

B.SC.,
MICROBIOLOGY

SYLLABUS

FROM THE ACADEMIC YEAR

2023-2024

**TAMILNADU STATE COUNCIL FOR HIGHER EDUCATION,
CHENNAI – 600 005**

Contents

- i. PO and PSO Description
- ii. Methods of Evaluation & Methods of Assessment
- iii. Semester Index.
- iv. Subjects – Core, Elective, Non major, Skill Enhanced, Ability Enhanced, Extension Activity, Environment, Professional Competency
 - 1) Course Lesson Box
 - 2) Course Objectives
 - 3) Units
 - 4) Learning Outcome
 - 5) Reference and Text Books
 - 6) Web Sources
 - 7) PO Mapping tables

LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK GUIDELINES BASED REGULATIONS FOR UNDER GRADUATE PROGRAMME

Programme:	B.Sc. MICROBIOLOGY
Programme Code:	
Duration:	3 Years (UG)
Programme Outcomes:	<p>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</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>PO6: Research-related skills: A sense of inquiry and capability for asking relevant/appropriate questions, problem arising, synthesising 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</p> <p>PO7: Cooperation/Team work: 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</p> <p>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.</p> <p>PO9: Reflective thinking: Critical sensibility to lived experiences, with self awareness and reflexivity of both self and society.</p> <p>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.</p> <p>PO 11 Self-directed learning: Ability to work independently, identify appropriate resources required for a project, and manage a project through to completion.</p> <p>PO 12 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.</p>

	<p>PO 13: 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 behaviour 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.</p> <p>PO 14: 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.</p> <p>PO 15: 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.</p>
<p>Programme Specific Outcomes:</p>	<p>On successful completion of Bachelor of Physics with Computer Applications programme, the student should be able to:</p> <p>PSO1: Disciplinary Knowledge: Understand the fundamental principles, concepts, and theories related to physics and computer science. Also, exhibit proficiency in performing experiments in the laboratory.</p> <p>PSO2: Critical Thinking: Analyse complex problems, evaluate information, synthesize information, apply theoretical concepts to practical situations, identify assumptions and biases, make informed decisions and communicate effectively</p> <p>PSO3: Problem Solving: Employ theoretical concepts and critical reasoning ability with physical, mathematical and technical skills to solve problems, acquire data, analyze their physical significance and explore new design possibilities.</p> <p>PSO4: Analytical & Scientific Reasoning: Apply scientific methods, collect and analyse data, test hypotheses, evaluate evidence, apply statistical techniques and use computational models.</p> <p>PSO5: Research related skills: Formulate research questions, conduct literature reviews, design and execute research studies, communicate research findings and collaborate in research projects.</p> <p>PSO6: Self-directed & Lifelong Learning: Set learning goals, manage their own learning, reflect on their learning, adapt to new contexts, seek out new knowledge, collaborate with others and to continuously improve their skills and knowledge, through ongoing learning and professional development, and contribute to the growth and development of their field.</p>

PO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
PO1	✓					
PO2		✓				
PO3			✓			
PO4				✓		
PO5					✓	
PO6						✓

2. Highlights of the Revamped Curriculum:

- Student-centric, meeting the demands of industry & society, incorporating industrial components, hands-on training, skill enhancement modules, industrial project, project with viva-voce, exposure to entrepreneurial skills, training for competitive examinations, sustaining the quality of the core components and incorporating application oriented content wherever required.
- The Core subjects include latest developments in the education and scientific front, advanced programming packages allied with the discipline topics, practical training, devising statistical models and algorithms for providing solutions to industry / real life situations. The curriculum also facilitates peer learning with advanced statistical topics in the final semester, catering to the needs of stakeholders with research aptitude.
- The General Studies and Statistics based problem solving skills are included as mandatory components in the ‘Training for Competitive Examinations’ course at the final semester, a first of its kind.
- The curriculum is designed so as to strengthen the Industry-Academia interface and provide more job opportunities for the students.
- The Statistical Quality Control course is included to expose the students to real life problems and train the students on designing a mathematical model to provide solutions to the industrial problems.
- The Internship during the second year vacation will help the students gain valuable work experience, that connects classroom knowledge to real world experience and to narrow down and focus on the career path.
- Project with viva-voce component in the fifth semester enables the student, application of conceptual knowledge to practical situations. The state of art technologies in conducting a Explain in a scientific and systematic way and arriving at a precise solution is ensured. Such

innovative provisions of the industrial training, project and internships will give students an edge over the counterparts in the job market.

Value additions in the Revamped Curriculum:

Semester	Newly introduced Components	Outcome/ Benefits
I	<p>Foundation Course To ease the transition of learning from higher secondary to higher education, providing an overview of the pedagogy of learning Literature and analyzing the world through the literary lens gives rise to a new perspective.</p>	<ul style="list-style-type: none"> ➤ Instill confidence among students ➤ Create interest for the subject
I,II,III,IV	<p>Skill Enhancement papers(Discipline centric /Generic/Entrepreneurial)</p>	<ul style="list-style-type: none"> ➤ Industry ready graduates ➤ Skilled human resource ➤ Students are equipped with essential skills to make them employable <hr/> <ul style="list-style-type: none"> ➤ Training on language and communication skills enable the gain knowledge and exposure in the competitive world. <hr/> <ul style="list-style-type: none"> ➤ Discipline centric skill will improve the technical knowhow of solving real life problems.
III,IV,V& VI	<p>Elective papers</p>	<ul style="list-style-type: none"> ➤ Strengthening the domain knowledge ➤ Introducing the stakeholders to the State-of Art techniques from the streams of multi-disciplinary, cross disciplinary and inter disciplinary nature ➤ Emerging topics in higher education/industry/communicationnetwork/healthsectoretc.areintroducedwith hands-on-training.

IV Semester	Elective Papers	<ul style="list-style-type: none"> ➤ Exposure to industry molds students in to solution providers ➤ Generate Industry ready graduates ➤ Employment opportunities enhanced
V Semester	Elective papers	<ul style="list-style-type: none"> ➤ Self-learning is enhanced ➤ Application of the concept to real situation is conceived resulting in tangible outcome
VI Semester	Elective papers	<ul style="list-style-type: none"> ➤ Enriches the study beyond the course. ➤ Developing a research framework and presenting their independent and intellectual idea effectively.
Extra Credits: For Advanced Learners/Honors degree		<ul style="list-style-type: none"> ➤ To cater to the needs of peer learners/research aspirants
Skills acquired from the Courses		Knowledge, Problem Solving, Analytical ability, Professional Competency ,Professional Communication and Transferrable Skill

