



Course Syllabus
Gyanmanjari Science College
Semester-2 (B.Sc.)

Subject: Fundamental of Microbial Culture - BSC1EM12306

Type of course: Major

Prerequisite: Basic knowledge of growth and cultivation of microorganisms.

Rationale: This course has been designed to make the students know about how to study individual microbes, cultivation enables research and practical application and control is essential for biotechnological processes.

Teaching and Examination Scheme

Teaching Scheme			Credits	Examination Marks		Total Marks
CI	T	P	C	SEE	CCE	
2	0	4	4	100	100	200

Legends: CI-Class Room Instructions; T – Tutorial; P - Practical; C – Credit; SEE - Semester End Evaluation;; V – Viva voce; CCE-Continuous and Comprehensive Evaluation; ALA- Active Learning Activities.



Course Content:

Sr. No	Course Content	Hrs.	% Weightage														
1	<p>Techniques for Isolation and Preservation of Pure Cultures</p> <p>Methods for Obtaining Pure Culture:</p> <ul style="list-style-type: none"> • Isolation by liquid media: Serial dilution • Isolation by plating methods: Streak, Pour, Spread plate • Selective isolation: Physical and chemical agents <p>Maintenance and Preservation of Pure Culture</p> <ul style="list-style-type: none"> • Periodic subculturing, Refrigeration, Mineral oil overlay <p>Practical</p> <ol style="list-style-type: none"> 1. Isolation of bacteria from soil, air, and water samples using the pour plate method and comparison of their microbial load 2. To study the selective isolation of microorganisms using physical and chemical agents that inhibit unwanted microbes and allow desired organisms to grow. 3. To evaluate the antimicrobial activity of natural/chemical agents against bacteria using disc diffusion 4. Preservation of microbial cultures by periodic subculturing and storage at low temperature (refrigeration). 5. Isolation of Halophilic Bacteria Using Salt Concentration. 6. Preservation and sealing of agar slant with paraffin oil/wax. 	T:P 6:12	20														
	<p>Evaluation method</p> <table border="1" data-bbox="263 1150 1005 1205"> <thead> <tr> <th data-bbox="263 1150 375 1205">Sr. No</th> <th data-bbox="375 1150 729 1205">Evaluation Methods</th> <th data-bbox="729 1150 845 1205">SEE</th> <th data-bbox="845 1150 1005 1205">CCE</th> </tr> </thead> <tbody> <tr> <td data-bbox="263 1205 375 1591">1</td> <td data-bbox="375 1205 729 1591"> <p>Microbial Detectives: Uncovering Spoilers in Rotten Fruit: Students will isolate and identify microorganisms from spoiled fruit samples to examine the bacteria and fungi responsible for food spoilage, and upload photographs of their results on the GMIU web portal.</p> </td> <td data-bbox="729 1205 845 1591"></td> <td data-bbox="845 1205 1005 1591">5</td> </tr> <tr> <td data-bbox="263 1591 375 1803">2</td> <td data-bbox="375 1591 729 1803"> <p>Counting the Invisible: Heterotrophs in Water: Faculty will provide different water samples from various sources, and students will detect and quantify heterotrophic bacteria using standard plate count methods.</p> </td> <td data-bbox="729 1591 845 1803">20</td> <td data-bbox="845 1591 1005 1803"></td> </tr> </tbody> </table>			Sr. No	Evaluation Methods	SEE	CCE	1	<p>Microbial Detectives: Uncovering Spoilers in Rotten Fruit: Students will isolate and identify microorganisms from spoiled fruit samples to examine the bacteria and fungi responsible for food spoilage, and upload photographs of their results on the GMIU web portal.</p>		5	2	<p>Counting the Invisible: Heterotrophs in Water: Faculty will provide different water samples from various sources, and students will detect and quantify heterotrophic bacteria using standard plate count methods.</p>	20			
	Sr. No			Evaluation Methods	SEE	CCE											
1	<p>Microbial Detectives: Uncovering Spoilers in Rotten Fruit: Students will isolate and identify microorganisms from spoiled fruit samples to examine the bacteria and fungi responsible for food spoilage, and upload photographs of their results on the GMIU web portal.</p>		5														
2	<p>Counting the Invisible: Heterotrophs in Water: Faculty will provide different water samples from various sources, and students will detect and quantify heterotrophic bacteria using standard plate count methods.</p>	20															



