL TECHNOLOGY**	Elective course - 5	**3**	**0**	**0**	**0**	**2**	**3**	**25**	**75**	**100**

Course Objectives	
CO1	To learn the basic tools in Microbial Biotechnology.
CO2	To learn about classification, characteristics of microalgae.
CO3	To formulate algal cultures and importance of culture collections.
CO4	To learn Upstream and Downstream techniques of microalgae.
CO5	To analyze the benefits of Microalgae for this universe.

Unit	Details	No. of Hours
1	Microalgae – Characteristics, Morphology, Habitat, Reproduction and Life cycle; Cyanobacteria; Freshwater algae and Marine algae; Factor influence Algal growth – Nutrients, Temperature and Light; Economical importance of Microalgae.	09
2	Microscopic examination of Algae; Cultivation of Algae in Culture medium; Photobioreactor based Microalgal production; Algal Single Cell Proteins (SCP); Mass cultivation of Chlorella, Spirulina and Dunaliella.	09
3	Microalgal Proteins and Peptides; Pigments and Food colorants from Microalgae; Growth promoting substance from Microalgae; Extracellular polymeric Substance from Algae.	09
4	Microalgae in Human welfare –Nutraceuticals, Pharmaceuticals, Biofertilizers (BGA) and Pollution control; Biofuels from Algae; Nanoparticles from microalgae; Algae in Transgenics; Microalgae in CO_2 sequestration.	09
5	Application of Microalgae in Synthetic biology; Bioluminescence; Quorum sensing in Microalgae; Algae in Space; Microalgal Toxins.	09
	Total	45

Course Outcomes	
Course Outcomes	On completion of this course, students will;
CO1	Understanding the benefits of Algae to environment.
CO2	Formulate algal cultures and importance of culture collections.
CO3	Describe commercial production of fuels and microbial enzymes.
CO4	Apply knowledge on Basic cultivation technology of microalgal cultivation technique.
CO5	Develop techniques on removal of heavy metals from contaminated water using microalgae.

Text Books	
1.	Amrik, S. A. 2003. Phycology: Principles, processes and applications. Daya Publishing House, New Delhi, India.
2.	Steve, P. 2009. Protozoans, Algae & amp; Other Protists, Capstone Press, USA.
3	Hoek, C., Mann, D. G and Jahns, H. M. 1995. Algae - An Introduction to Phycology, 39; Cambridge University Press, UK.
4	Sharma, O. P. 2001. Textbook of Algae. Tata McGraw Hill Company, New Delhi, India.

References Books	
1	Ismail, R., Sanjay K. Gupta, Amritanshu, S., Poonam, S., Sheena, K and Faizal, B. 2016. Microalgae Applications in Wastewater Treatment. 7th Edition, New India Publication, New Delhi, India.
2	Biris, E. S., Maria, T., Tania, M., Radu, M and Antonia, O. 2016. Applications of Microalgae in Wastewater Treatments. ProEnvironment, India.
3	Stephen, J. O. 1993. Bacteria, Algae, and Protozoa - Cold Spring Harbor Laboratory Press, USA.
4	Sarabhai, B. P and Arora, C. K. 2005. Textbook of Algae. Anmol Publishing Pvt. Ltd. New Delhi, India.
Web Resources	
1	https://search.worldcat.org/zh-cn/title/827267000
2	https://lib.rivier.edu/search?/aRichman%2C+Kimberly+D./arichman+kimberly+d/-3%2C-1%2C0%2CB/frameset&FF=arichmond+amos&1%2C1%2C
3	https://www.routledge.com/Algal-Biotechnology-Applications-for-Industrial-Development-and-Human-Welfare/Sahu-Sridhar/p/book/9781003219194
4	https://www.kci.go.kr/kciportal/ci/sereArticleSearch/ciSereArtiView.kci?sereArticleSearchBean.artiId=ART002385488#listCita
5	https://www.slideshare.net/slideshow/nptel-biomass-refinery-bookpdf/252031686

Mapping with Programme Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	3	3	3	2	3	2	3	1
CO2	3	3	3	2	3	3	3	2	3	2	3
CO3	3	1	2	3	3	3	2	3	2	2	3
CO4	3	3	2	3	3	3	2	3	1	3	2
CO5	3	3	1	2	3	2	1	2	2	1	2
Total	15	13	10	13	15	14	10	13	10	11	11
Average	3.0	2.6	2.0	2.6	3.0	2.8	2.0	2.6	2.0	2.2	2.2