Credit Distribution for UG Programmes

Sem I	Credit	H	Sem II	Credit	H	Sem III	Credit	H	Sem IV	Credit	H	Sem V	Credit	H	Sem VI	Credit	H
Part 1. Language – Tamil	3	6	Part..1. Language – Tamil	3	6	Part..1. Language – Tamil	3	6	Part..1. Language – Tamil	3	6	5.1 Core Course – \CC IX	4	5	6.1 Core Course – CC XIII	4	6
Part.2 English	3	6	Part..2 English	3	6	Part..2 English	3	6	Part..2 English	3	6	5.2 Core Course – CC X	4	5	6.2 Core Course – CC XIV	4	6
1.3 Core Course – CC I	5	5	2..3 Core Course – CC III	5	5	3.3 Core Course – CC V	5	5	4.3 Core Course – CC VII Core Industry Module	5	5	5. 3.Core Course CC -XI	4	5	6.3 Core Course – CC XV	4	6
1.4 Core Course – CC II	5	5	2.4 Core Course – CC IV	5	5	3.4 Core Course – CC VI	5	5	4.4 Core Course – CC VIII	5	5	5. 4.Core Course –/ Project with viva- voce CC -XII	4	5	6.4 Elective -VII Generic/ Discipline Specific	3	5
1.5 Elective I Generic/ Discipline Specific	3	4	2.5 Elective II Generic/ Discipline Specific	3	4	3.5 Elective III Generic/ Discipline Specific	3	4	4.5 Elective IV Generic/ Discipline Specific	3	3	5.5 Elective V Generic/ Discipline Specific	3	4	6.5 Elective VIII Generic/ Discipline Specific	3	5
1.6 Skill Enhancement Course SEC-1	2	2	2.6 Skill Enhancement Course SEC-2	2	2	3.6 Skill Enhancement Course SEC-4,	1	1	4.6 Skill Enhancement Course SEC-6	2	2	5.6 Elective VI Generic/	3	4	6.6 Extension Activity	1	-

						(Entrepreneurial Skill)						Discipline Specific					
1.7 Skill Enhancement -(Foundation Course)	2	2	2.7 Skill Enhancement Course – SEC-3	2	2	3.7 Skill Enhancement Course SEC-5	2	2	4.7 Skill Enhancement Course SEC-7	2	2	5.7 Value Education	2	2	6.7 Professional Competency Skill	2	2
						3.8 E.V.S.	-	1	4.8 E.V.S	2	1	5.8 Summer Internship /Industrial Training	2				
	23	30		23	30		22	30		25	30		26	30		21	30
Total – 140 Credits																	

Choice Based Credit System (CBCS), Learning Outcomes Based Curriculum Framework (LOCF) Guideline Based Credit and Hours Distribution System for all UG courses including Lab Hours

First Year – Semester-I

Part	List of Courses	Credit	No. of Hours
Part-1	Language – Tamil	3	6
Part-2	English	3	6
Part-3	Core Courses & Elective Courses [in Total]	13	14
Part-4	Skill Enhancement Course SEC-1	2	2
	Foundation Course	2	2
		23	30

Semester-II

Part	List of Courses	Credit	No. of Hours
Part-1	Language – Tamil	3	6
Part-2	English	3	6
Part-3	Core Courses & Elective Courses including laboratory [in Total]	13	14
Part-4	Skill Enhancement Course -SEC-2	2	2
	Skill Enhancement Course -SEC-3 (Discipline / Subject Specific)	2	2
		23	30

FIRST SEMESTER

Sl.NO	Course Category	Course	Credit distribution				Overall Credits	Total contact Hours/week	Marks		
			L	T	P	S			CIA	ESE	Total
1	Part -I	Language - Tamil	L				3	6	25	75	100
2	Part -II	English	L				3	6	25	75	100
3	Part -III	Cc-1 (Fundamentals of microbiology and microbial diversity)	L				5	5	25	75	100
4	Part -III	CC-2 (Practical I - Fundamentals of microbiology and microbial diversity)			P		5	5	40	60	100
5	Part -III	EL-1 (Basic and Clinical Biochemistry)	L				3	4	25	75	100
6	Part -IV	SEC-1 (Social and Preventive medicine)	L				2	2	25	75	100
7	Part -IV	FC (Basic Microbiology)	L				2	2	25	75	100
		Total					23	30			

SECOND SEMESTER

Sl.No	Course Category	Course	Credit distribution				Overall Credits	Total contact Hours/w week	Marks		
			L	T	P	S			CIA	ESE	Total
1	Part –I	Language - Tamil	L				3	6	25	75	100
2	Part –II	English	L				3	6	25	75	100
3	Part -III	CC-3 (Microbial Physiology and metabolism)	L				5	5	25	75	100
4	Part -III	CC-4 (Practical II - Microbial Physiology and metabolism)			P		5	5	40	60	100
5	Part -III	EL-2 (Bio Instrumentation)	L				3	4	25	75	100
6	Part –IV	SEC-2 (Nutrition & Health Hygiene)	L				2	2	25	75	100
7	Part –IV	SEC-3 (Sericulture)	L				2	2	25	75	100
		Total					23	30			

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
22MBUGC T1	FUNDAMENTALS OF MICROBIOLOGY AND MICROBIAL DIVERSITY	Core Course – 1	Y	-	-	-	5	5	25	75	100
Course Objectives											
CO1	Learn the fundamental principles about different aspects of Microbiology including recent developments in the area.										
CO2	Describe the structural organization, morphology and reproduction of microbes.										
CO3	Explain the methods of cultivation of microbes and measurement of growth.										
CO4	Understand the microscopy and other basic laboratory techniques – culturing, disinfection and sterilization in Microbiology.										
CO5	Compare and contrast the different methods of sterilization.										

UNIT	Details	No.of Hours	Course Objectives
I	History and Evolution of Microbiology, Classification – Three kingdom, five kingdom, six kingdom and eight kingdom. Microbial biodiversity: Introduction to microbial biodiversity-ecological niche. Basic concepts of Eubacteria, Archaeobacteria and Eucarya. Conservation of Biodiversity.	12	CO1
II	General characteristics of cellular microorganisms (Bacteria, Algae, Fungi and Protozoa) and acellular microorganisms - (Viruses, Viroids, Prions), Differences between prokaryotic and eukaryotic microorganisms. Structure of Bacterial cell wall, cell membrane, capsule, flagella, pili, mesosomes, chlorosomes, phycobilisomes, spores, and gas vesicles. Structure of fungi (Mold and Yeast), Structure of microalgae.	12	CO2
III	Bacterial culture media and pure culture techniques. Mode of cell division, Quantitative measurement of growth. Anaerobic culture techniques.	12	CO3
IV	Microscopy – Simple, bright field, dark field, phase contrast, fluorescent, electron microscope – TEM & SEM, Confocal microscopy, and Atomic Force Microscopy. Stains and staining methods.	12	CO4
V	Sterilization–moist heat - autoclaving, dry heat – Hot air oven, radiation – UV, Ionization, filtration – membrane filter and disinfection, antiseptic; Antimicrobial agents.	12	CO5
	Total	60	
Course Outcomes			
Course Outcomes	On completion of this course, students will;		
CO1	Study the historical events that led to the discoveries and inventions and understand the Classification of Microorganisms.	PO5, PO6, PO10	
CO2	Gain Knowledge of detailed structure and functions of prokaryotic cell organelles.	PO10	

CO3	Understand the various microbiological techniques, different types of media, and techniques involved in culturing microorganisms.	PO11
CO4	Explain the principles and working mechanism of different microscopes/Microscope, their function and scope of application.	PO4, PO11
CO5	Understand the concept of asepsis and modes of sterilization and disinfectants.	PO4, PO11

Text Books

1	Pelczar.M. J., Chan E.C.S. and Noel. R.K. (2007). Microbiology. 7 th Edition.,McGraw – Hill, New York.
2	Willey J., Sherwood L., and Woolverton C. J., (2017). Prescott’s Microbiology. 10 th Edition., McGraw-Hill International edition.
3	Tortora, G.J., Funke, B.R., Case,C.L. (2013). Microbiology. An Introduction 11 th Edition., A La Carte Pearson.
4	Salle. A.J (1992). Fundamental Principles of Bacteriology. 7 th Edition., McGraw Hill Inc.New York.
5	Boyd, R.F. (1998). General Microbiology,2 nd Edition., Times Mirror, Mosby CollegePublishing, St Louis.

