



Karmaveer Bhaurao Patil University, Satara

Syllabus for

B. Sc. I Microbiology

Under

Faculty of Science and Technology
(As per NEP 2020)

With effect from Academic Year 2024-2025

Syllabus for Bachelor of Science (B. Sc.) Part – I Microbiology

PREAMBLE:

This syllabus is framed to give sound knowledge with understanding of Microbiology to undergraduate students at first year of four years of B.Sc. degree course. Students learn Microbiology as a separate subject from B.Sc. I. The goal of the syllabus is to make the study of Microbiology popular, interesting and encouraging to the students for higher studies including research. The new and updated syllabus is based on a basic and applied approach with vigor and depth. The syllabus meets the needs of industries and research. The syllabus is prepared after long discussion with number of faculty members of the subject and experts from industries and research fields. The units of the syllabus are well defined, taking into consideration the level and capacity of students.

GENERAL OBJECTIVES OF THE COURSE:

1. To nurture academicians with focus and commitment to their subject.
2. To create a skilled work force to match the requirements of the industries and research.
3. To develop scientific attitude is the major objective so as to make students open minded, critical and curious.
4. To develop skill in practical work, experiments and laboratory materials and equipment along with the collection and interpretation of scientific data to contribute to science.

PROGRAMME OUTCOMES

1. The students will graduate with proficiency in the subject of their choice.
2. The students will be eligible to continue higher studies in abroad.
3. The students will be eligible to pursue higher position in industries.
4. The students will be eligible for jobs in government organization.

PROGRAM SPECIFIC OBJECTIVES:

1. To learn fundamental techniques in Microbiology such as culturing microbes, maintaining microbes, safety issues related to handling of microbes, Good Microbiological practices etc.
2. To acquire practical skills through the laboratory work, exposure to industries and interaction with industry experts.
3. To develop moderately advanced skills in working with microbes such as pilot scale culturing, downstream processes, diagnostics and advanced techniques in molecular biology etc.
4. To be familiarized with the applicability of knowledge and Interdisciplinary approach in everyday life as well as in various other fields like agriculture, environment, industries such as food and dairy industries, distilleries, pharmaceutical industries, immunology and medical microbiology etc.
5. To become informed citizens who can understand and evaluate the impact of new research discoveries in the life sciences and will be able to pursue a wide range of careers, including biological and medical research in higher education institutions as well as careers in public and global health, scientific writing, environmental organizations, and food, pharmaceuticals and biotechnology industries

PROGRAMME SPECIFIC OUTCOMES:

After completing B. Sc. Microbiology Programme, the students will

1. Explain the applications of microorganisms in agriculture, environment, food and dairy industries, distilleries, pharmaceuticals, immunology, and medical microbiology.
2. Describe the characteristics, classification, visualization, growth control, isolation, maintenance of microorganisms, and basic concepts of infection and immunity.
3. Apply microbiology knowledge to bioremediation, waste management, diagnostics, and experiments in microbiology, immunology, molecular biology, recombinant DNA technology, and microbial genetics.
4. Pursue higher studies in fields such as medical, industrial, food, marine microbiology, and virology.
5. Build careers in academia, research, government, pharmaceuticals, food and beverage, bakery, winery, water treatment, and develop entrepreneurship in agriculture, horticulture, plant tissue culture, and herbal industries.

1. TITLE: **Microbiology**

2. YEAR OF IMPLEMENTATION: **2024-2025**

3. DURATION: **01 year**

4. PATTERN: **Semester examination**

5. MEDIUM OF INSTRUCTION: **English**

6. BATCH SIZE -20 Students per batch

7. ELIGIBILITY OF STUDENTS : As per guidelines obtained from University by following rules and regarding reservations by Government of Maharashtra

8. ELIGIBILITY OF CORE FACULTY : As per the rules & regulations of the University Grants Commission (UGC) and the Government of Maharashtra

9. STRUCTURE OF COURSE:

As per NEP-2020 (2.0)

