



**SARVAJANIK  
UNIVERSITY**

INCLUSIVE | INTEGRATED | INNOVATIVE

*creating an enlightened society...*

## **Faculty of Science**

**SHREE RAMKRISHNA INSTITUTE OF COMPUTER EDUCATION  
AND APPLIED SCIENCES, SURAT**

## **B.Sc. Microbiology**

### **Syllabus (Effective from 2021)**

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| <b>B.Sc. Microbiology</b> |                                           |
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## **A. About B.Sc. Microbiology Programme**

The Department of Microbiology of SRKI at Sarvajani University runs a **full time three-year program of six semesters**, leading to award of Bachelor of Science (B.Sc.) degree in Microbiology. The curriculum is designed to train the students in basic and advanced areas of Microbiology, keeping in mind the latest advances in the field. Particular emphasis is laid on the practical aspects of the field. Students are taught how to plan experiments, perform them carefully, analyze the data accurately, and present the results both, qualitatively and quantitatively. The students are offered basic and advanced level courses in Microbial Diversity, Microbial Physiology, Virology, Immunology, Enzymology, Environmental Microbiology, Molecular biology, Recombinant DNA technology, Industrial Microbiology, Food Microbiology etc. During the programme students were also exposing to industrial and relevant field visit.

## **B. Programme Objective**

- The objective of the B.Sc. Microbiology is to equip the students to gain fundamental knowledge and analytical skills at an advanced level in the field of microbiology.
- The program emphasizes to apply knowledge acquired about prokaryotic and eukaryotic cellular processes, interaction of microorganisms among themselves, with physical and chemical agents and higher order organisms in environment and biological systems to various conditions.
- The laboratory training in addition to theory is included so that the students will acquire the skills to qualify for the positions in industry, clinical laboratory or for further education in a Master program.

## **C. Eligibility**

- The candidate must have passed 10+2 or an equivalent examination with Biology as one of the subjects. **OR** Vocational course in Home Science **OR** Diploma in Pharmacy. **OR** The candidate who has passed equivalent exam from other subjects or boards need to avail eligibility certificate for this programme from the Board of Equivalence (BoE) of the Sarvajani University.



## E. Evaluation Scheme

| <b>B.Sc. Microbiology</b> |                                             |               |                         |                        |
|---------------------------|---------------------------------------------|---------------|-------------------------|------------------------|
| <b>Evaluation</b>         | <b>Criteria</b>                             | <b>Theory</b> | <b>Practical</b>        |                        |
|                           |                                             |               | <b>Sem – I &amp; II</b> | <b>Sem – III to VI</b> |
| Internal                  | Continuous & Comprehensive Evaluation (CCE) | 40            | 30                      | 40                     |
|                           | Attendance                                  | 10            | 10                      | 10                     |
|                           | Assignment                                  | 20            | --                      |                        |
|                           | Internal Practical Test and Viva - Voce     | --            | 30                      | 50                     |
| External                  | External Evaluation                         | 30            | 30                      | 50                     |
| Total                     |                                             | 100           | 100                     | 150                    |

## F. Syllabus

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| <b>Name of faculty: Science</b>                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>Department: Microbiology</b> |
| <b>Program: B. Sc Microbiology Sem 2</b>                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>Type: DSC-3</b>              |
| <b>Subject: Nutrition and Growth of Microorganisms</b>                                                                                                                                                                                                                                                                                                                                                                                                              |                                 |
| <b>Credit: 04</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>Total learning hours: 60</b> |
| <b>Course description:</b> This subject provides knowledge about the nutritional requirements of microorganisms and how those nutrients are transported inside the cell. Additionally, it also inculcates the information about the growth pattern and measurement of microorganisms, media used for various purposes along with their ingredients along with the methods and factors to be considered for culturing microbes in the laboratory conditions.         |                                 |
| <b>Student learning outcome:</b> This course makes the student thorough with the principles for growing microorganisms. After completion of this course, they can have knowledge of: <ul style="list-style-type: none"> <li>• Nutrients are required by different types of microorganism.</li> <li>• Principles of microbial growth</li> <li>• How to prepare media and grow microbes in the laboratory.</li> <li>• Measurement of microbial population.</li> </ul> |                                 |

