

**VIJAYANAGARASRIKRISHNADEVARAYAUNIVERSITY**  
**Department of UG Studies and Research in**  
**Microbiology**

Jnanasagaracampus, Vinayakanagara, Cantonment, Ballari-583105



**Syllabus**  
**for**  
**BACHELOR OF SCIENCE**  
**As per NEP-2020**

*With effect from 2021-2022*

## **Title of the Course: B.Sc.Microbiology.**

### **Program Outcomes:**

Competencies need to be acquired by the candidate securing B.Sc. (Basic) or B.Sc. (Hons)

By the end of the program the students will be able to:

1. Knowledge and understanding of concepts of microbiology and its application in pharma, food, agriculture, beverages, nutraceutical industries.
2. Understand the distribution, morphology and physiology of microorganisms and demonstrate the skills in aseptic handling of microbes including isolation, identification and maintenance.
3. Competent to apply the knowledge gained for conserving the environment and resolving the environmental related issues.
4. Learning and practicing professional skills in handling microbes and contaminants in laboratories and production sectors.
5. Exploring the microbial world and analyzing the specific benefits and challenges.
6. Applying the knowledge acquired to undertake studies and identify specific remedial measures for the challenges in health, agriculture, and food sectors.
7. Thorough knowledge and application of good laboratory and good manufacturing practices in microbial quality control.
8. Understanding biochemical and physiological aspects of microbes and developing broader perspective to identify innovative solutions for present and future challenges posed by microbes.
9. Understanding and application of microbial principles in forensic and working knowledge about clinical microbiology.
10. Demonstrate the ability to identify ethical issues related to recombinant DNA technology, GMOs, intellectual property rights, biosafety and biohazards.
11. Demonstrate the ability to identify key questions in microbiological research, optimize research methods, and analyze outcomes by adopting scientific methods, thereby improving the employability.
12. Enhance and demonstrate analytical skills and apply basic computational and statistical techniques in the field of microbiology

### **LEARNING OUTCOMES**

- Demonstrate skills as per National Occupational Standards (NOS) of “Lab Technician/ Assistant” Qualification Pack issued by Life Sciences Sector Skill Development Council - LFS/Q0509, Level 3.
  - Perform microbiology and analytical techniques. Knowledge about environment, health, and safety (EHS), good laboratory practices (GLP), good manufacturing practices (GMP) and standard operating procedures (SOP)
  - Demonstrate professional skills at work, such as decision making, planning, and organizing, Problem solving, analytical thinking, critical thinking, and documentation.
1. Principles which underlies sterilization of culture media, glassware and plastic ware to be used for microbiological work.
  2. Principles of a number of analytical instruments which the students have to use during the study and also later as microbiologists for performing various laboratory

manipulations.

3. Handling and use of microscopes for the study of microorganisms which are among the basic skills expected from a practicing microbiologist. They also get introduced a variety of modifications in the microscopes for specialized viewing.
4. Several separation techniques which may be required to be handled later as microbiologists.

**Pedagogy :**

The general pedagogy to be followed for theory and practicals are as under. Lecturing, Tutorials, Group/Individual Discussions, Seminars, Assignments, Counseling, Remedial Coaching. Field/Institution/Industrial visits, Hands on training, Case observations, Models/charts preparations, Problem solving mechanism, Demonstrations, Project presentations, Experiential documentation and Innovative methods.

Active learning as per LSSSDC (NSDC) LFS/Q0509 guidelines, at skill training Level 3. Case studies about application of microbial biomolecules in various industries. Seminar on topics of microbial biochemistry

## B.Sc. in Microbiology

### Semester-I

<b>Subject Title: Fundamentals of Microbiology</b>	
<b>Credits: 04</b>	<b>Category: DSC1</b>
<b>Contact Hours: 56</b>	<b>Marks: 40+60=100</b>

#### Course Outcomes:

By the end of the course the student will be able to:

- Understand the major contributions of scientists in microbiology, origin of microorganisms
- Perform Staining, sterilization and preservation techniques of microorganisms.
- Gain knowledge in the organisation and reproduction of prokaryotic microorganisms
- And eukaryotic Microorganisms
- Gain skills in handling Instruments in performing Microbial experiments.