Sem (Level)	Courses			OE	AEC / VEC / IKS	Total Credits	Degree/ Cum. Cr. MEME
	Course I	Course II	Course III				
SEM I (4.5)	DSC I (2) DSC II (2) DSC P I (2)	DSC I(2) DSC II(2) DSC P I (2)	DSC I (2) DSC II(2) DSC P I (2)	OE I (2)	IKS I (2) (Generic)	22	UG Certificate: 44
SEM II (4.5)	DSC III(2) DSC IV (2) DSC PII (2)	DSC III (2) DSC IV (2) DSC PII (2)	DSC III (2) DSC IV (2) DSC PII(2)	OE II (2)	VEC I (2) DEGG and IIC	22	
Total Credit	12	12	12	04	04	44	

10. COURSE TITLE

First Semester

Sr. No.	Course	Theory				Practical		
		Course No. & Course Code	Title of Paper	No. of lectures per week	Credits	Course No. & Course Code	No. of Practical Per week	Credits
1.	DSC I	BMiT 111	Introduction to Microbiology	2	2	BMiP 113	1	2
2.	DSC II	BMiT 112	Techniques in Microbiology	2	2			
3.	DSC III		Practical I	2	2			

Second Semester

Sr. No.	Course	Theory				Practical		
		Course No. & Course Code	Title of Paper	No. of lectures per week	Credits	Course No. & Course Code	No. of Practical Per week	Credits
1.	DSC I	BMiT 121	Microbial growth	2	2	BMiP123	1	2
2.	DSC II	BMiT 122	Biomolecules					
3.	DSC III		Practical II	2	2			

11. EVALUATION STRUCTURE:

First Semester

Course	Course Category	Course Code	Internal Evaluation			ESE	Total Marks	Credits
			CCE-I	CCE-II	CCE-III			
Major	T	BMiT 111	10	10	10	30	50	02
	T	BMiT 112	10	10	10	30	50	02
	P	BMiP 113	20			30	50	02

Second Semester

Course	Course Category	Course Code	Internal Evaluation			ESE	Total Marks	Credits
			CCE-I	CCE-II	CCE-III			
Major	T	BMiT 121	10	10	10	30	50	02
	T	BMiT 122	10	10	10	30	50	02
	P	BMiP 123	20			30	50	02

***Best of two scores of internal evaluation will be considered for final mark entry**

DSC: Discipline Specific Course; T: Theory; P: Practical

12. OTHER FEATURES:

A) LIBRARY:

Reference books, Textbooks, journals, and Periodicals are available in Institute and Departmental Library. (Separate reference lists are attached along with the respective course syllabus)

B) EQUIPMENT:

a) Computer, LCD projector, visualizer, smart board

b) Laboratory Equipment:

1. Microscope with a digital camera
2. Hot Air Oven
3. Digital weighing balance
4. Incubator
5. pH meter
6. Refrigerator
7. Microtome
8. Autoclave etc.

	Karmaveer Bhaurao Patil University, Satara (A State Public University Est. u/s 3(6) of MPUA 2016) Faculty of Science and Technology	
	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Microbiology	
	Programme: B. Sc.	Semester – I
	Type : DSC	Marks: 50
	Credits : 2	From: A. Y. 2024-25
	Name of the Course: BMiT 111- Introduction to Microbiology	
Course Objectives: By the end of the course, students should be able to: 1) describe the contributions of prominent scientists to the development and advancement of microbiology. 2) discuss the scope and emerging applications of microbiology in various areas of biological sciences. 3) differentiate microorganisms based on their morphological and differential characteristics. 4) explain the structure and functions of different components of a typical bacterial cell.		
Course Outcomes: By the end of the course, students will be able to: 1) explain the contribution of scientists in development of microbiology. 2) describe the scope of microbiology in upcoming areas of biological sciences. 3) examine morphological and differential characteristics of different groups of microorganisms. 4) evaluate the structure and functions of different parts of typical bacterial cell.		
Module	Title and Contents	Hrs.
Module 1	History and Development of Microbiology 1.1 Theory of abiogenesis and biogenesis 1.2 Contributions of Anton Van Leeuwenhoek, Louis Pasteur, Robert Koch, John Tyndall, Martinus W. Beijerinck, Sergei N. Winogradsky. Paul Ehrlich, Edward Jenner, Joseph Lister.	8
Module 2	Scope and Branches of Microbiology 2.1 Air Microbiology, Water Microbiology, Sewage Microbiology, Agricultural Microbiology, Food & dairy Microbiology, Industrial Microbiology, Medical Microbiology 2.2 Advanced branches in Microbiology: Pharmaceutical microbiology, Geomicrobiology, Nano-biotechnology and Space Microbiology, Bioinformatics.	8
Module 3	Microbial Diversity 3.1 5 kingdom classification system 3.2 Differences in prokaryotic and eukaryotic organisms General characteristics of different groups– acellular microorganisms. (Viruses, Viroid’s and Prions) and cellular microorganisms (Bacteria, Archaeobacteria, Rickettsia, Algae, Fungi and Protozoa) with emphasis on occurrence and economic importance.	6