3 – Strong, 2 - Medium, 1 – Low

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
25UMBS31	**ORGANIC FARMING & BIOFERTILISER TECHNOLOGY**	Skill Elective course - 4	**1**	**0**	**1**	**0**	**2**	**2**	**25**	**75**	**100**

Course Objectives	
CO1	Impart knowledge about the significance of organic farming and strategies to increase the yield to conserve environment.
CO2	To encourage organic farming in urban areas.
CO3	Comprehensive knowledge about bacterial biofertilizers, its advantages and future perspective.
CO4	Structure and characteristic features of Cyanobacterial and fungal biofertilizer
CO5	Develop the knowledge and skill to produce, analyze the quality of packaging, storage and assess the shelf life and bioefficacy of biofertilizers.

Unit	Details	No. of Hours
1	Organic farming – definition, history and scope. Biofertilizer – introduction, types and significance. Role of beneficial microbes in soil fertility	06
2	PGPR - Nitrogen fixing microbes – Symbiotic N2 fixers: Rhizobium - isolation, identification and mass production (liquid and solid state), carrier material selection (lignite, peat and charcoal). Associative and free living N2 fixers – Azospirillum and Azotobacter – isolation and mass multiplication.	06
3	Phosphate solubilizers - Bacteria (*Bacillus megaterium*, *Pseudomonas striata*) and Fungi (*Aspergillus awamori*, *Penicillium*). Phosphate mobilizers – AMF / VAM.	06
4	Composting – Aerobic and anaerobic methods, green manuring, panchakavya – green leaf manuring. Plant health management, biological control agents – Trichoderma and Pseudomonas fluorescens of disease suppression. Biopesticides – Bacillus thuringiensis.	06
5	Biofertilizer production technology – fermentation and lyophilized inoculants, Quality control standards, testing for efficiency parameters. Regulatory scenario – certification, labeling and accreditation procedures for organic products.	06
	Total	30

Course Outcomes	
Course Outcomes	On completion of this course, students will;
CO1	Become an Entrepreneur with wide knowledge about farming and sustainable resources.
CO2	Implement organic farming in urban areas with knowledge on compost.
CO3	Gain knowledge about the bacterial biofertilizers and its advantages
CO4	Understand the significance about Cyanobacterial and fungal biofertilizers
CO5	Understand and implement the use of bio fertilizers.

Text Books	
1.	A.K. Sharma (2006). Hand book of Organic Farming
2.	A.C.Gaur (2017). Hand book of Organic Farming and Biofertilizers
3	N.S. Subbarao (2017). Bio-fertilizers in Agriculture and Forestry (4th Edition) Med tech publisher
4	SubbaRao, N. S. (2002). Soil Microbiology. Soil Microorganisms and Plant Growth. (4th Edition), Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
5	Dubey, R. C. (2008). A Textbook of Biotechnology. S. Chand & Co., New Delhi.
References Books	
1	Masanobu Fukuoka, Frances Moore Lappe Wendell Berry (2009). The One-Straw Revolution: An Introduction to Natural Farming, 1st edition, YRB Classics.
2	SujitChakrabarty(2018). Organic Home Gardening Made Easy, 1st Edition,
3	Singh and Purohit (2008). Biofertilizer technology. Agrobios, India.
4	Bansal M (2019). Basics of Organic Farming CBS Publisher.
5	Hurst, C.J., Crawford R.L., Garland J.L., Lipson D.A., Mills A.L. and Stetzenbach L.D. (2007). Manual of Environmental Microbiology. (3rd Edition). American Society for Microbiology.
Web Resources	
1	https://agritech.tnau.ac.in/org_farm/orgfarm_introduction.html
2	https://www.fao.org/organicag/oa-faq/oa-faq6/en/
3	https://www.india.gov.in/topics/agriculture/organic-farming
4	https://www.scribd.com/document/787697965/Organic-Farming-and-Biofertilizer-Technology
5	https://agritech.tnau.ac.in/ta/org_farm/orgfarm_compost.html

Mapping with Programme Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	3	3	3	2	3	2	3	3
CO2	3	3	3	2	3	3	3	2	3	2	3
CO3	3	1	2	3	3	3	2	3	2	2	3
CO4	3	3	2	3	3	3	2	3	3	3	3
CO5	3	3	1	2	3	2	1	2	2	1	3
Total	15	13	10	13	15	14	10	13	12	11	15
Average	3.0	2.6	2.0	2.6	3.0	2.8	2.0	2.6	2.4	2.2	3.0