References Books

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

	Microorganisms, 13 th 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/	
Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
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	

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1					M	M				M	
CO2										M	M
CO3											S
CO4				M							S
CO5				M							S

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
22MBU GCP1	PRACTICAL I - FUNDAMENTALS OF MICROBIOLOGY AND MICROBIAL DIVERSITY	Core Course II- Practical I	-	-	Y	-	5	5	40	60	100
Course Objectives											
CO1	Acquire knowledge on Cleaning of glass wares, GLP and sterilization.										
CO2	Gain knowledge on media preparation and cultural characteristics.										
CO3	Learn the pure culture technique										

CO4	Learn the microscopic techniques and staining methods.		
CO5	Acquire knowledge on stain and staining methods		
UNIT	Details	No.of Hours	Course Objectives
I	Cleaning of glass wares, Microbiological good laboratory practice and safety. Sterilization and assessment of sterility– Autoclave, hot air oven, and membrane filtration.	12	CO1
II	Media preparation: liquid media, solid media, semi-solid media, agar slants, agar deeps, agar plates.	12	CO2
III	Preparation of basal, differential, enriched, enrichment, transport, and selective media preparation- quality control of media, growth supporting properties, sterility check of media. Pure culture techniques: streak plate, pour plate, decimal dilution.	12	CO3
IV	Culture characteristics of microorganisms: growth on different media, growth characteristics, and description. Demonstration of pigment production. Microscopy: light microscopy and bright field microscopy.	12	CO4
V	Staining techniques: smear preparation, simple staining, Gram's staining and endospore staining. Study on Microbial Diversity using Hay Infusion Broth-Wet mount to show different types of microbes, hanging drop.	12	CO5
	Total	60	

Course Outcomes

Course Outcomes	On completion of this course, students will;	
CO1	Practice sterilization methods; learn to prepare media and their quality control.	PO4, PO7, PO8, PO9, PO11
CO2	Learn streak plate, pour plate and serial dilution and pigment production of microbes.	PO4, PO7, PO8, PO9
CO3	Understand Microscopy methods, different Staining techniques and motility test.	PO4, PO7, PO8, PO9, PO11
CO4	Observe culture characteristics of microorganisms.	PO4, PO7, PO8, PO9
CO5	Study on Microbial Diversity using Hay Infusion Broth-Wet mount	PO4, PO7, PO8, PO9
Text Books		
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 (1 st 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.	
References Books		
1	Atlas.R (1997). Principles of Microbiology, 2 nd Edition, Wm.C.Brown publishers.	
2	Amita J, Jyotsna A and Vimala V (2018). Microbiology Practical Manual. (1 st Edition). Elsevier India	
3	Talib VH (2019). Handbook Medical Laboratory Technology. (2 nd Edition). CBS	
4	Wheelis M, (2010). Principles of Modern Microbiology, 1st Edition. Jones and Bartlett Publication.	
5	Lim D. (1998). Microbiology, 2 nd Edition, WCB McGraw Hill Publications.	

Web Resources		
1	http://www.biologydiscussion.com/micro-biology/sterilisation-and-disinfection-methods-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-to-microbiology/a-brief-history-of-microbiology	
Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	40 Marks
	Attendance and Class Participation	
External Evaluation	End Semester Examination	60 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	

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1				M			L	M	L		M
CO2				S			L	L	L		
CO3				S			M	M	L		M
CO4				S			M	L	L		
CO5				S			M	L	L		

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CI A	Exter nal	Total
22MBUGDE1	BASIC AND CLINICAL BIOCHEMISTRY	Elective Generic / Discipline Specific Elective-I	Y	-	-	-	3	4	25	75	100
Course Objectives											
CO1	Attain thorough knowledge on carbohydrates and lipids, their characteristic properties and organization in carrying out all the living functions which constitute the life.										
CO2	Explain the biological activity of amino acids and proteins.										
CO3	Identify the metabolic errors in enzymes of carbohydrates and lipids.										
CO4	Describe the disorders in amino acid metabolism.										
CO5	Interpret the consequences, biochemical, clinical features, diagnosis and treatment of metabolic diseases of day today life.										
UNIT	Details								No.of Hours	Course Objectives	
I	Biomolecules -Carbohydrate – General properties, function, structure, classification– monosaccharides (Glucose, Fructose, Galactose), Oligoaccharides (Sucrose, Maltose, Lactose) and polysaccharides (Starch, Glycogen,) and biological significance. Lipids – General properties, functions, structure, classification (Simple, Derived and Complex), Cholesterol, LDL, HDL – biological significance.								12	CO1	

II	Biomolecules - Amino acids – General properties, functions, structure, classification and biological significance. Proteins– General structure, Properties, functions, classification and biological significance.	12	CO2
III	Disorders of Metabolism: Disorders of carbohydrate metabolism: diabetes mellitus, ketoacidosis, hypoglycemia, glycogen storage diseases, galactosemia and lactose intolerance. Disorders of lipid metabolism: hyperlipidemia, hyperlipoproteinemia, hypercholesterolemia, hypertriglyceridemia, sphingolipidosis.	12	CO3
IV	Disorders of Metabolism: Disorders of amino acid metabolism: alkaptonuria, phenylketonuria, phenylalaninemia, homocystineuria, tyrosinemia, aminoacidurias.	12	CO4
V	Evaluation of organ function tests: Assessment and clinical manifestations of renal, hepatic, pancreatic, gastric and intestinal functions. Diagnostic enzymes: Principles of diagnostic enzymology. Clinical significance of aspartate aminotransferase, alanine aminotransferase, creatine kinase, aldolase and lactate dehydrogenase.	12	CO5
	Total	60	

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Explain the structure, classification, biochemical functions and significance of carbohydrates and lipids	PO1
CO2	Differentiate essential and non-essential amino acids, biologically important modified amino acids and their	PO1

	functions, Illustrate the role, classification of Proteins and recognize the structural level organization of proteins, its functions and denaturation.	
CO3	Assess defective enzymes and Inborn errors. Recognize diseases related to carbohydrate and lipid metabolism.	PO4, PO5, PO6
CO4	Discuss and evaluate the pathology of amino acid metabolic disorders.	PO4, PO5, PO6
CO5	Appraise the imbalances of enzymes in organ function and relate the role of Clinical Biochemistry in screening and diagnosis.	PO5, PO6, PO9

Text Books

1	Satyanarayana, U. and Chakrapani, U (2014).Biochemistry,4 th Edition, Made Simple Publisher.
2	Jain J L, Sunjay Jain and Nitin Jain (2016). Fundamentals of Biochemistry, 7 th Edition, S Chand Company.
3	AmbikaShanmugam's (2016). Fundamentals of Biochemistry for Medical Students, 8 th Edition. Wolters Kluwer India Pvt Ltd.
4	Vasudevan. D.M.Sreekumari.S, Kannan Vaidyanathan (2019). Textbook Of Biochemistry For Medical Students. Kindle edition, Jaypee Brothers Medical Publishers
5	Jeremy M. Berg, LubertStryer, John L. Tymoczko, Gregory J. Gatto (2015). Biochemistry, 8 th edition. WH Freeman publisher.