Module 4	Bacterial Cell Organization 4.1 Structure of typical bacterial cell 4.2 Cell wall: Structure, function and chemical composition 4.3 Cell membrane: Structure, function and chemical composition 4.4 Capsule and slime layer: Structure, composition and function 4.5 Flagella: Structure, composition and function 4.6 Pili: Structure, composition and function 4.7 Cytoplasm: Ribosomes, mesosomes, nucleoid material	8
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Reference Books:

1. Frobisher, M. *Fundamentals of Microbiology*. 7th ed. Philadelphia: W. B. Saunders, 1962.
2. Ingraham, John L., and Catherine A. Ingraham. *Introduction to Microbiology*. 3rd ed. Thomson Brooks/Cole, 2004.
3. Madigan, Michael T., and John M. Martinko. *Brock's Biology of Microorganisms*. 11th ed. Upper Saddle River, NJ: Pearson Education, 2006.
4. Pelczar, Michael J., Jr., E. C. S. Chan, and Noel R. Krieg. *Microbiology*. 5th ed. New Delhi: Tata McGraw-Hill, 1993.
5. Powar, C. B., and H. F. Dagainawala. *General Microbiology*. Himalaya Publishing House, 2010.
6. Prescott, Lansing M., John P. Harley, and Donald A. Klein. *Microbiology*. 6th ed. New York: McGraw-Hill, 2005.
7. Prescott, Lansing M., John P. Harley, and Donald A. Klein. *Microbiology*. 6th ed. New York: McGraw-Hill Higher Education, 2006.
8. Salle, A. J. *Fundamental Principles of Bacteriology*. 7th ed. New Delhi: Tata McGraw-Hill Publishing Co., 1971.
9. Stanier, Roger Y., Edward A. Adelberg, and John L. Ingraham. *General Microbiology*. 5th ed. London: Macmillan Press, 1987.
10. Tortora, Gerard J., Berdell R. Funke, and Christine L. Case. *Microbiology: An Introduction*. 8th ed. Boston: Pearson Education, 2006.
11. Willey, Joanne M., Linda M. Sherwood, and Christopher J. Woolverton. *Prescott's Microbiology*. 8th ed. 2013.

Evaluation Pattern:	
Total Marks: 50	
Internal Continuous Evaluation: (20 Marks) 1. CCE - I: 10 Marks: Home Assignment 2. CCE - II: 10 Marks: Short and long answer questions Test/Seminar/Open Book Test/Quiz/Case study/Book review/Field work/ Industry visit 3. CCE- III: 10 marks: Compulsory MCQ test 4. (Note: Best of two CCE marks will be considered)	End Semester Examination: (30 Marks) 1. Question-1: Solve the following questions (five questions of 2 marks) 10 M 2. Question-2: Attempt any two questions (three questions of 10marks) 20 M 3. Question-3: Attempt any four questions (five questions of 5 marks) 20 M 4. (Note: Conversion of 50 marks of ESE to 30 marks)