### Unit-1: Fundamental principles of Bacterial Growth

**(Duration: 10 Hrs)**

- 1.1 Bacterial Cell Cycle
- 1.2 Binary Fission
- 1.3 Peptidoglycan Biosynthesis
- 1.4 The rate of population growth
- 1.5 The population growth curve
- 1.6 Continuous culture

### Unit-2: Nutritional requirements of microorganisms

**(Duration: 07 Hrs)**

- 2.1 Macroelements and Microelements required by microorganisms
- 2.2 Chemical analysis of microbial cytoplasm
- 2.3 Sources of Essential Nutrients
- 2.4 Nutritional types of microorganisms

### Unit-3: Transport of nutrients

**(Duration: 10Hrs)**

- 3.1 The movement of molecules

- 3.2 Adaptations to osmotic variations in the environment
- 3.3 Mechanism of Nutrient Transport: Passive, Facilitated Diffusion, Active Transport, Group Translocation & Iron Uptake

**Unit-4: Media for Microbial Cultivation (Duration: 08 Hrs)**

- 4.1 Media Ingredients
- 4.2 Preparation of Media
- 4.3 Classification and Types of Media: Physical, Chemical and Functional
- 4.4 Media for different purpose

**Unit-5: Cultivation of Bacteria & Pure culture techniques (Duration: 06 Hrs)**

- 5.1 Definitions
- 5.2 Techniques of Isolation, Inoculation and Incubation of Bacteria: Streak Plate, Spread Plate, Pour Plate and Enrichment
- 5.3 Cultivation of Aerobes and Anaerobes
- 5.4 Microbial growth on solid media

**Unit-6: Growth of Fungi and Protozoa (Duration: 06 Hrs)**

- 6.1 Fungal Nutrition
- 6.2 Fungal Identification and Cultivation
- 6.3 Biology of Protozoa
  - 6.3.1 Nutrition and Habitat Range
  - 6.3.2 Life Cycles and Reproduction

**Unit-7: Environmental factors affecting growth of microorganisms (Duration: 07 Hrs)**

- 7.1 Temperature
- 7.2 Oxygen Concentration
- 7.3 pH
- 7.4 Solute and Water Activity
- 7.5 Pressure & Radiations
- 7.6 Microbial growth in natural environments: Oligotrophic Environments, Biofilms, Cell-cell communication within microbial populations, Interdomain communication.

**Unit-8: Measurement of Microbial Population (Duration: 06 Hrs)**

- 8.1 Direct Methods Requiring Incubation
- 8.2 Direct Methods Not Requiring Incubation

### 8.3 Indirect Methods of Microbial Population Measurement

#### Reference Books:

- Atlas R. M. (2004). Handbook of Microbiological Media. CRC Press. (ISBN:0-8493-1818-1).
- Bauman R. W. (2012). Microbiology with Diseases by Body Systems 3<sup>rd</sup> Ed. Pearson. ISBN: (978-0-321-73267-5)
- Cowan K. M. and Smith H. (2018). Microbiology - A Systems Approach 5<sup>th</sup> Ed. Mc Graw Hill Education (ISSN: 978-1-259-70661-5).
- H. A. Modi. Handbook of Elementary Microbiology Vol.1. Akta Prakashan.
- Madigan M. et al., (2015) Brock Biology of Microorganisms 14<sup>th</sup> Ed. Pearson Education Ltd. (ISBN 978-0-321-89739-8).
- Willey J, Sherwood I and Woolverton (2014). Prescott's Microbiology 9<sup>th</sup> Ed. Mc Graw Hill Education (ISBN: 978-0-07-340240-6).