References Books

1	AmitKessel & Nir Ben-Tal (2018). Introduction to Proteins: structure, function and motion. 2 nd Edition, Chapman and Hall.
2	David L. Nelson and Michael M. Cox (2017). Lehninger Principles of Biochemistry, 7 th Edition W.H. Freeman and Co., NY.
3	LupertStyrer, Jeremy M. Berg, John L. Tymaczko, Gatto Jr., Gregory J (2019). Biochemistry. 9 th Edition ,W.H.Freeman & Co. New York.

4.	Donald Voet, Judith Voet, Charlotte Pratt (2016). Fundamentals of Biochemistry: Life at the Molecular Level, 5 th Edition, Wiley.
5.	Joy PP, Surya S. and AswathyC (2015). Laboratory Manual of Biochemistry, Edition 1.,Publisher:Kerala agricultural university.
Web Resources	
1	https://www.abebooks.com › plp
2	https://kau.in/document/laboratory-manual-biochemistry
3	https://metacyc.org
4	https://www.medicalnewstoday.com
5	https://journals.indexcopernicus.com

Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
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	

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	M										
CO2	M										
CO3				S	S	S					
CO4				S	S	S					
CO5					S	S			S		

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CI A	External	Total
22MBUGSEC1	Social and Preventive medicine	Skill enhancement Course SEC - 1	Y	-	-	-	2	2	25	75	100
Course Objectives											
CO1	Describe the concepts of health and disease and their social determinants										
CO2	Summarize the health management system										
CO3	Know about the various health care services										
CO4	Outline the goals of preventive medicine										
CO5	Gain knowledge about alternate medicine										

UNIT	Details	No.of Hours	Course Objectives
I	Introduction to social medicine: History of social medicine-concepts of health and disease-social determinants of health and disease-Health and quality of life-Health information system- measures of population health-health policies.	6	CO1
II	Health management: 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	CO2
III	Health care and services: Health care of the community-information, education, communication and training in health-maternal & child health-school health services- Geriatrics-care and welfare of the aged-mental health-health services through general practitioners.	6	CO3
IV	Preventive medicine: Introduction- role of preventive medicine- levels of prevention-Risk assessment in communities and vulnerable population –surveillance, monitoring and reporting of disease outbreaks - forecasting and control measures in community setting – early detection methods.	6	CO4
V	Prevention through alternate medicine: Unani, Ayurveda, Homeopathy, Naturopathy systems in epidemic and pandemic outbreaks. International health regulations. Infectious disease outbreak case studies and precautionary response during SARS and MERS coronavirus, Ebola and novel SARS-COV2 outbreaks.	6	CO5
	Total	30	
Course Outcomes			

Course Outcomes	On completion of this course, students will;	
CO1	Identify the health information system	PO1,PO5, PO6
CO2	Associate various factors with health management system	PO1,PO2, PO3,PO5, PO6, PO9
CO3	Choose the appropriate health care services	PO1,PO5, PO6
CO4	Appraise the role of preventive medicine in community setting	PO4,PO5, PO6
CO5	Recommend the usage of alternate medicine during outbreaks	PO1,PO5, PO6
Text Books		
1.	Park.K (2021). Textbook of preventive and social medicine, 26 th edition. BanarsidasBhanot publishers.	
2.	Mahajan& Gupta (2013). Text book of preventive and social medicine, 4 th edition. Jaypeebrothers 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 Biostatistics. 12 th edition, Jaypee Brothers Medical Publishers.	
5.	Lal Adarsh Pankaj Sunder (2011). Textbook of Community Medicine: Preventive and Social Medicine, CBS publisher.	
References 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 Behavioral Medicine. Guilford Press.	
4	Marie Eloise 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-articles-ppts-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	
Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
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
--------------------	--

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	S				S	S					
CO2	S	S		M	S	S			M		
CO3				M	S	S					
CO4	S			S	S	M					
CO5	S				S	S					

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	BASIC MICROBIOLOGY	Foundation Course –	Y	-	-	-	2	2	25	75	100
Course Objectives											
CO1	Learn the fundamental principles of Prokaryotic and Eukaryotic Cellular Organisation and microbial cell division										
CO2	Describe the Importance and Application of Microbiology in various fields of Life Sciences										

CO3	Introduce different types of microbial classification.		
CO4	Understand the basic methods of identifying microbes from different sources		
CO5	Explain different types of microbial adaptations in different sources.		
UNIT	Details	No.of Hour s	Course Objectives
I	Prokaryotes and Eukaryotes. Difference between Prokaryotes and Eukaryotes. Bacteria- basic cell structure with examples. Microbial cell division and its types	6	CO1
II	Scope , Importance and Applications of Microbes in different fields of Lifescience.	6	CO2
III	Microbial Taxonomy, Bergeys Manual of Systematic Bacteriology.	6	CO3
IV	Basic methods of Identifying Microbes from different sources and its importance	6	CO4
V	Important microbes in soil, water , Air, Food and other sources	6	CO5
	Total	30	
Course Outcomes			

Course Outcomes	On completion of this course, students will;	
CO1	Study the basic aspects of Prokaryotic and Eukaryotic cell and the different types of microbial cell division.	PO1, PO6, PO9
CO2	Gain Knowledge on the scope, importance and Application of Microbes in different fields of Lifesciences.	PO1, P07,PO11
CO3	Understand Microbial Taxonomy and learn the Bergeys manual of Systematic Bacteriology.	PO5, PO8, PO11
CO4	Explain different methods of Identifying microbes from various sources.	PO3,PO4, PO5, PO8 PO11
CO5	Understand the important microbes in different sources.	PO4, PO5, PO7, PO8, PO10,PO11
Text Books		
1	Pelczar.M. J., Chan E.C.S. and Noel. R.K. (2007). Microbiology. 7 th Edition.,McGraw – Hill, New York.	
2	Willey J., Sherwood L., and Woolverton C. J., (2017). Prescott's Microbiology. 10 th Edition., McGraw-Hill International edition.	
3	Tortora, G.J., Funke, B.R., Case,C.L. (2013). Microbiology. An Introduction 11 th Edition., A La Carte Pearson.	
4	Salle. A.J (1992). Fundamental Principles of Bacteriology. 7 th Edition., McGraw Hill Inc.New York.	
5	Boyd, R.F. (1998). General Microbiology,2 nd Edition., Times Mirror, Mosby CollegePublishing, St Louis.	
References Books		
1	Jeffrey C. Pommerville., Alcamo's Fundamentals of Microbiology (9 th Edition). Jones &Bartlett learning 2010.	
2	Stanier R.Y, Ingraham J. L., Wheelis M. L., and Painter R. R. (2010). General Microbiology, 5 th Edition., MacMillan Press Ltd	
3	Tortora, G.J., Funke, B.R. and, Case, C.L (2013). Microbiology-An Introduction,	

	11 th Edition., Benjamin Cummings.	
4	Nester E., Anderson D., Roberts C. E., and Nester M. (2006). Microbiology-A Human Perspective, 5 th Edition., McGraw Hill Publications.	
5	Madigan M.T., Martinko J.M., Stahl D.A, and Clark D. P. (2010). Brock - Biology of Microorganisms, 13 th 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/	
Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
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	

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1					M	M				M	
CO2										M	M
CO3											S
CO4				M							S
CO5				M							S

SEMESTER II

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CI A	External	Total
22MBU GCT2	MICROBIAL PHYSIOLOGY AND METABOLISM	Core Course III	Y	-	-	-	5	5	25	75	100
Course Objectives											
CO1	Study the basic principles of microbial growth.										
CO2	Understand the basic concepts of aerobic and anaerobic metabolic pathways.										
CO3	Analyze the role of individual components in overall cell function.										
CO4	Provide information on sources of energy and its utilization by microorganisms.										