	Karmaveer Bhaurao Patil University, Satara (A State Public University Est. u/s 3(6) of MPUA 2016) Faculty of Science and Technology	
	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Microbiology	
	Programme: B. Sc.	Semester – I
	Type : DSC	Marks: 50
	Credits : 2	From: A. Y. 2024-25
	Name of the Course: BMiT 112 Techniques in Microbiology	
Course Objectives: By the end of the course, students should be able to: 1) explain the principles and demonstrate the working and applications of light and electron microscopy techniques. 2) identify and differentiate various morphological forms of bacteria using simple and special staining techniques. 3) clarify the modes of action of different sterilizing agents and disinfectants and apply them appropriately. 4) illustrate the principles and demonstrate the working and applications of chromatography, colorimetry, and electrophoresis.		
Course Outcomes: By the end of the course, students will be able to: 1) compare the principle, working and applications of light and electron microscopic techniques. 2) identify various morphological forms of bacteria using simple and special staining techniques. 3) specify the mode of action and application of different sterilizing agents and disinfectants. 4) analyze different samples of biomolecules by using chromatography, colorimeter and electrophoresis.		
Module	Title and Contents	Hrs.
Module 1	Microscopy 1.1 Terms in microscopy - Magnification, Refractive index, Numerical aperture, Resolving power 1.2 Types of Microscopes i)Light Microscope - Types: Bright field, Dark field, Phase contrast, fluorescent microscope Compound Microscope: Parts, image formation, Ray diagram and applications. ii)Electron Microscope - TEM and SEM - Parts, principle of image formation, Ray diagram and applications. iii) Comparative study of compound and electron microscope.	8
Module 2	Stain and Staining Techniques 2.1 Definition of dye, stain, fixative, mordant, accentuators, decolorizing agent. Classification of stain: acidic, basic and neutral. 2.2 Common staining techniques-Principle, procedure, mechanism and application of simple staining, negative staining, differential staining, Gram and acid-fast staining, impregnation method. 2.3 Special staining methods-Cell wall, Capsule and Volutin granules	8

Module 3	Control of microorganisms 3.1 Definitions- sterilization, disinfection, Antiseptic, Germicide, Microbiostasis, Antisepsis & sanitization. 3.2 Physical agents of control of microorganisms- Temperature (dry heat and moist heat), Filtration -asbestos and membrane filter, Radiations- U.V Rays, Gamma Rays Checking of efficiency of Sterilization Biological and Chemical indicators 3.3 Chemical agents for control of microorganisms- mode of action, applications and advantages of Phenolic and phenolic compound, Alcohol (Ethyl alcohol), Halogen compounds (Chlorine & Iodine), Heavy metal (Cu and Hg)	8
Module 4	Analytical techniques 4.1 Principle, working and applications of 4.2 Chromatography (Paper and Thin layer chromatography) 4.3 Colorimeter and Spectrophotometer Electrophoresis	6

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1. Frobisher, M. *Fundamentals of Microbiology*. 7th ed. Philadelphia: W. B. Saunders, 1962.
2. Ingraham, John L., and Catherine A. Ingraham. *Introduction to Microbiology*. 3rd ed. Thomson Brooks/Cole, 2004.
3. Madigan, Michael T., and John M. Martinko. *Brock's Biology of Microorganisms*. 11th ed. Pearson Education, 2006.
4. Pelczar, Michael J., Jr., E. C. S. Chan, and Noel R. Krieg. *Microbiology*. 5th ed. Tata McGraw-Hill Press, 1993.
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6. Prescott, L. M., J. P. Harley, and D. A. Klein. *Microbiology*. 6th ed. McGraw-Hill Companies, 2005.
7. Prescott, L. M., J. P. Harley, and D. A. Klein. *Microbiology*. 6th ed. McGraw-Hill Higher Education, 2006.
8. Salle, A. J. *Fundamental Principles of Bacteriology*. 7th ed. Tata McGraw-Hill Publishing Co., 1971.
9. Stanier, R. Y., E. A. Adelberg, and J. L. Ingraham. *General Microbiology*. 5th ed. Macmillan Press, 1987.
10. Tortora, G. J., B. R. Funke, and C. L. Case. *Microbiology: An Introduction*. 8th ed. Pearson Education, 2006.
11. Willey, J. M., L. M. Sherwood, and C. J. Woolverton. *Prescott's Microbiology*. 8th ed. McGraw-Hill Higher Education, 2013.