3 – Strong, 2 - Medium, 1 – Low

SECOND YEAR – IV SEMESTER

Course Code	Course Name	Cate gory	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
25UMBC41	**IMMUNOLOGY AND IMMUNOTECHNOLOGY**	Core course - 7	3	1	2	0	5	6	25	75	100

Learning Objectives	
LO1	To gain knowledge about immune system, organs of immunity and cells involved.
LO2	To distinguish the types of antigens and antibodies; their properties.
LO3	To provide in-depth knowledge on immuno-techniques.
LO4	To discuss the role of MHC system in transplantation; functions of Tumor specific antigens.
LO5	To impart knowledge on immunological disorders.

Unit	Content	Hours
1	History of Immunology: Contributions of Lous Pasteur, Edward Jenner, Elie Metchnikoff and Karl Landsteiner. Cells involved in immune response – Lymphoid cells, myeloid cells and erythroid cells. Hematopoiesis, Structure and function of primary and secondary lymphoid organs – thymus, bone marrow, lymph node and spleen. Types of immunity – innate, acquired and herd.	18
2	Antigen and Antibody: Antigens - Properties of haptens, epitopes, adjuvants, and cross reactivity; Antibodies- structure, properties, classes (IgG, IgA, IgM, IgD & IgE). Production of antibodies – hybridoma technology; Applications of Monoclonal antibodies	18
3	Antigen and Antibody interactions - Immunodiffusion (SRID and ODD), immunoelectrophoresis. Agglutination test (Hemagglutination – Blood group and TPHA), Latex agglutination (ASO, CRP & RPR), Immunofluorescence test, ELISA, RIA and Western Blot.	18
4	Complement system – Types - Classical, alternative and lectin pathway. Biological function of 'C' proteins. Cytokines – structure and function. Vaccines – Live attenuated, toxoid, subunit, conjugate, viral vector, mRNA and DNA vaccines. Immunization schedule.	18
5	Immunodeficiency diseases - Autoimmune diseases, Hypersensitivity reactions and types. Major histocompatibility complex – MHC genes, class I, class II and class II MHC molecules, HLA tissue typing. Transplant Immunology	18
	Total	90

CO	Course Outcomes
CO1	Assess the fundamental concepts of immunity, contributions of the organs and cells in immune responses.
CO2	Investigate the structures of Ag and Ab; Immunization.
CO3	Justify the Immunoassay and Immunotechniques.
CO4	Explain about the immunologic processes governing graft rejection and therapeutic modalities for immunosuppression in transplantation
CO5	Analyze the overreaction by our immune system leading to hypersensitive conditions and its consequences.

Textbooks:	
1	Richard Coico, Geoffrey Sunshine, Eli Benjamini. (2003). Immunology – A Short Course. 5thEdition., Wiley-Blackwell, New York.
2	Judith A.Owen, Jenni Punt, Sharon A. Stranford, Janis Kuby. (2013). Immunology, 7thEdition., W. H. Freeman and Company, New York.
3	Abul K. Abbas, Andrew H. Lichtman, Shiv Pillai. (2021). Cellular and Molecular Immunology, 10thEdition.,Elsevier.
4	Robert R. Rich, Thomas A. Fleisher, William T. Shearer, Harry Schroeder, Anthony J. Frew, Cornelia M. Weyand. (2018).Clinical Immunology: Principles and Practice, 5th Edition. Elsevier.
5	Pravash Sen. Gupta. (2003). Clinical Immunology. Oxford University Press.