CO5	Study the different types of metabolic strategies.		
Unit	Details	No.of Hours	Course Objectives
I	Physiology of microbial growth: Batch – continuous - synchronous cultures; Growth Curve and measurement method (turbidity, biomass, and cell count). Control of microbial growth.	12	CO1
II	Nutrition requirements - Photoautotrophs, Photoorganotrophs, Chemolithotrophs (Ammonia, Nitrite, Sulfur, Hydrogen, Iron oxidizing Bacteria), Chemoorganotrophs. Nutrition transport mechanisms – Passive diffusion and Active transport. Factors affecting microbial growth.	12	CO2
III	An overview of Metabolism - Embden Meyerhof Pathway, Entner-Doudoroff Pathway, Pentose Phosphate Pathway, Tricarboxylic Acid Cycle. Electron Transport Chain and Oxidative Phosphorylation. ATP synthesis. Fermentation-Homolactic Fermentation, Heterolactic Fermentation, Mixed Acid Fermentation, Butanediol Fermentation.	12	CO3
IV	Photosynthesis - An Overview of chloroplast structure. Photosynthetic Pigments, Light Reaction-Cyclic and non-cyclic Photophosphorylation. Dark Reaction - Calvin Cycle.	12	CO4
V	Bacterial reproduction - Binary fission, Budding, Reproduction through conidia, cyst formation, endospore formation. Fungi asexual and sexual reproduction, Microalgae reproduction. Asexual and sexual reproduction of protozoa.	12	CO5
	Total	60	
Course Outcomes			
Course Outcomes	On completion of this course, students will;		
CO1	Describe microorganisms based on nutrition.	PO6, PO9	
CO2	Know the concept of microbial growth and identify the factors affecting bacterial growth.	PO6, PO7, PO9	

CO3	Explain the methods of nutrient uptake.	PO6, PO9
CO4	Describe anaerobic and aerobic energy production.	PO6, PO9
CO5	Elaborate on the process of bacterial photosynthesis and reproduction.	PO6, PO9
Text Books		
1	Schlegel, H.G. (1993). General Microbiology.,7 th Edition, Press syndicate of the University of Cambridge.	
2	RajapandianK.(2010). Microbial Physiology, Chennai: PBS Book Enterprises India.	
3	MeenaKumari. S. Microbial Physiology, Chennai 1 st 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.	
References 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, 3 rd edition. Wiley – LISS, A John Wiley & Sons. Inc. Publications.
5	BhanuShrivastava. (2011). Microbial Physiology and Metabolism: Study of Microbial Physiology and Metabolism. Lambert academic Publication.

Web 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

Methods of Evaluation

Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
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

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1						M			M		
CO2						M	L		M		
CO3						M			M		
CO4						M			M		
CO5						M			M		

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
22MBU GCP2	MICROBIAL PHYSIOLOGY AND METABOLISM	CCIV- CORE PRAC TICAL II	-	-	Y	-	5	5	40	60	100

Course Objectives

CO1	Understand the principles of motility test.
CO2	Understand the basic concepts of staining methods.

CO3	Learn the bacterial count using different methods and anaerobic culture.		
CO4	Study the morphological demonstration of microorganisms and identification.		
CO5	Study the biochemical identification of the bacteria.		
UNIT	Details	No.of Hours	Course Objectives
I	Motility demonstration: hanging drop, wet mount preparation, semi-solid agar, Craigie's tube method. Staining techniques: Smear preparation, permanent specimen preparation, Capsular, and Acid-fast staining	12	CO1
II	Direct counts – Direct cell count (Petroff-Hausser counting chamber), Turbidometry. Viable count - pour plate, spread plate. Bacterial growth curve.	12	CO2
III	Anaerobic culture methods. Antibiotic sensitivity testing: Disc diffusion test- quality control with standard strains.	12	CO3
IV	Morphological variations in algae, fungi and protozoa. Micrometry: Demonstration of the size of yeast, fungal filaments and protozoa.	12	CO4
V	Methods of bacterial identification- morphological, physiological, and biochemical methods - IMViC test, H ₂ S, TSI, Oxidase, catalase, urease test, and Carbohydrate fermentation test. Maintenance of pure culture, paraffin method, stab culture, maintenance of mold culture.	12	CO5
	Total	60	
Course Outcomes			
Course Outcomes	On completion of this course, students will;		
CO1	Describe hanging drop, wet mount preparation, semi-solid agar, Craigie's tube method.	PO6, PO7, PO8, PO9, PO11	

CO2	Demonstrate Smear preparation, permanent specimen preparation, Capsular, and Acid-fast staining.	PO6, PO7, PO8, PO9, PO11
CO3	Explain antibiotic sensitivity testing: Disc diffusion test- quality control with standard strains.	PO6, PO7, PO8, PO9, PO11
CO4	Describe demonstration of the size of yeast, fungal filaments and protozoa.	PO6, PO7, PO8, PO9, PO11
CO5	Elaborate on the bacterial identification- morphological, physiological, and biochemical methods.	PO6, PO7, PO8, PO9, PO11

Text Books

1	James G Cappucino and N. Sherman MB (1996). A lab manual Benjamin Cummins, New York .
2	Kannan. N (1996).Laboratory manual in General Microbiology. Palani Publications.
3	Sundararaj T (2005). Microbiology Lab Manual (1 st edition) publications.
4	Gunasekaran. P (2007). Laboratory manual in Microbiology. New age international publisher.
5	Elsa Cooper (2018). Microbial Physiology: A Practical Approach. Callisto Reference publisher.

References Books

1	DavidWhite., James Drummond., Clay Fuqua (2012) Physiology and Biochemistry of Prokaryotes. 4th Ed. Oxford University Press, New York.
2	Robert K. Poole (2004). Advances in Microbial Physiology, Elsevier Academic Press, New York, Volume 49.

3	Kim B.H., Gadd G.M. (2008). Bacterial Physiology and Metabolism. Cambridge University Press, Cambridge.
4	Dawes, I.W and Sutherland L.W (1992). Microbial Physiology (2 nd edition), Oxford Blackwell Scientific Publications.
5	Moat, A.G and J.W Foaster, (1995). Microbial Physiology, 3 rd edition. Wiley – LISS, A John Wiley & Sons. Inc. Publications.