Evaluation Pattern:	
Total Marks: 50	
Internal Continuous Evaluation: (20 Marks) 5. CCE - I: 10 Marks: Home Assignment 6. CCE - II: 10 Marks: Short and long answer questions Test/Seminar/Open Book Test/Quiz/Case study/Book review/Field work/ Industry visit 7. CCE- III: 10 marks: Compulsory MCQ test 8. (Note: Best of two CCE marks will be considered)	End Semester Examination: (30 Marks) 5. Question-1: Solve the following questions (five questions of 2 marks) 10 M 6. Question-2: Attempt any two questions (three questions of 10marks) 20 M 7. Question-3: Attempt any four questions (five questions of 5 marks) 20 M 8. (Note: Conversion of 50 marks of ESE to 30 marks)

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	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Microbiology	
	Programme: B. Sc.	Semester – I
	Type : DSC	Marks: 50
	Credits : 2	From: A. Y. 2024-25
	Name of the Course: BMiP 113 Practical I (based on BMiT 111 and BMiT 112)	

Course Objectives: By the end of the course, students should be able to:

- 1) apply appropriate safety measures while working in a microbiology laboratory and demonstrate the correct handling and operation of a microscope.
- 2) prepare stains, buffers, reagents, and physiological saline using appropriate laboratory procedures.
- 3) demonstrate bacterial morphology using various staining techniques and differentiate bacterial cells based on their staining characteristics.
- 4) analyze and interpret the observations obtained from microbiological experiments and draw appropriate conclusions.

Course Outcomes: By the end of the course, students will be able to:

- 1) demonstrate the safety measures in the microbiology laboratory and handling of microscope and laboratory instruments.
- 2) demonstrate basic techniques in microbiology like wrapping of glasswares, cotton plugging etc.
- 3) prepare stains, buffer, reagents & physiological saline.
- 4) examine bacterial morphology using various staining procedures

Module	Title and Contents	Hrs.
1.	Demonstration of basic techniques in Microbiology: Wrapping of glassware, cotton plugging, cleaning and washing glassware, biological waste disposal.	60
2.	Introduction and use of common laboratory glass ware: Test tubes, culture tubes, suspension tubes, screw capped tubes, Petri Plates, pipettes, Erlenmeyer flask, Volumetric Flask, Glass spreader, Durham's Tube, Cragie's Tube, inoculating needles (Wire Loop, stab needles).	
3.	Study of biosafety- aseptic techniques, table disinfection, hand washing, use of apron, proper disposal of used material, cleaning and sterilization of glassware.	
4.	Use, care and study of compound microscope.	
5.	Demonstration/Working principle and application of laboratory equipment's -Incubator, Autoclave, Hot air oven, Membrane filter, Distilled water plant.	
6.	Preparation of: a) Stains (0.5% basic fuchsin & 0.5% crystal violet), b) Buffer (Phosphate buffer pH 7.0), c) Reagents (1N and 1M HCl and NaOH Solutions), d) Physiological Saline.	
7.	Perform morphology of bacteria by -Monochrome staining method.	
8.	Perform morphology of bacteria by -Negative staining method.	
9.	Study of gram nature of bacteria by Gram staining.	
10.	Perform motility by Hanging drop technique.	
11.	Demonstration of Acid fast staining-Permanent slide only.	
12.	Perform bacterial capsule staining by Maneval's method	

13.	Perform bacterial cell wall staining by Chance's method.	
14.	Perform bacterial volutin granule staining by Albert's method	
15.	Wet mount preparation of fungus.	

Reference Books:

1. Arora, B., and D. R. Arora. *Practical Microbiology*. New Delhi, India: CBS Publishers and Distributors, 2020.
2. Atlas, R. M. *Handbook of Microbiological Media*. Ukraine: Taylor and Francis, 2010.
3. Baker, F. J. *Bacteriological Techniques*. Butterworth & Co. Publishers Ltd., 1967.
4. Cruickshank, R. S., J. P. Duguid, B. P. Marmion, and R. H. Swain. *Medical Microbiology*. Vols. 1–2. 12th ed. Edinburgh: Churchill Livingstone, 1980.
5. Dubey, R. C., and D. K. Maheshwari. *Practical Microbiology*. New Delhi, India: S. Chand and Company Limited, 2012.
6. Goldman, E., and L. Green. *Practical Handbook of Microbiology*. Taylor & Francis, 2008.
7. Patel, R. *Experimental Microbiology*. Vols. 1–2. 5th ed. Aditya Book Centre, 2009.