Reference Books:

1	Janeway Travers. (1997). Immunobiology- the immune system in health and disease. Current Biology Ltd. London, New York. 3rd Edition.
2	Peter J. Delves, Seamus Martin, Dennis R. Burton, Ivan M. Roitt. (2006). Roitt's Essential Immunology, 11thEdition.,Wiley-Blackwell.
3	William R Clark. (1991). The Experimental Foundations of Modern Immunology. 3rdEdition. John Wiley and Sons Inc. New York.
4	Frank C. Hay, Olwyn M. R. Westwood. (2002). Practical Immunology, 4thEdition., Wiley-Blackwell.
5	Noel R. Rose, Herman Friedman, John L. Fahey. (1986). Manual of Clinical Laboratory Immunology. ASM.3rd Edition.
Web resources:	
1	https://www.ncbi.nlm.nih.gov/books/NBK279395/
2	https://med.stanford.edu/immunol/phd-program/ebook.html
3	https://ocw.mit.edu/courses/hst-176-cellular-and-molecular-immunology-fall- 2005/pages/lecture-notes/
4	Immunology Overview - Medical Microbiology - NCBI Bookshelf (nih.gov)
5	https://archive.nptel.ac.in/content/storage2/courses/102103038/download/module1.pdf

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	3	3	3	3	2	3
CO2	3	2	3	3	2	2	2	3	1	3	2
CO3	3	3	2	1	2	2	2	3	3	1	3
CO4	3	3	2	3	2	2	2	2	3	3	2
CO5	3	2	3	3	3	3	3	3	3	3	2
Total	15	13	13	12	11	12	12	14	13	12	12
Average	3.0	2.6	2.6	2.4	2.2	2.4	2.4	2.8	2.6	2.4	2.4

3 – Strong, 2- Medium, 1- Low

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
25UMBC42P	**PRACTICAL IV- IMMUNOLOGY AND IMMUNOTECHNOLOGY**	Core course - 8	0	0	3	0	2	3	25	75	100

Learning Objectives	
LO1	To gain hands-on knowledge to identify Blood group and typing.
LO2	To acquire adequate skill to perform latex agglutination reactions.
LO3	To analyze precipitation reactions in gels.
LO4	To investigate the antigen & antibody reactions in electrophoresis.
LO5	To familiarize with blood cell counting

Unit	Content	Hours
1	Identification of blood group and typing.	09
2	Latex Agglutination reactions- RF, ASO, CRP	09
3	Double immune diffusion Single Radial Immuno Diffusion Method.	09
4	Electrophoresis - Serum and Immuno. ELISA - Demo	09
5	WBC counting RBC counting Differential blood count	09
	Total	45

CO	Course Outcomes
CO1	Assess the blood groups and types
CO2	Competently perform serological diagnostic tests such as RF, ASO, CRP
CO3	Illustrate the antigen antibody reactions in gel.
CO4	Compare & contrast antigens and antibodies in electrophoresis
CO5	Examine the immune cells

Textbooks:	
1	Talwar. (2006). Hand Book of Practical and Clinical Immunology, Vol. I, 2nd edition, CBS.
2	Asim Kumar Roy. (2019). Immunology Theory and Practical**,** Kalyani Publications.
3	Richard Coico, Geoffrey Sunshine, Eli Benjamini. (2003). Immunology – A Short Course. 5thEdition., Wiley-Blackwell, New York.
4	Judith A.Owen, Jenni Punt, Sharon A. Stranford, Janis Kuby. (2013). Immunology, 7thEdition., W. H. Freeman and Company, New York.
5	Pravash Sen. Gupta. (2003). Clinical Immunology. Oxford University Press.

Reference Books:

1	Frank C. Hay, Olwyn M. R. Westwood. (2008).Practical Immunology, 4th Edition, Wiley Blackwell.
2	Wilmore Webley. (2016). Immunology Lab Manual, LAD Custom Publishing.
3	Rose. (1992). Manual of Clinical Lab Immunology, ASM.
4	Janeway Travers. (1997). Immunobiology- the immune system in health and disease. Current Biology Ltd. London, New York. 3rd Edition.
5	Peter J. Delves, Seamus Martin, Dennis R. Burton, Ivan M. Roitt. (2006). Roitt's Essential Immunology, 11thEdition.,Wiley-Blackwell.
Web resources:	
1	https://www.researchgate.net/publication/275045725_Practical_Immunology_A_Laboratory_Manual
2	https://www.urmc.rochester.edu/MediaLibraries/URMCMedia/labs/frelingerlab/documents/Immunology-Lab-Manual.pdf
3	https://courses.lumenlearning.com/boundless-biology/chapter/dna-replication/
4	Immunology Overview - Medical Microbiology - NCBI Bookshelf (nih.gov)
5	https://webstor.srmist.edu.in/web_assets/downloads/2021/18BTC106J-lab-manual.pdf