Web Resources

1	https://sites.google.com/site/microbialphysiologyoddsem/teaching-contents
2	https://courses.lumenlearning.com/boundless-microbiology/chapter/microbial-Nutrition
3	https://onlinecourses.swayam2.ac.in/cec20_bt14/preview
4	https://www.studocu.com/microbial-physiology-practicals
5	https://www.agr.hokudai.ac.jp/microbial-physiology

Methods of Evaluation

Internal Evaluation	Continuous Internal Assessment Test	40 Marks
	Attendance and Class Participation	
External Evaluation	End Semester Examination	60 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.

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1						M	L	M	L		M
CO2						M	M	L	M		L
CO3						L	M	M	L		M
CO4						L	M	M	M		M
CO5						M	M	M	M		M

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CI A	External	Total
22MBUGDE 2	BIO INSTRUMENTATION	Elective Generic /Discipline Specific Elective II	Y	-	-	-	3	4	25	75	100

Course Objectives

CO1	Understand the analytical instruments and study the basic principles in the field of sciences.
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	Course Objectives
I	Basic instruments: pH meter, Buffer of biological importance, Centrifuge- Preparative, Analytical and Ultra, Laminar Air Flow, Autoclave, Hot Air Oven and Incubator. Biochemical calculations-preparations of Molar solutions - Buffers- Phosphate, Acetate, TE, TAE- calculation of Normality ,PPM- Ammonium sulphate precipitation.	12	CO1
II	Spectroscopic Techniques: Spectroscopic Techniques: Colorimeter, Ultraviolet and visible, Infra red and Mass Spectroscopy.	12	CO2
III	Chromatographic and Electrophoresis Techniques: Chromatographic Techniques: Paper, Thin Layer, Column, HPLC and GC. Electrophoresis Techniques: Starch Gel, AGE, PAGE.	12	CO3
IV	Imaging techniques: Principle, Instrumentation and application of ECG, EEG, EMG, MRI, CT and PET scan radioisotopes.	12	CO4
V	Fluorescence and radiation based techniques: Spectrofluorimeter, Flame photometer, Scintillation counter, Geiger Muller counter, Autoradiography.	12	CO5
	Total	60	
Course Outcomes			
Course Outcomes	On completion of this course, students will;		
CO1	Gain knowledge about the basics of instrumentation.	PO1,PO4,PO11	
CO2	Exemplify the structure of atoms and molecules by using the principles of spectroscopy.	PO4,PO10,PO11	

CO3	Evaluate by separating and purifying the components.	PO4,PO7,PO11
CO4	Understand the need and applications of imaging techniques.	PO7,PO8,PO11
CO5	Categorize the working principle and applications of fluorescence and radiation.	PO10,PO11
Text Books		
1.	Jayaraman J (2011). Laboratory Manual in Biochemistry, 2 nd Edition. Wiley Eastern Ltd., New Delhi .	
2.	Ponmurugan. P and Gangathara PB (2012). Biotechniques.1 st Edition. MJP publishers.	
3	Veerakumari, L (2009).Bioinstrumentation- 5 th Edition -.MJP publishers.	
4	Upadhyay, Upadhyay and Nath (2002). Biophysical chemistry – Principles and techniques 3 rd 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, 3 rd Edition. Pearson Publication.	
2	SkoogA.,WestM (2014). Principles of Instrumental Analysis – 14 th Edition W.B.SaundersCo.,Philadephia.	
3	N.Gurumani. (2006). Research Methodology for biological sciences- 1 st Edition – MJP Publishers .	
4	Wilson K, and Walker J (2010). Principles and Techniques of Biochemistry and Molecular Biology.7 th Edition. Cambridge University Press .	
5	Webster, J.G. (2004). Bioinstrumentation- 4 th 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-andapplications/
3	http://www.wikiscales.com/articles/electronic-analytical-balance/ Page 24 of 75
4	https://study.com/academy/lesson/what-is-chromatography-definition-typesuses.html
5	http://www.rsc.org/learn-chemistry/collections/spectroscopy/introduction

Methods of Evaluation

Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
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

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	L			M							S
CO2				L						M	S
CO3				L			M				S
CO4							S	S			S
CO5										M	S

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CI A	External	Total
22MBUGS EC2	Nutrition & Health Hygiene	Skill Enhancement Course - SEC-2	Y	-	-	-	2	2	25	75	100
Course Objectives											
CO1	Learn about nutrition and their importance										
CO2	Make student understand the nutritional facts for a better life.										
CO3	Learn information to optimize our diet										
CO4	Impart knowledge on different health care programs taken up by India										

CO5	Learn knowledge on different health indicators and types of hygiene methods		
Unit	Details	No.of Hours	Course Objectives
I	Nutrition – definition, importance, Good nutrition, and mal nutrition; Balanced Diet: Basics of Meal Planning. Carbohydrates, Lipids, Proteins and Vitamins –functions, dietary sources, effects of deficiency. Macro and micro minerals –functions, effects of deficiency; food sources of Calcium, Potassium, and Sodium; food sources of Iron, Iodine, and Zinc. Importance of water– functions, sources, requirements and effects of deficiency	5	CO1
II	Nutrition for Life Cycle: Balanced diet - Normal, Pregnant, lactating women, Infancy, young children Adolescents, Adults, and the Elderly; Diet Chart; Nutritive value of Indian foods.	5	CO2
III	Improper diets: Definition, Identification, Signs and Symptoms - malnutrition, under-nutrition, over-nutrition, Protein Energy Malnutrition, obesity; Nutritional Disease and Disorder - hypertension, diabetes, anemia, osteomalacia, cardiovascular disease.	5	CO3
IV	Health - Determinants of health, Key Health Indicators, Environment health & Public health; Health-Education: Principles and Strategies. Health Policy & Health Organizations: Health Indicators and National Health Policy of Govt. of India; Functioning of various nutrition and health organizations in India.	5	CO4
V	Hygiene – Definition; Personal, Community, Medical and Culinary hygiene; WASH (Water, Sanitation and Hygiene) programme. Rural Community Health: Village health sanitation & Nutritional committee. Community & Personal Hygiene: Environmental Sanitation and Sanitation in Public places.	5	CO5
	Total	25	

Course Outcomes

Course Outcomes	On completion of this course, students will;	
CO1	Learn the importance of nutrition for a healthy life	PO5, PO6, PO7, PO8, PO10
CO2	Study the nutrition for life cycle	PO5, PO6, PO7, PO8, PO10
CO3	Know the health care programmes of India	PO5, PO6, PO7, PO8, PO10
CO4	Learn the importance of community and personal health & hygiene measures	PO5, PO6, PO7, PO10
CO5	Create awareness on community health and hygiene	PO5, PO6, PO7, PO10