<b>Module I</b>	<b>Historical development, major contributions, origin of microorganisms</b>		<b>11hrs</b>
	Historical development of microbiology -Theory of spontaneous generation, Biogenesis and Abiogenesis. Contributions of Anton Von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister and Edward Jenner, Alexander Fleming, Martinus Beijerinck, Sergei Winogradsky, Elei Metchnikoff. <b>Contributions of Indian scientists in the field of Microbiology.</b> Fossil evidences of microorganisms. Primitive cells and evolution of microorganisms.		
<b>Module II</b>	<b>Staining, sterilization and preservation of microorganisms</b>		<b>11hrs</b>
	Staining: Nature of <b>stains</b> , principles, mechanism, methods and types of staining- Simple, Differential-Gram staining, Acid fast staining, staining of capsule, cell wall, endospore, inclusion bodies. Sterilization: Principles, types and techniques, Physical, chemical, radiation and mechanical Preservation of microorganisms: Methods of preservation of microorganism, slant culture, stab culture, soil culture mineral oil overlaying, glycerol preservation.		
<b>Module III</b>	<b>Types, structure, organisation and reproduction of prokaryotic microorganisms</b>		<b>12hrs</b>
	Overview of Prokaryotic Cell Structure: Size, shape, arrangement. Diagram of Prokaryotic cell organisation, cell wall structure and Gram staining, cell membrane; Bacterial and Archaeal, Cytoplasmic matrix- Cytoskeleton, ribosome, inclusion granules: Composition and function. Nuclear Materials – Bacterial chromosomes structure (its differences with the Eukaryotic chromosome); Extra Chromosomal materials. Components external to cell wall- capsule, slime, s-layer, pilli, fimbriae, flagella; structure, motility, chemotaxis. Bacterial Endospore - Examples of spore forming organisms, habitats, function, formation and germination. Reproduction in bacteria and bacterial cell cycle.		
<b>Module IV</b>	<b>Types, structure, organisation and reproduction of eukaryotic Microorganisms</b>		<b>12hrs</b>

	Over view of eukaryotic cell structure: General structure and types of cells; <b>External cell coverings and cell membrane</b> . Structure and function of Cytoplasmic matrix- cytoskeleton: Structure and function; single Membrane organelles- Endoplasmic reticulum, Golgi complex, Lysosome, Vesicles and Ribosomes; Double Membrane organelles- Nucleus, Mitochondrion and Chloroplast: Structure and Functions; Peroxisomes; Organelles of motility- Structure and movement of flagella and cilia. Reproduction in Eukaryotic microorganisms		
<b>Module V</b>	<b>Instrumentation in Microbiology</b>		<b>10hrs</b>
	Microscope and its modifications – Light, phase contrast and interference, Fluorescence, Confocal, Electron (TEM and SEM), Electron tunneling and AFM. Working principle and operation of instruments used in microbiology laboratory- Autoclave, Laminar air flow system, Incubator, Hot air oven, Orbital shaker, pH meter, Spectrophotometer, Centrifuges.		

## B.Sc in Microbiology; Semester-I

<b>Subject Title: Practical: Fundamentals of Microbiology Lab</b>	
<b>Credits: 02</b>	<b>Category: DSC1P</b>
<b>Total Contact Hours: 56</b>	<b>Marks:25+25=50</b>

### Course Outcomes:

By the end of the course the student will be able to:

- Perform Staining, sterilization and preservation techniques of microorganisms.
  - Gain skills in handling Instruments in performing Microbial experiments.
1. Microbiological laboratory standards and safety protocols.
  2. Standard aseptic conditions of Microbiological laboratory.
  3. Operation and working principles of Light/ Compound microscope.
  4. Applications of basic microbiological tools (Pipettes, Micropipette, Bunsen burner, Inoculation loop, Spreader).
  5. Demonstration and observations of microorganisms from natural sources under light microscope (Bacteria, Yeast, Protozoa and Algae).
  6. Demonstration of bacterial motility by hanging drop method.
  7. Simple staining.
  8. Differential staining - Gram staining.
  9. Acid fast staining.
  10. Structural staining - Flagella and Capsule.
  11. Bacterial endospore staining.
  12. Staining of reserved food materials.
  13. Staining of fungi by Lactophenol cotton blue.
  14. Negative staining.

### Text Books:

1. Prescott, Harley, Klein's Microbiology, J.M. Willey, L.M. Sherwood, C.J. Woolverton, 7th International, edition 2008, McGraw Hill.
2. Foundations in Microbiology, K. P. Talaro, 7th International edition 2009, McGraw Hill.
3. A Textbook of Microbiology, R. C. Dubey and D. K. Maheshwari, 1st edition, 1999, S. Chand & Company Ltd.
4. Brock Biology of Microorganisms, M.T.Madigan, J.M.Martinko, P. V. Dunlap, D. P. Clark-12th edition, Pearson International edition 2009, Pearson Benjamin Cummings.
5. Microbiology – An Introduction, G. J.Tortora, B. R.Funke, C. L. Case, 10th ed. 2008,Pearson Education.
6. General Microbiology, Stanier, Ingraham et al, 4th and 5th edition 1987, Macmillan education limited.
7. Microbiology- Concepts and Applications, Pelczar Jr,Chan, Krieg, International ed, McGraw Hill.
8. Schlegel, H.G. 1995.General Microbiology. Cambridge University Press, Cambridge, 655 pp.