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	3	3	3	2	3
CO2	3	2	3	3	2	2	2	3	1	3	2
CO3	3	3	2	1	2	3	2	3	3	1	3
CO4	3	3	2	3	2	3	2	2	3	3	2
CO5	3	2	3	3	3	3	3	3	3	3	2
Total	15	13	13	12	11	13	12	14	13	12	12
Average	3.0	2.6	2.6	2.4	2.2	2.6	2.4	2.8	2.6	2.4	2.4

3 – Strong, 2- Medium, 1- Low

Course Code	Course Name	Cate gory	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
25UMBA41	**FOOD PROCESSING TECHNOLOGY**	Elective course - 6	3	1	0	0	4	4	25	75	100

Learning Objectives	
LO1	To provide knowledge on objectives of food preservation.
LO2	To explain the freshness criteria and quality assessment of meat and fish.
LO3	To outline the methods of milk processing and fermented milk products.
LO4	To explain the importance of fat and oil processing.
LO5	To discuss the methods of microbiological examination of foods.

Unit	Content	Hours
1	Introduction to food preservation –objectives and techniques of food preservation. Preservation: principles of high temperature, low temperature, radiation, chemical preservatives and bio preservatives	12
2	Freshness criteria and quality assessment of meat and fish – spoilage and methods of preservation. Production of byproducts after processing waste and their utilization. Role of packaging material, types of packaging material.	12
3	Composition of milk; assessment of milk, thermal processing of fluid milk - pasteurization (LTH, HTST & UHT techniques). Fermented milk products-cheese, Butter milk, Yogurt, Kumis, Kefir and Acidophilus milk. Hygiene and sanitation requirement in food processing and fermentation industries.	12
4	Importance of fats and oils in Food-Extraction of fats and Oils- Rendering, pressing, solvent extraction, pressing of oil - degumming, refining, bleaching, deodorization, fractionation, pyrolysis of fats, toxicity of frying oil.	12
5	Methods for the microbiological examination of foods. Food borne illness and diseases. Microbial cultures for food fermentation. Indian Factories Act on safety, HACCP, Safety from adulteration of food.	12
	Total	60

CO	Course Outcomes
CO1	Assess the fundamental concepts of food preservation.
CO2	Investigate the quality assessment of meat and fish.
CO3	Design the processing of milk and milk quality assessment.
CO4	Explain about the importance of fats and oils.
CO5	Plan the food safety and adulteration detection.

Textbooks:	
1	Avantina Sharma. (2006). Text Book of Food Science and Technology, International Book Distributing Co, Lucknow, UP.
2	Sivasankar. (2005). Food Processing and Preservation, 3rd Edition.,Prentice hall of India Pvt Ltd, NewDelhi.
3	Ramaswamy H & Marcotte M. (2006). Food Processing: Principles & Applications. Taylor & Francis.
4	NIIR Board of Food and Technologist. (2005). Modern Technology of Food Processing and Agrobased industries, National Institute of Industrial Research, Delhi.
5	Adams M.R. and Moss M. O (2007).Food Microbiology.New Age International.

Reference Books:

1	Fellos PJ. (2005). Food Processing Technology: Principle &Practice 2ndEdition. CRC.
2	Peter Zeuthen and Leif Bogh-Sorenson. (2005). Food Preservation Techniques, Woodl and Publishing Ltd, Cambridge, England.
3	Gustavo V. Barbosa-Canovas, Maria S. Tapia, M. Pilar Cano. (2004). Novel Food Processing Technologies, CRC.
4	Suman Bhatti, Uma Varma. (1995). Fruit and vegetable processing organizations and institutions, 1st Edition., CBS Publishing, New Delhi.
5	MirdulaMirajkar, Sreelatha Menon. (2002). Food Science and Processing Technology Vol-2,Commercial processing and packaging, Kanishka publishers, New Delhi.
Web resources:	
1	https://sites.google.com/a/uasd.in/ecourse/food-processing-technology
2	https://nptel.ac.in/courses/1261050
3	https://engineeringinterviewquestions.com/biology-notes-on-food-adulteration/
4	Food Processing Technology | Food News & Views Updated Daily (foodprocessingtechnology. com)
5	https://archive.nptel.ac.in/content/storage2/courses/103103029/module6/lec34/1.html