	3	Journal		5											
	4	Microbe Mastery: Serial Dilutions, Streaks, and Beyond: Students will prepare a model showing Methods of Pure Culture Isolation and Preservation (Serial dilution, Streak, Lyophilization, etc.) and submit/upload on GMIU web portal.		10											
	Total		20	20											
2	<p>Microbial Growth and Identification Techniques</p> <p>Cultivation of Aerobic Bacteria</p> <ul style="list-style-type: none"> Media: Nutrient broth, Nutrient agar, MacConkey agar, EMB agar, Mannitol salt agar, SS agar, Wilson-Blair agar <p>Cultivation of aerobic bacteria by using solid and liquid media.</p> <p>Cultivation of anaerobic bacteria:</p> <ul style="list-style-type: none"> Media: Thioglycollate broth, Robertson's cooked meat medium, litmus milk medium. Cultivation of anaerobic bacteria by using broth medium and anaerobic jar. <p>Practical:</p> <p>7. Inoculation and incubation techniques for aerobic bacteria on liquid media</p> <p>8. Detection of Coliform Bacteria in Milk using EMB Agar.</p> <p>9. To isolate and identify bacterial species present in a skin specimen using standard culture techniques.</p> <p>10. Isolation and Identification of <i>Escherichia coli</i> from sewage Water Sample using EMB Agar.</p> <p>11. Isolation of Acidophiles and Alkaliphiles Using pH-selective Media</p> <p>12. Preparation of media for anaerobes: Thioglycollate broth medium, Robertson's cooked meat medium, litmus milk medium.</p> <p>13. Isolation of anaerobic bacteria from soil sample using prepared media</p> <p>Evaluation method</p> <table border="1"> <thead> <tr> <th>Sr. No</th> <th>Evaluation Methods</th> <th>SEE</th> <th>CCE</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Report Preparation: Students will prepare a detailed report on Aerobic and Anaerobic Culture Media, highlighting composition, selective/differential properties, and specific applications. PDF</td> <td></td> <td>5</td> </tr> </tbody> </table>					Sr. No	Evaluation Methods	SEE	CCE	1	Report Preparation: Students will prepare a detailed report on Aerobic and Anaerobic Culture Media, highlighting composition, selective/differential properties, and specific applications. PDF		5		
	Sr. No	Evaluation Methods	SEE	CCE											
1	Report Preparation: Students will prepare a detailed report on Aerobic and Anaerobic Culture Media, highlighting composition, selective/differential properties, and specific applications. PDF		5												
					T:P 6:12	20									



		to be uploaded on GMIU web portal.				
	2	<p>Cultivation Strategies: Aerobic vs. Anaerobic Microbes:</p> <p>Students will cultivate the same bacterial culture in both Nutrient agar (aerobic) and Thioglycollate broth (anaerobic). They will analyze oxygen requirements based on growth distribution.</p>	10			
	3	<p>Case-Based Media Selection: Students are given short case scenarios (e.g., "You need to isolate <i>Salmonella</i> from stool samples"). They must choose the most appropriate medium (SS agar, Wilson-Blair agar, etc.) and explain why.</p>	10			
	4	Journal		5		
	5	<p>Food Microbe Match-Up: Identifying Beneficial and Spoilage Bacteria in Everyday Foods: Students will prepare a flowchart listing common foods along with the beneficial (probiotic/fermentative) and harmful (spoilage/pathogenic) microorganisms associated with each. They will compare "good vs. bad" bacteria found in foods and upload the completed activity on the GMIU web portal.</p>		10		
		Total	20	20		
3		<p>Cultivation and Diagnostic Identification of Fungi & Yeasts</p> <p>Cultivation of fungi and yeast:</p> <ul style="list-style-type: none"> • Culture Media: Potato Dextrose Agar (PDA), Rose Bengal Agar, Czapek-Dox Agar, Glucose Yeast Extract Agar • Cultivation Techniques: Inoculation and incubation on solid media; demonstration of colony growth patterns, pigmentation, and texture 			T:P 6:12	20



<p>Practical:</p> <p>14. Rose Bengal Agar (RBA): Isolation of fungi from environmental samples; understanding its inhibitory effect on bacterial growth.</p> <p>15. Isolation of yeast from fermented foods (curd, idli batter, fruit juices).</p> <p>16. To isolate the presence of fungal spores in the surrounding air By using PDA plate.</p> <p>17. To estimate the fungal (mould/yeast) load in a food sample using serial dilution and plate count.</p> <p>18. To determine the susceptibility of a fungal isolate to selected antifungal agents using the disc diffusion method.</p> <p>19. Preparation of Lactophenol Cotton Blue (LPCB) mount for fungal structures.</p> <p>• Evaluation method</p>			
Sr. No	Evaluation Methods	SEE	CCE
1	<p>“Yeast in Our Daily Life” – Mini Project: Students will prepare a mini project on how yeast helps in our day-to-day life, listing its applications in industry and pharmaceuticals. The project should be uploaded on the GMIU portal.</p>		5
2	<p>Slide Culture Technique: Students will perform a fungal slide culture using Lactophenol Cotton Blue to observe undisturbed spore structures. They will examine the slide under a microscope and interpret key morphological features, including conidia, sporangia, and yeast budding patterns.</p>	10	
3	<p>Exploring Fungi: Faculty will provide images of fungi, and students will identify the scientific name of the fungus, analyze its type and habitat, draw a diagram, describe its</p>	10	