### Reference Books:

1. Alexopoulos, C.J., Mims, C.W., and Blackwell, M. 2002. Introductory Mycology. John Wiley and Sons (Asia) Pvt. Ltd. Singapore. 869 pp.
2. Atlas, R.M. 1984. Basic and practical microbiology. Mac Millan Publishers, USA. 987pp.

3. Black, J.G. 2008. Microbiology principles and explorations. 7edn. John Wiley and Sons Inc., New Jersey 846 pp.
4. Torator, G.J., Funke, B.R. and Case, C.L. 2007. Microbiology 9<sup>th</sup> ed. Pearson Education Pte. Ltd., San Francisco. 958pp.
5. Pommerville, J.C. Alcamo's Fundamentals of Microbiology. Jones and Bartlett Pub..Sudbury, 835 pp.

## B. Sc. Microbiology; Semester-I

### Subject Title: Microbes in Waste to Wealth

<b>Sub.Code:</b> 21BSC101MB1	<b>Marks:</b> 60+40=100
<b>Credits:</b> 03	<b>Category:</b> OEC1

**Course Outcomes:** The students completing the course will have the ability to

- Discuss issues related to recycling and resource recovery from wastes and wastewater
- Develop management plans for fly ash, plastic wastes ,agriculture waste,
- Recover biofuel from wastes and biomass

<b>ModuleI</b>	<b>Introduction to Microbes</b>	<b>10hrs</b>
	Properties, classification and Types, structure, organization and reproduction of prokaryotic and eukaryotic microorganisms. Functional role of microorganisms. Interactions with living and nonliving things, Biogeochemical cycles. Applications of Microorganisms in industry, food, Agriculture, environment and in Health.	
<b>ModuleII</b>	<b>Introduction to Wastes</b>	<b>12hrs</b>
	Problem of Wastes, Types of Solid Waste, Waste Characterization ,Source Reduction Solid Waste Reduction, Waste reduction strategies - Polluter Pays Principle (PPP), Assimilative Capacity and the Precautionary Principle, World Scenario in Scrap Trade Extended Producer Responsibility (EPR), Carrying Capacity, Precautionary Principle .Waste Reduction Towards Zero Waste Sustainable Living, Waste Reduction at Business (Producer) Level, Waste Reduction at Individual Level: Zero Waste Living, Waste Reduction at Community Level.	
<b>Module III</b>	<b>Recycling of waste</b>	<b>10hrs</b>
	Recycle and Reuse of Waste Re-use, General Process of Recycling, Precautions for Recycling –Aluminium, Glass, Precautions while Recycling of Plastics, Precautions while Recycling paper Amplifying benefits from waste	
<b>Module IV</b>	<b>Agriculture Wastes Waste To Wealth</b>	<b>12hrs</b>
	Types of organic and inorganic wastes Industrial, domestic, agriculture (vegetable, fruit, flower,), Plastic waste, hospital waste, construction waste, Mining waste, Animal, poultry, fishery, marine waste.  Technologies for Converting Wastes from Crops/ Crop By-Products into High Value Products,Technologies for Converting Wastes from Horticultural Crops/Crop By-Products into High Value Products Processes/ Technologies for Converting Agricultural Wastes into Wealth Technologies for Converting Fisheries & Animal Wastes into High Value Products. Composting-Vermi composting	



Module V	Municipal solid waste ,Industrial waste to wealth	12hrs
<p>Municipal Solid waste. Sources, domestic, industrial and Industrial wastes- Mineral wastes In identification waste Minimizing options -Recovery and Recycle- Incineration Energy from waste- Pyrolysis, chemical processing- Legislative measures for garbage disposal. flyash - Nature- Direct Replacement of Cement- Waste Land Development- Soil Amendment to grow Crops- Utilization of Flyash In Afforestation, Limitation of Land Application of Fly Ash, Amount and types of plastic waste – Recycling of plastic waste- cement manufacture from industrial solid waste – Paper industry waste – Calcium carbide industry waste, textile industry waste, sugar industry waste, palm oil industry waste, Alcohol industry waste, Ecotourism.</p>		

**Text Books:**

- Agarwal S.K. “Wealth from Waste”, Bhushannangia, APH Publishing Corporation, New Delhi, 2005
- Nemerow N.L., “Industrial Water Pollution”, Addison – Wesley Publishing Company inc., USA, 1978

**References Books:**

- Wesley Eckenfelder Jr. W, Industrial water pollution control, McGraw Hill book Co, New Delhi, 1989.
- Mahajan S.P. “Pollution Control in process industries”, Tata McGraw Hill Publishing Co Ltd., New Delhi, 1989.