#### Further Reading:

- Pelczar, Chan and Krieg (2001). Microbiology- Concepts and Applications 5<sup>th</sup> Ed. Tata Mc Graw Hill Publishing Company Ltd. (ISBN-13: 978-0-07-462320-6).
- Salle A. J. (1984) Fundamental Principles of Bacteriology, 7<sup>th</sup> Ed. Tata Mc Graw Hill Publishing Company Ltd. (ISBN: 0-07-099-562-1).

#### List of Practicals

- 1 Preparation of Nutrient broth and Nutrient Agar slants and plates.
- 2 Isolation Techniques: Streak Plate, Spread Plate and Pour Plate methods.
- 3 Demonstration of selective and differential media: Mac Conkey Agar, EMB Agar.
- 4 Enumeration of bacteria by Heterotrophic plate count method (HPC)
- 5 Effect of temperature on growth of microorganisms
- 6 Effect of pH of the medium on growth of microorganisms
- 7 Effect of osmotic pressure on growth of microorganisms
- 8 Demonstration of measurement of microorganisms by micrometry.

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| <b>Name of faculty: Science</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>Department: Microbiology</b> |
| <b>Program: B.Sc. Microbiology Sem 2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>Type: DSC-4</b>              |
| <b>Subject: Microbial Diversity</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                 |
| <b>Credit: 04</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>Total learning hours: 60</b> |
| <b>Course description:</b><br><br>This course offers majors information about remarkable environmental and metabolic diversity of prokaryotic, eukaryotic microorganisms and some viruses. Major topics covering include information about microbial world, diversity of bacteria, mycology, phycology, virology, protistology and some multicellular parasites. As various microbes thrive throughout the biosphere, this paper will define the limits of life and creating conditions contributing for the better survival of other living forms in universe. |                                 |
| <b>Student learning outcome:</b> <ul style="list-style-type: none"> <li>• Students will expand knowledge about events of evolution and diverse group of microbes</li> <li>• Complete awareness about major group of organism including bacteria, fungi, algae , protozoa, viruses, and some parasites.</li> <li>• Expanded knowledge will be gain with respect to microbial cell structure and reproduction systems.</li> </ul>                                                                                                                                 |                                 |

**Unit-1: Introduction to Microbial World**
**(Duration: 08 Hrs)**

- 1.1 Members of the Microbial World
- 1.2 Microbial Evolution
- 1.3 Prokaryotic Versus Eukaryotic Microorganism

**Unit-2: Diversity of Bacteria**
**(Duration: 08 Hrs)**

- 2.1 Cyanobacteria
- 2.2 Microorganisms in Phyllosphere, Rhizosphere and Rhizoplane
- 2.3 Nitrogen-Fixing Bacteria , Agrobacterium
- 2.4 Extremophiles.

**Unit-3: Mycology**
**(Duration: 08 Hrs)**

- 3.1 Fungi: Structure, Distribution and Importance
- 3.2 Fungal Reproduction
- 3.3 Endomycorrhizae
- 3.4 Ectomycorrhizae
- 3.5 Arbuscular



**Unit-4: Phycology****(Duration: 08 Hrs)**

- 4.1 Introduction to Phycology
- 4.2 Characteristics of algae
- 4.3 Algae: similarities and Diversities
- 4.4 Occurrence and distribution of algae
- 4.5 Reproduction in algae

**Unit-5: Fundamental s of Virology****(Duration: 08 Hrs)**

- 5.1 Virion Structure
- 5.2 Viral Multiplication
- 5.3 Types of Viral Infections
- 5.4 Viroids and Satellites
- 5.5 Prions

**Unit-6: Essentials of Virology****(Duration: 08 Hrs)**

- 6.1 Cultivation of viruses
- 6.2 Bacteriophage: T4 and Lambda
- 6.3 Archaeal Viruses
- 6.4 Tobacco Mosaic Virus
- 6.5 Poliovirus