Evaluation Pattern:	
Total Marks: 50	
Internal Evaluation (20 marks): • Journal/ Student Performance- 10 Marks • Viva: 10 Marks	End Semester Examination (30 Marks): Question 1 Major -14 Marks Question 2 Minor- 8 Marks Question 3 Minor- 8 Marks

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	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Microbiology	
	Programme: B. Sc.	Semester – II
	Type : DSC	Marks: 50
	Credits : 2	From: A. Y. 2024-25
	Name of the Course: BMiT 121 Microbial growth	
Course Objectives: By the end of the course, students should be able to: 1)explain the different phases and patterns of microbial growth and apply appropriate methods for the enumeration of microorganisms 2)classify microorganisms based on their nutritional requirements. 3)describe the composition and functions of different components of bacterial culture media. 4)apply suitable techniques for the isolation and preservation of microorganisms.		
Course Outcomes: By the end of the course, students will be able to: 1) compare different phases and pattern of microbial growth. 2) classify the microorganisms on basis of their nutritional requirements. 3) design specific growth medium for a particular group of bacteria. 4) isolate and preserve the pure culture by using suitable techniques.		
Module	Title and Contents	Hrs.
Module 1	Microbial growth 1.1 Modes of cell division: Binary division, budding, fragmentation 1.2 Growth curve- phases, Diauxic growth and Synchronous growth 1.3 Kinetics of bacterial growth (Exponential growth model) 1.4 Measurement of bacterial growth- Microscopic methods -Direct microscopic count, counting cells using improved Neubauer chamber, Plate counts (Total viable count), Turbidometric methods	08
Module 2	Microbial Nutrition 2.1 Nutrition requirement of microorganisms-Water, Macronutrients and Micronutrients 2.2 Types of microorganisms depending on growth factors – auxotrophs, prototrophs, fastidious organisms. 2.3 Nutritional types of microorganisms depending on carbon and energy source.	08
Module 3	Culture Media 3.1 Common components of culture media and their functions. 3.2 Types of media based on consistency– Liquid, Solid, Semisolid, Biphasic 3.3 Types of culture media– Natural and Synthetic, Semisynthetic, Differential, Enriched, Enrichment, Selective, Transport, Indicator media.	08

Module 4	Cultivation of Microorganisms 4.1 Pure culture techniques- Serial dilution technique, streak plate technique, spread plate technique, pour Plate technique 4.2 Cultivation of an aerobic bacteria by using media components and by exclusion of air or oxygen. 4.3 Preservation of microbial culture - sub culturing, overlaying with mineral oils, Lyophilization	06
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Reference Books:

1. Frobisher, M. *Fundamentals of Microbiology*. 7th ed. Philadelphia: W. B. Saunders, 1962.
2. Ingraham, John L., and Catherine A. Ingraham. *Introduction to Microbiology*. 3rd ed. Thomson Brooks/Cole, 2004.
3. Madigan, Michael T., and John M. Martinko. *Brock's Biology of Microorganisms*. 11th ed. Pearson Education, 2006.
4. Pelczar, Michael J., Jr., E. C. S. Chan, and Noel R. Krieg. *Microbiology*. 5th ed. Tata McGraw-Hill Press, 1993.
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11. Willey, J. M., L. M. Sherwood, and C. J. Woolverton. *Prescott's Microbiology*. 8th ed. McGraw-Hill Higher Education, 2013.