Text Books	
1.	Bamji, M.S., K. Krishnaswamy & G.N.V. Brahmam (2009) Textbook of Human Nutrition (3rd edition) Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi
2.	Swaminathan (1995) Food & Nutrition (Vol I, Second Edition) The Bangalore Printing & Publishing Co Ltd., Bangalore
3	SK. Haldar (2022). Occupational Health and Hygiene in Industry. CBS Publishers.
4	Acharya, Sankar Kr, Rama Das, Minati Sen (2021). Health Hygiene and Nutrition Perception and Practices. Satish Serial Publishing House
5	Dass (2021). Public Health and Hygiene, Notion Press
References Books	
1	Vijaya Khader (2000) Food, nutrition & health, Kalyan Publishers, New Delhi
2	Srilakshmi, B., (2010) Food Science, (5 th Edition) New Age International Ltd., New Delhi
3	Arvind Kumar Goel (2005). A College Textbook of Health & Hygiene, ABD Publishers
4	Sharma D. (2015). Textbook on Food Science and Human Nutrition. Daya Publishing House.
5	Revilla M. K. F., Titchenal A. and Draper J. (2020). Human Nutrition. University of Hawaii, Mānoa.
Web Resources	
1	National Rural Health Scheme: https://nhm.gov.in/index1.php?lang=1&level=1&sublinkid=969&lid=49
2	National Urban Health Scheme: https://nhm.gov.in/index1.php?lang=1&level=1&sublinkid=970&lid=137
3	Village health sanitation & Nutritional committee

	https://nhm.gov.in/index1.php?lang=1&level=1&sublinkid=149&lid=225
4	Health Impact Assessment - https://www.who.int/hia/about/faq/en/
5	Healthy Living https://www.nhp.gov.in/healthylivingViewall

Methods of Evaluation

Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
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
Analyse (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
--------------------	--

Mapping with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1					S	M	M	M		S	
CO2					S	M	M	M		S	
CO3					S	M	M	M		S	
CO4					S	S	L			S	
CO5					S	S	M			S	

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CI A	External	Total
22MBUGSEC3	SERICULTURE	Skill Enhancement Course - SEC-3	Y	-	-	-	2	2	25	75	100

Course Objectives			
CO1	Acquire knowledge on the concepts of origin, growth and study of Sericulture as science and scientific approach of mulberry plant.		
CO2	Describe the morphology and physiology of silkworm.		
CO3	Discuss effective management of silkworm diseases.		
CO4	Demonstrate field skills in mulberry cultivation and silkworm rearing with an emphasis on technological aspects.		
CO5	Demonstrate entrepreneurship abilities, innovative thinking, planning, and setting up small-scale enterprises.		
Unit	Details	No.of Hours	Course Objectives
I	General introduction to Sericulture, its distribution in India. Botanical distribution and taxonomical characters of mulberry varieties and species. Biology of Mulberry plant and Mulberry crop cultivation and protection.	5	CO1
II	Silkworm- biology-morphology of silkworm. Life cycle of silkworm- egg, larva, pupa, and moth.	5	CO2
III	Silkworm pathology: Introduction to Parasitism, Commensalism, Symbiosis and Parasite relationship - Mulberry Silkworm Diseases: Introduction, types, Pebrine, Grasserie, Muscardine, Flacherie, Symptoms and Pathogens, Mode of Infection, Prevention and Control -Non – mulberry silkworm diseases: Pebrine, Bacterial and viral diseases. Brief Account of Pests and Predators of Silkworms, Nature of damage and control measures.	5	CO3
IV	Rearing of silkworm. Cocoon assessment and processing technologies. Value added products of mulberry and silkworms.	5	CO4
V	Entrepreneurship and rural development in sericulture: Planning for EDP, Project formulation, Marketing, Insectary facilities and	5	CO5

	equipments: Location, building specification, air conditioning and environmental control, furnishings and equipment, sanitation and equipment, subsidiary facilities.		
	Total	25	
Course Outcomes			
Course Outcomes	On completion of this course, students will;		
CO1	Discuss the overall aspects of Sericulture and the biology and varieties of mulberry plant. Creates awareness among students about the economic importance and suitability of Sericulture in Indian conditions.	PO1, PO5, PO7	
CO2	Familiarize with the lifecycle of silk worm.	PO1, PO2	
CO3	Explain common diseases of silkworm encountered during rearing, sources of infection, disease symptoms, pre-disposing factors and their management practices.	PO1, PO5	
CO4	Attain thorough knowledge about the cultivation of mulberry, maintenance of the farm, seed technology, silkworm rearing, post cocoon techniques like stifling, reeling, and utilization of by-products.	PO7, PO8, PO10	
CO5	Plan the facilities required for establishment of insectary. Competent to transfer the knowledge and technical skills to the Seri-farmers. Analyze the importance of sericulture in entrepreneurship development and emerge as potential entrepreneur.	PO5, PO7, PO8	
Text Books			
1	Ganga, G. and Sulochana Chetty (2010). Introduction to Sericulture, J., Oxford and IBH Pub. Co. Pvt. Ltd., New Delhi.		
2	Dr. R. K. Rajan & Dr. M. T. Himanharaj (2005). Silkworm Rearing Technology, Central Silk Board, Bangalore.		

3	Dandin S B, Jayant Jayaswal and Giridhar K (2010). Handbook of Sericulture technologies,Central Silk Board, Bangalore.
4	M. C. Devaiah, K. C. Narayanaswamy and V. G. Maribashetty(2010). Advances in Mulberry Sericulture,,CVG Publications, Bangalore
5	<i>T.V.SatheandJadhav.A.D.(2021). Sericulture and Pest Management, Daya Publishing House.</i>

References Books

1	S. Morohoshi (2001). Development Physiology of Silkworms 2 nd Edition, Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi
2	Hamamura, Y (2001). Silkworm rearing on Artificial Diet. Oxford & IBH publishing Co., Pvt. Ltd. NewDelhi.
3	M.Johnson, M.Kesary (2019).Sericulture, 5 th .Edition.Saras Publications.
4	Manisha Bhattacharyya (2019). Economics of Sericulture, Rajesh Publications.
5	Muzafar Ahmad Bhat, Suraksha Chanotra, Zafar Iqbal Buhroo, Abdul Aziz and Mohd.Azam (2020). <u>A Textbook on Entrepreneurship Development Programme in Sericulture</u> , IP Innovative Publication.

Web Resources

1	https://egyankosh.ac.in > bitstream
2	https://archive.org > details > SericultureHandbook
3	https://www.academic.oup.com
4	https://www.sericulture.karnataka.gov.in
5	https://www.silks.csb.gov.in

Methods of Evaluation

Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
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

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	S				S		S				
CO2	M				S						
CO3	S				S						
CO4							S	S		S	
CO5					S		S	S			

ALLIED Microbiology Courses

ALLIED PAPER - MICROBIOLOGY-I

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	MICROBIOLOGY-I	ALLIED-I	Y	-	-	-	3	4	25	75	100
Course Objectives											
CO1	Understand and remember the historical aspects of Microbiology and Microorganisms and to analyse the roles of different technical outputs.										
CO2	Explain and relate the commonly used microscopes used to visualize microorganisms.										
CO3	Identify the different structural components of bacteria and to classify them based on that and relate their features of different microbial groups										
CO4	Understand the mechanism and types of staining techniques and transfer learnt techniques in needy places.										
CO5	Describe and classify the diverse kinds of sterilization and determine the suitability of techniques to value samples.										

Unit-I

Introduction to Microbiology- History of Microbiology- Anton von Leeuwenhoek, Robert Koch, Louis Pasteur, Edward Jenner, Alexander Fleming.

Unit-II

Microscopy- Optical or Light microscope- Dark and Bright microscope- Phase contrast microscope- Florescent microscope and Electron microscope.

Unit-III

Morphology – Size of Bacteria- Shape of bacteria- Bacterial Anatomy- Cell wall, Cytoplasmic membrane, Cytoplasm, Mesosome, Intra-cytoplasmic inclusion, Nucleoid, Pili and Flagella- Types of flagella.