	characteristics and spore formation, and mention whether it is pathogenic or beneficial.											
4	Journal		5									
5	Creative Assignment – “Pathogenic vs. Industrial Fungi”: Students will prepare a comparative chart/poster showing differences between pathogenic fungi (e.g., <i>Candida albicans</i> , <i>Aspergillus fumigatus</i>) and industrially useful fungi/yeast (e.g., <i>Saccharomyces cerevisiae</i> , <i>Penicillium</i>). Must include morphology, habitat, importance, and applications. To be uploaded on GMIU portal.		10									
	Total	20	20									
4	<p>Principles and Strategies of Microbial Control:</p> <ul style="list-style-type: none"> • General principles of microbial control. • Characteristics of ideal antimicrobial agents. • Physical agents used for microbial control: pH, temperature, radiation, osmotic pressure. • Understanding of terms: Bacteriostatic, bactericidal, germicidal, disinfectants, antiseptic, sanitizer. <p>Practical:</p> <p>20. Study of the effect of chemicals on microbial growth.</p> <p>21. Effect of Heat on Microbial Growth (Thermal Death Time)</p> <p>22. To test the effectiveness of different antiseptics and disinfectants on bacterial growth.</p> <p>23. To check how food preservatives inhibit microbial growth.</p> <p>24. Effect of Different pH Levels on Microbial Growth</p> <p>Evaluation method:</p> <table border="1"> <thead> <tr> <th>Sr. No</th> <th>Evaluation Methods</th> <th>SEE</th> <th>CCE</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Flow Diagram of Microbial Control Methods: Students will create a comprehensive flow diagram showing physical and chemical microbial control methods, their principles,</td> <td></td> <td>5</td> </tr> </tbody> </table>	Sr. No	Evaluation Methods	SEE	CCE	1	Flow Diagram of Microbial Control Methods: Students will create a comprehensive flow diagram showing physical and chemical microbial control methods, their principles,		5		T:P 6:12	20
Sr. No	Evaluation Methods	SEE	CCE									
1	Flow Diagram of Microbial Control Methods: Students will create a comprehensive flow diagram showing physical and chemical microbial control methods, their principles,		5									



		examples of agents, and target microorganisms. Upload diagram with labeled images/photos on GMIU portal.			
	2	Case Study Analysis – Environmental Factors: Faculty will provide scenarios (e.g., water treatment, food storage, hospital surface disinfection). Students will analyze how temperature, pH, osmotic pressure, and radiation affect microbial survival and propose appropriate control strategies.	10		
	3	Antimicrobial Spot Test Observation: Students will perform or observe a spot test with chemical agents (e.g., silver nitrate, alcohol, phenol) on bacterial lawns. They will record zones of inhibition, interpret results, and compare efficacy of different agents.	10		
	4	Journal		5	
	5	Comparative Table – Bacteriostatic vs. Bactericidal Agents: Students will construct a table summarizing key features, examples, mode of action, and typical applications for bacteriostatic, bactericidal, germicidal, disinfectants, antiseptics, and sanitizers. Photograph or scan the table and upload it on the GMIU portal.		10	
		Total	20	20	
5		Applications and Innovations in Microbial Culture <ul style="list-style-type: none"> Industrial applications (fermentation, probiotics, enzyme production, biofertilizers) Medical and diagnostic microbiology (pathogen culture, antimicrobial resistance) 		T:P 6:12	20



<p>Practical:</p> <p>25. To study the effect of sugar concentration on the rate of fermentation by <i>Saccharomyces cerevisiae</i> and monitor CO₂ production as an indicator of metabolic activity.</p> <p>26. Isolation of probiotic from probiotic food (e.g., buttermilk).</p> <p>27. To check Isolated probiotics survive in acidic pH.</p> <p>28. Isolate Phosphate Solubilization bacteria from soil sample</p> <p>29. To study the ability of <i>Bacillus</i> spp. to produce amylase and hydrolyze starch, and to compare enzymatic activity among different isolates or conditions.</p> <p>30. Study of Bioremediation by Dye-Degrading Bacteria</p> <p>31. Isolation of microorganisms from different waste water sample and interpret its result</p> <p>32. To determine the ability of isolated microorganisms from wastewater to degrade tryptophan by performing the indole test.</p> <p>33. To isolate specific pathogens from mixed cultures using selective and differential media</p> <p>Evaluation method</p>			
Sr. No	Evaluation Methods	SEE	CCE
1.	<p>Environmental& Agricultural Applications</p> <p>Poster/Flashcard Activity: Students create a poster/flashcard set on bioremediation, wastewater treatment, nitrogen fixation, and soil health.</p>		5
2.	<p>Microbial Spotlights: Industrial Wonders:</p> <p>Faculty will provide the names of selected microorganisms, and students will identify their industrial applications, including the type of product or process they are used in.</p>	10	
3.	<p>Study of Amylase Production by <i>Bacillus</i> spp.: Students will perform an amylase test using starch agar plates to observe zones of hydrolysis.</p>	10	