Evaluation Pattern:

Total Marks: 50

Internal Continuous Evaluation (20 Marks): 1. CCE - I: 10 Marks: Home Assignment 2. CCE - II: 10 Marks: Short and long answer questions Test/Seminar/Open Book Test/Quiz/Case study/Book review/Field work/ Industry visit 3. CCE- III: 10 marks: Compulsory MCQ test 4. (Note: Best of two CCE marks will be considered)	End Semester Examination (30Marks): 1. Question-1: Solve the following questions (five questions of 2 marks) 10 M 2. Question-2: Attempt any two questions (three questions of 10marks) 20 M 3. Question-3: Attempt any four questions (five questions of 5 marks) 20 M 4. Note: Conversion of 50 marks of ESE to 30 marks
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	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Microbiology	
	Programme: B. Sc.	Semester – II
	Type : DSC	Marks: 50
	Credits : 2	From: A. Y. 2024-25
	Name of the Course: BMiT 122- Biomolecules	
Course Objectives: By the end of the course, students should be able to: 1) identify and describe the structures of different monosaccharides and polysaccharides. 2) explain and differentiate the primary, secondary, tertiary, and quaternary structures of proteins. 3) clarify Watson and Crick’s double-stranded model of DNA and compare the structures and functions of the three major forms of DNA. 4) classify lipids based on their chemical composition and differentiate their major classes.		
Course Outcomes: By the end of the course, students will be able to: 1) draw the structures of different monosaccharides and polysaccharides. 2) compare the primary, secondary, tertiary and quaternary structures of protein. 3) describe Watson and Crick’s double stranded model of DNA and compare structure and functions of three forms of RNA 4) classify lipids based on their composition.		
Module	Title and Contents	Hrs.
Module 1	Carbohydrates 1.1 Definition, classifications and brief account of- Monosaccharides - Structure of glucose, fructose. 1.2 Disaccharides - Structures of lactose and sucrose. 1.3 Polysaccharides - Structures of starch and cellulose.	08
Module 2	Proteins 2.1 Amino acids- the building blocks of proteins, General formula and classification of amino acids, concept of zwitterion. 2.2 Structure of protein: Primary structure of proteins, secondary structure of proteins (alpha helix, β pleated sheet), tertiary and quaternary structure of proteins. 2.3 Enzyme: Definitions, Structure - Concept of apoenzyme, coenzyme, cofactor, prosthetic group and active site Types- extracellular, intracellular, constitutive and inducible enzyme	08
Module 3	Nucleic Acids 3.1 DNA: Composition- Structure of Purines, Pyrimidines, Structure of nucleoside, nucleotide, Structure of DNA (Watson and Crick’s double helical model), salient features 3.2 RNA - Composition, Structure and function of mRNA, tRNA, rRNA	08

Module 4	Lipids 4.1 Simple Lipids- Fats and oils, waxes 4.2 Compound Lipids- Phospholipids, Glycolipids 4.3 Derived lipids – Steroids, Terpenes.	06
Reference Books: 1. Berg, Jeremy M., John L. Tymoczko, and Lubert Stryer. <i>Biochemistry</i> . 7th ed. New York: W. H. Freeman, 2010. 2. Nelson, David L., Albert L. Lehninger, and Michael M. Cox. <i>Lehninger Principles of Biochemistry</i> . 5th ed. Palgrave Macmillan, 2008. 3. Powar, C. B., and H. I. Dagainawala. <i>General Microbiology</i> . Vol. 1. Pune, India: Himalaya Publishing House Private Limited, 2005. 4. Powar, C. B., and H. I. Dagainawala. <i>General Microbiology</i> . Vol. 2. Pune, India: Himalaya Publishing House Private Limited, 2005. 5. Sadasivam, S., and A. Manickam. <i>Biochemical Methods</i> . New Age International (P) Limited, 2007. 6. Satyanarayana, U., and U. Chakrapani. <i>Biochemistry</i> . 4th ed. Elsevier India, 2013.		
Evaluation Pattern:		
Total Marks: 50		
Internal Continuous Evaluation (20 Marks): 1. CCE - I: 10 Marks: Home Assignment 2. CCE - II: 10 Marks: Short and long answer questions Test/Seminar/Open Book Test/Quiz/Case study/Book review/Field work/ Industry visit 3. CCE- III: 10 marks: Compulsory MCQ test 4. (Note: Best of two CCE marks will be considered)		End Semester Examination (30Marks): 1. Question-1: Solve the following questions (five questions of 2 marks) 10 M 2. Question-2: Attempt any two questions (three questions of 10marks) 20 M 3. Question-3: Attempt any four questions (five questions of 5 marks) 20 M 4. Note: Conversion of 50 marks of ESE to 30 marks