Unit-IV

Staining techniques- simple, differential - Gram's, Acid fast stain, Special stain- Negative – Albert stain and Spore stain.

Unit-V

Sterilization technique- Physical agents- Sunlight, Drying, Heat, Dry heat- Hot air oven, Moist heat- Autoclave – Filtration- Radiations.

REFERENCES

1. Ananthanarayanan and Paniker's –Text book of Microbiology- ninth edition, University press
2. Michael J Pelczar, Microbiology 5th edition McCraw Hill, Education Pvt.Ltd.
3. SARAS Microbiology, low price edition, SARAS publication

On completion of the course, students will be able to

COURSE OUTCOME

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Understand and remember the history of Microbiology.	PO1, PO6, PO9
CO2	Explain and relate the commonly used microscope.	PO1, P07, PO11
CO3	Summarize the bacterial anatomy and characterize its morphological features.	PO5, PO8, PO11

CO4	Describe basic and specialized staining technique and indicate its importance.	PO3, PO4, PO5, PO8 PO11
CO5	Identify the diverse kinds of sterilization techniques to value samples.	PO4, PO5, PO7, PO8, PO10, PO11

Mapping of Course Outcomes with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	M										
CO2	M										
CO3				S	S	S					
CO4				S	S	S					
CO5					S	S			S		

ALLIED PAPER –MICROBIOLOGY PRACTICAL-I

COURSE OBJECTIVES:

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	MICROBIOLOGY PRACTICAL-I	ALLIED PRACTICAL-I	-	-	Y	-	2	2	40	60	100
Course Objectives											
CO1	To make the students aware of basic laboratory rules and regulations and the fundamental instruments used in microbiology labs.										

CO2	To perform microscopic staining and wet mount studies.
CO3	To carryout motility of microorganisms.
CO4	To understand the sterilization methods.
CO5	To employ the suitable technique to control microorganisms.

1. Simple staining
2. Gram's staining
3. Negative staining
4. Spore staining
5. Motility of bacteria- Hanging drop method
6. Light microscope (DEMO)
7. Hot Air Oven (DEMO)
8. Autoclave (DEMO)
9. Membrane filter (DEMO)
10. Control of microorganisms- UV Radiation (DEMO)

REFERENCES

1. Bharti Arora. D.R.Arora, Practical Microbiology, CBS Publishers & Distributors Pvt.Ltd.
2. James G.Cappuccino, Natalie Sherman, Microbiology –A laboratory Manual- Seventh Edition- Published by Dorling Kindersley (India) Pvt.Ltd.
3. Ananthanarayanan and Paniker's –Text book of Microbiology- ninth edition, University press

Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	40 Marks
	Attendance and Class Participation	
External Evaluation	End Semester Examination	60 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.	

COURSE OUTCOMES

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Make the students aware of basic laboratory rules and regulations and the fundamental instruments used in microbiology labs	PO1, PO6, PO9
CO2	Identify and characterize microorganism using microscopic staining and wet mount studies.	PO1, P07, PO11
CO3	Apply the hanging drop method to observe motility.	PO5, PO8, PO11
CO4	Analyse appropriate sterilization methods	PO3, PO4, PO5, PO8 PO11

CO5	Employ the microbial control measure	PO4, PO5, PO7, PO8, PO10, PO11

Mapping of Course Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1		M									
CO2		M									
CO3						S	S	S			
CO4						S	S	S			
CO5							S	S		S	

ALLIED PAPER – MICROBIOLOGY-II

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	MICROBIOLOGY - II	ALLIED-II	Y	-	-	-	3	4	25	75	100

Course Objectives	
CO1	Describe and classify the diverse kinds of sterilization and media and discover the suitability of techniques and media to value samples.
CO2	Employ microbial cultural methods and cultivation techniques.
CO3	Apply the techniques to detect microbial populations in water.
CO4	Analyse the air borne microbes and its measurements.
CO5	Examine the milk quality using common lab tests and detect milk borne diseases.

Unit-I

Culture media- types of media- Liquid-Solid-simple media- complex media- synthetic and defined media- special media- blood agar- LJ Media- MacConkey agar medium- Transport medium.

Unit-II

Culture methods- Aerobic culture method- streak culture – Lawn and carpet culture – stoke culture- stab culture- pour plate- liquid culture- anaerobic culture methods- McIntosh – Filder anaerobic jar. Robertson cooked meat medium.

Unit-III

Bacteriology of water- bacteriological examination- detection of coliform bacteria- presumptive method- MPN Technique- Eijkman test- Membrane filtration method, fecal *Streptococci*, *Clostridium species*.

Unit-IV

Bacteriology of Air- Airborne infection- droplets infection- microbial content of air- dust- droplets- droplet nuclei- measurement of air contamination- sedimentation or settle plate method.

Unit-V

Bacteriological examination of Milk- viable count- test for coliform bacilli- methylene blue reduction test- Phosphatase test- turbidity test- examination specific pathogens- tubercle bacilli- *Burucella* sps.,

REFERENCES

1. Ananthanarayanan and Paniker's –Text book of Microbiology- ninth edition, University press
2. Michael J Pelczar, Microbiology 5th edition McCraw Hill, Education Pvt.Ltd.
3. SARAS Microbiology, low price edition, SARAS publication

COURSE OUTCOMES

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Describe and classify the diverse kinds of media and suitability of media to value samples.	PO1, PO6, PO9
CO2	Recognize and correlate different types of microbial culture methods.	PO1, P07,PO11
CO3	Recite the significance of water quality tests	PO5, PO8, PO11
CO4	Memorize the distribution of air microbes and their isolation techniques	PO3,PO4, PO5, PO8 PO11
CO5	Analyse the bacteriological examination of milk quality tests	PO4, PO5, PO7, PO8, PO10, PO11

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1					M	M				M	
CO2										M	M
CO3											S
CO4				M							S
CO5				M							S

ALLIED PAPER – MICROBIOLOGY PRACTICAL- II

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	MICROBIOLOGY PRACTICAL--II	ALLIED PRACTICAL-II	-	-	Y	-	2	2	40	60	100
Course Objectives											
CO1	To develop microbial liquid culture media										
CO2	To cultivate microorganisms using different techniques										
CO3	To observe water quality using MPN technique.										
CO4	To isolate air microorganisms.										
CO5	To examine milk quality using different techniques.										

1. Preparation of liquid media (nutrient broth, peptone water)
2. Preparation of Solid media (agar plate, agar slant)
3. Pure culture technique
4. Streak plate technique
5. MPN Test
6. Settle plate method (detection of air contamination)
7. Total viable count of milk
8. Methylene blue reduction test of milk
9. Turbidity test for milk
10. Phosphatase test of milk

REFERENCES

1. Bharti Arora. D.R.Arora, Practical Microbiology, CBS Publishers & Distributors Pvt.Ltd.
2. James G.Cappuccino, Natalie Sherman, Microbiology –A laboratory Manual- Seventh Edition- Published by Dorling Kindersley (India) Pvt.Ltd.
3. Ananthanarayanan and Paniker’s –Text book of Microbiology- ninth edition, University press

COURSE OUTCOMES (COs), On completion of the Practicals, Students will be able to

Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	40 Marks
	Attendance and Class Participation	
External Evaluation	End Semester Examination	60 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.

COURSE OUTCOME