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	3	3	3	3	2	3
CO2	3	2	2	3	2	3	2	3	2	3	2
CO3	3	3	2	2	2	2	2	3	3	2	3
CO4	3	3	2	3	2	2	2	2	3	3	2
CO5	3	2	3	3	3	3	3	3	3	3	2
Total	15	13	12	13	11	13	12	14	14	13	12
Average	3.0	2.6	2.4	2.6	2.2	2.6	2.4	2.8	2.8	2.6	2.4

3 – Strong, 2- Medium, 1- Low

Course Code	Course Name	Cate gory	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
25UMBA42	**VERMITECHNOLOGY**	Elective course - 7	3	0	0	0	2	3	25	75	100

Learning Objectives	
LO1	To study about the properties of Vermicomposting.
LO2	To classify and compare the characteristics of Earthworm species.
LO3	To describe the process and benefits of Vermicomposting.
LO4	To understand the biology of Earthworms and its role in Vermicomposting.
LO5	To learn the ability of Earthworms in Organic farming and Solid waste reclamation.

Unit	Content	Hours
1	Vermitechnology – History and Scope; Influence of Soil Microorganisms in Vermitechnology; Development and Future of Vermitechnology in India and other countries.	09
2	Earthworm – Diversity, Morphology and Life cycle; Burrowing activity of Earthworms; Effect of Earthworm is Soil structure; Microclimate of Rhizosphere and Drillosphere.	09
3	Composting – Process and Substrate used in Microbial Composting and Vermicomposting; Difference between Microbial Composting and Vermicomposting; Vermicast; Factors affecting Composting process; Analysis of Physico-chemical characteristics and Microbial quality of Compost materials.	09
4	Earthworm in Vermicompost – *Eisenia fetida, Eisenia andrei, Eudrilus eugeniae* and *Perionyx excavates*; Feeding habits and food for Composting worms; Packaging, Marketing and Cost benefit analysis of Vermicompost; Applications of Vermicompost.	09
5	Vermiculture; Vermiculture Unit – Materials Required and Maintenance; Vermiwash and its Applications; Problems during Vermicomposting; Benefits of Earthworms other than Vermicomposting.	09
	Total	45

CO	Course Outcomes
CO1	Provide the knowledge to the students about Organic farming through Composting and Vermicomposting.
CO2	Compare the difference between Microbial composting and Vermicomposting.
CO3	Observe the Biology of Earthworms and its role in Vermicomposting process.
CO4	Finding the details of Earthworms and its role in Solid waste reclamation.
CO5	Categorize the types of Earthworms and feed needed for Vermicomposting.

Textbooks:	
1	Vijaya Ramesh, K. 2019. Environmental Microbiology, MJP Publishers, Chennai, India.
2	Subba Rao N.S. 2017. Soil Microbiology, 4th Edition, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, India.
3	Satchell, J. E. 1983. Earthworm Ecology: From Darwin to Agriculture. Chapman and Hall, London.
4	Singh, M.K. & Singh, P. 2015. Handbook on Vermicomposting: Requirements, Methods, Advantages and Applications, 1st Edition, Anchor Academic Publishing, Hamburg

Reference Books:

1	Satyanarayana, U. 2005. Biotechnology, 1st Edition, Books and Allied (P) Ltd., Kolkata, India.
2	Edwards, C. A and Bohlen, P. J. 2010. Biology and Ecology of Earthworms. 3rd Edition, Chapman and Hall, London.
3	Ismail, S. A. 2011. Vermitechnology: The Biology Earth worm. 4th Edition, Orient Longman, United Kingdom.
4	Kale Radha, D. 2015. Earthworm: Cinderella of organic farming. 2nd Edition, Prism Books Pvt. Ltd., Bangalore, India.
Web resources:	
1	https://soil.evs.buffalo.edu/index.php?title=Red_wiggler_worms&direction=next&oldid=5620
2	https://journals.indexcopernicus.com/search/article?articleId=4687588
3	https://www.motherearthnews.com/organic-gardening/guide-to-vermicomposting-zmaz83jazshe/
4	https://www.konaequity.com/company/vermitechnology-unlimited-10399546718/
5	https://gacbe.ac.in/pdf/ematerial/18BZO35S-U1.pdf

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	3	3	3	3	2	3
CO2	3	2	3	3	2	2	2	3	1	3	3
CO3	3	3	2	1	2	2	2	3	3	1	3
CO4	3	3	2	3	2	2	2	2	3	3	3
CO5	3	2	3	3	3	3	3	3	3	3	3
Total	15	13	13	12	11	12	12	14	13	12	15
Average	3.0	2.6	2.6	2.4	2.2	2.4	2.4	2.8	2.6	2.4	3.0