4.	Journal		5		
5.	Yeast Fermentation / Bacterial Growth Study - Faculty provides OD or CO ₂ readings over time. Students plot growth curves, identify Lag, Log, Stationary, Decline phases, and explain physiological changes. Upload report on GMJU portal.		10		
	Total	20	20		
				90	100%

RUBRICS:**UNIT 1**

Counting the Invisible: Heterotrophs in Water: Evaluation based on Aseptic Technique Accuracy of Dilution & Inoculation - 5

Principle, Procedure, Observation & Colony count & Result and interpretation - 15

UNIT 2

Cultivation Strategies: Aerobic vs. Anaerobic Microbes: Evaluation based on Practical handling, Growth Observation & Analysis-5

Data Recording & Documentation, Result Interpretation-5

Case-Based Media Selection:

Appropriate Media Selection-4

Explanation & Application of Microbiological Principles -6

UNIT 3

Slide Culture Technique: Evaluation based on

Preparation & Technique-4

Microscopic Observation & Morphological Interpretation -6

Exploring Fungi: Identification & Nomenclature-2

Morphological Description, Diagram & Labeling & Pathogenicity / Beneficial Role -8



UNIT 4

Case Study Analysis – Environmental Factors: Evaluation based on
 Identification of Environmental Factors-3
 Analysis & Interpretation and Control Strategies-7

Antimicrobial Spot Test Observation:

Experimental Setup & Technique-4
 Observation & Measurement & Data Analysis & Interpretation-6

UNIT 5

Yeast Fermentation / Bacterial Growth Study: Evaluation based on
 Preparation & Aseptic Technique, Execution of Procedure, Observation & Measurement-6

Recording & Presentation of Data and Interpretation & Conclusion-4

Microbial Spotlights: Industrial Wonders:(organisms name 4)

Accuracy of Microorganism Identification & Correct Industrial Applications - 2.5

Distribution of Marks (Revised Bloom's Taxonomy)						
Level	Remembrance (R)	Understanding (U)	Application (A)	Analyze (N)	Evaluate (E)	Create (C)
Weightage %	10%	20%	20%	20%	20%	10%

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.



Course Outcome:

After learning the course, the students should be able to:	
CO1	Acquire hands-on skills in pure culture techniques to separate, grow, and maintain microorganisms with accuracy and precision.
CO2	Develop skills to prepare, inoculate, and cultivate aerobic and anaerobic bacteria using selective, differential, and enrichment media with precision.
CO3	Gain hands-on expertise in cultivating, identifying, and preserving fungi & yeasts using selective media and diagnostic techniques.
CO4	Understand and apply physical and chemical methods to control microbial growth, evaluating the effectiveness of disinfectants, antiseptics, and environmental parameters through practical experiments.
CO5	Explore and apply microbial skills in industrial fermentation, enzyme production, probiotics, and environmental bioremediation, integrating hands-on experiments with real-world microbial applications.

Instructional Method:

The course delivery method will depend upon the requirement of content and needs of students. The teacher, in addition to conventional teaching methods by black board, may also use any tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.

From the content 10% topics are suggested for flipped mode instruction. Students will use supplementary resources such as online videos, NPTEL/SWAYAM videos, e-courses, Virtual Laboratory.

The internal evaluation will be done on the basis of the Active Learning Assignment.

Practical/Viva examination will be conducted at the end of semester for evaluation of performance of students in the laboratory.



Reference Books:

- [1] Microbiology: Pelczar MJ, Chan ECS and Kreig NR, Tata Mc Grow Hill.
- [2] General Microbiology: Stanier RY, Adelberg EA and Ingraham JL, Mac Millan Press Inc.
- [3] General Microbiology Vol I & II: Powar&Daginawala, Himalaya Publishing House.
- [4] Introduction to Microbiology: Ingraham JL and Ingraham CA, Thomson Brooks/Cole.
- [5] Principles of Microbiology: Atlas RM, Wm C Brown Publishers.
- [6] Brock's biology of Microorganisms Madigan MT and Martinko JM, Pearson Education Inc.
- [7] Microbiology: An introduction: Tortora GJ, Funke BR and Case CL, Pearson Education Inc.
- [8] Elementary Microbiology: Modi HA, volume- I & II.
- [9] General Microbiology: Dubey RC.