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	Board of Studies in Microbiology	
	Programme: B. Sc.	Semester – II
	Type : DSC	Marks: 50
	Credits : 02	From: A. Y. 2024-25
	Name of the Course: BMiP 123 -Practical II (based on BMiT 121 and BMiT 122)	

Course Objectives: By the end of the course, students will be able to: 1) demonstrate the correct techniques for weighing ingredients, adjusting the pH of culture media, and operating an autoclave. 2) apply appropriate techniques for the isolation of microorganisms. 3) analyze the biochemical characteristics of bacteria using suitable biochemical tests. 4) perform and interpret qualitative tests for the identification of carbohydrates.		
Course Outcomes: By the end of the course, students should be able to: 1) prepare and sterilize culture media. 2) perform various techniques of isolation of bacteria. 3) operate instruments in Microbiology laboratory. 4) detect protein and carbohydrates in samples.		

Module	Title and Contents	Hrs.
1.	Demonstration of laboratory equipment's- Colorimeter, laminar air flow, anaerobic jar, pH meter, electronic balance, colony counter.	60
2.	Preparation and sterilization of nutrients broth, MacConkey's agar, Sabouraud's agar	
3.	Enumeration of bacteria from fermented food / soil / water samples by pour plate technique	
4.	Enumeration of bacteria from fermented food / soil / water samples by spread plate technique.	
5.	Isolation of bacteria by streak plate technique. (Colony and cultural characteristics)	
6.	To detect the ability of bacteria to produce amylase enzyme.	
7.	To detect the ability of bacteria to produce catalase enzyme.	
8.	To detect the ability of bacteria to produce caseinase enzyme	
9.	To check the ability of microorganism to ferment sugar.	
10.	To check the ability of microorganisms to produce H ₂ S.	
11.	Qualitative analysis of biomolecules Carbohydrate. i) General Test for Carbohydrate- Molisch Test ii) Test for Reducing Sugar – Benedict's Test iii)Test for Non reducing Sugar- Benedict's Test iv) Test for Starch- Iodine Test	
12.	Qualitative analysis of biomolecules Proteins. i) Detection of Protein by Biuret Test ii) Acetic Acid Test	
13.	Isolation of pure cultures of bacteria by four quadrant streaking method and study of colony characteristics, Gram Staining and motility of <i>E. coli</i>	

14.	Isolation of pure cultures of bacteria by four quadrant streaking method and study of colony characteristics, Gram Staining and motility of <i>Bacillus</i> species
15.	Isolation of pure cultures of bacteria by four quadrant streaking method and study of colony characteristics, Gram Staining and motility of <i>Staphylococcus aureus</i> .

Reference Books:

1. Arora, B., and D. R. Arora. *Practical Microbiology*. New Delhi, India: CBS Publishers and Distributors, 2020.
2. Atlas, R. M. *Handbook of Microbiological Media*. Ukraine: Taylor & Francis, 2010.
3. Plummer, David T. *An Introduction to Practical Biochemistry*. 3rd ed. New Delhi: Tata McGraw-Hill Publishing Company Limited, 1993.
4. Dubey, R. C., and D. K. Maheshwari. *Practical Microbiology*. New Delhi, India: S. Chand and Company Limited, 2012.
5. Jayaram, J. *Laboratory Manual of Biochemistry*. India: New Age International Publishers, 2011.
6. Shivashankara, A. R., M. K. Ganesh, and Y. M. Shivaraja Shankara. *Laboratory Manual for Practical Biochemistry*. India: Jaypee Brothers Medical Publishers Pvt. Ltd., 2012.
7. Singh, R., and S. K. Sawhney. *Introductory Practical Biochemistry*. UK: Alpha Science International, 2005.

Evaluation Pattern:

Total Marks: 50

Internal Evaluation (20 marks): 1. Journal/ Students Performance: 10 Marks 2. Viva: 10 Marks	End Semester Examination (30 Marks): 1. Question 1 Major- 14 marks 2. Question 2 Minor - 8 marks 3. Question 3 Minor - 8 marks
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