3 – Strong, 2- Medium, 1- Low

Course Code	Course Name	Cate gory	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
25UMBS41	**MUSHROOM TECHNOLOGY**	Skill Elective course - 5	1	0	1	0	2	2	25	75	100

Learning Objectives	
LO1	To encode the Nutritional and Medicinal importance of the Mushrooms.
LO2	To differentiate Edible and Poisonous Mushrooms and their effects.
LO3	To gain a good understanding on Substrates and Spawn production for Mushroom cultivation.
LO4	To obtain knowledge on Post-harvest Technology of Mushrooms.
LO5	To understand various Mushroom diseases and its control measures.

Unit	Content	Hours
1.	Mushroom – Historical development, Morphology and Life cycle; Classification of Mushroom; Nutritional & Medicinal value of Mushroom; Edible and non-edible mushroom; Medicinal and Environmental uses of Mushrooms.	06
2.	Mushroom farms – Farm layout and Farm hygiene; Substrates used for Mushroom cultivation; Spawn production, Starter culture, Sterilization process, Clean Environmental Condition, Cultures, Preparation of Media & Slants, Spawn containers, Mother Spawn, Preparation of Final Spawn, Precautions and Storage of Spawn.	06
3.	Growth factors for Mushroom cultivation; Cultivation of Button mushroom (*Agaricus bisporus*), Oyster mushroom (*Pleurotus sajor – caju*), Milky mushroom (*Calocybe indica*) and Paddy straw mushroom (*Volvariella volvacea*); Insect pests and its management during Mushroom cultivation.	06
4.	Diseases of Mushrooms – Bacterial disease (Bacterial blotch, Mummy disease & Drippy gill), Viral disease (Die back disease); Fungal diseases (Dry bubble disease, Wet bubble disease, Cobweb disease, *Trichoderma* Blotch).	06
5.	Post-harvest Technology of Mushroom – Harvesting, Grading, Packaging & Storage. Transportation, Preservation and Marketing (Fresh market and Drying); Environmental impact of Mushroom cultivation; Mushroom food recipes; Mushroom Research Centers in India.	06
	Total	30

CO	Course Outcomes
CO1	Provides the information about the Cultivation, Nutritional value and Pharmacological value of Mushrooms.
CO2	Gaining knowledge about different types of Edible and Poisonous mushrooms.
CO3	Analyze the pathological damages caused by microorganisms on mushrooms.
CO4	Demonstrate the methods for Disease control in Mushrooms.
CO5	Develops Entrepreneurial skill on Production and Marketing of Mushroom.

Textbooks:	
1	Kannaiyan. 2001. Handbook of Edible Mushrooms, TNAU Publication, Coimbatore, India.
2	Alice, D., K. Muthusamy and M. Yesuraja. 1999. Mushroom Culture, Agricultural College, Research Institute Publications, Madurai, Tamil Nadu, India.
3	Manigandan, M and P. Saranraj. 2024. Textbook of Mushroom Technology. JPS Scientific Publication, India.

Reference Books:

1	Marimuthu, T. 1991. Oster Mushroom, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.
2	Nita Bhal. 2000. Handbook on Mushrooms, 2nd Edition, Volume - I and II, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, India.
3	Tripathi, D. P. 2005. Mushroom Cultivation, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, India.
Web resources:	
1	https://www.mushroomlink.com.au/?userIdentifier=69717461
2	https://agris.fao.org/search/en/records/6759749ac7a957febdf747c8
3	https://www.mdpi.com/2309-608X/12/3/205
4	https://pubmed.ncbi.nlm.nih.gov/40558962/
5	https://www.scribd.com/document/843693367/Mushroom-Culture-Technology-Biologynotesonline

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	2	3	3	3	2	3
CO2	3	2	2	3	2	3	2	3	1	3	3
CO3	3	3	3	2	3	2	2	3	3	2	3
CO4	3	3	2	3	2	3	2	2	3	3	3
CO5	3	2	3	3	3	2	3	3	3	3	3
Total	15	13	12	13	13	12	12	14	13	13	15
Average	3.0	2.6	2.4	2.6	2.6	2.4	2.4	2.8	2.6	2.6	3.0

3 – Strong, 2- Medium, 1- Low