**Unit-7: Protistology****(Duration: 08 Hrs)**

- 7.1 Overview of protist
- 7.2 Protist Morphology
- 7.3 Encystment and Excystment
- 7.4 Protist Reproductive cell structure
- 7.5 Importance of Protist

**Unit-8: Multicellular Parasites****(Duration: 04 Hrs)**

- 8.1 Mosquitoes
- 8.2 Fleas
- 8.3 Lice
- 8.4 Tick
- 8.5 Mites

### Reference Books:

- Jacquelyn G Black Microbiology 8<sup>th</sup> Edition (2013). John Wiley & Sons Singapore Pte.Ltd (ISBN :978-0-470-64621-2)
- James T Staley, Robert P Gunsalus, Stephen Lory, Jerome J Perry. Microbial Life 2<sup>nd</sup> Edition (2007) Sinauer Associates, Inc All right reserved .(ISBN: 978-0-87893-685-4)
- Joanne M. Willey , Linda M. Sherwood , Christopher J. Woolverton Prescotts Microbiology. Mc Graw Hill. 9<sup>th</sup> Edition (2014). (ISBN 978-0-07-340240-6)
- Microbiology :A Human Perspective Nesters Eight Edition (2015) .Published by McGraw Hill Education (ISBN 978-0-07352259-3)
- O.P Sharma : Algae Diversity of Microbes and Cryptogams. (2011): Tata Mc Graw Hill Education Private Limited New Delhi. (ISBN -13:978-0-07-068194-1)

### Further Reading:

- Ananthanarayan and Panikar Text book of Microbiology. 7<sup>th</sup> edition (2005).Orient Longman Private Limited. (ISBN 81 250 2808 0)
- HA Modi .Hand book of Elementary Microbiology. 1<sup>st</sup> edition.(2019). Shanti Prakashan. (ISBN 97893501010)

### List of Practicals

- 1) Types of stain and preparation of staining solution
- 2) Demonstration of bacterial lysis by bacteriophage.
- 3) Preparation of bacteriological and mycological cultural media & Study of economically important fungi . (*Aspergillus*, *Penicillium*, *Mucor*, *Rhizopus*, *Curvularia*, *Helminthosporium*, *Cunninghaemella*, *Fusarium*, *Alternaria*)
- 4) Cultivation of anaerobic bacteria using Thioglycollate medium
- 5) Disposal of laboratory waste and cultures
- 6) Gram staining & Acid fast staining
- 7) Special staining: Cell wall, Metachromatic Granules, Flagella, Capsule, Endospore.

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|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|
| <b>Name of faculty: Science</b>                                                                                                                                                                                                                                                                                   | <b>Department: Environmental Science</b> |
| <b>Program: B.Sc. Sem 2</b>                                                                                                                                                                                                                                                                                       | <b>Type: DSE-2</b>                       |
| <b>Subject: Microbial Ecology</b>                                                                                                                                                                                                                                                                                 |                                          |
| <b>Credit: 04</b>                                                                                                                                                                                                                                                                                                 | <b>Total learning hours: 60</b>          |
| <b>Student learning outcome:</b> <ul style="list-style-type: none"> <li>• Having basic knowledge of microbial ecology and its fundamental concepts.</li> <li>• Understanding dynamics and interactions of microbial communities.</li> <li>• Understanding of microbial association with higher plants.</li> </ul> |                                          |

### **Unit:1 Scope and overview of microbial ecology**

- 1.1 The scope of microbial ecology
- 1.2 Historical overview
- 1.3 Relation of microbial ecology with environmental science
- 1.4 Sources of information

### **Unit:2 Microbial Evolution and Biodiversity**

- 2.1 Chemical evolution
- 2.2 Cellular evolution
- 2.3 Bacterial and Archaeal Biodiversity
- 2.4 Eukaryal biodiversity

### **Unit:3 Physical Environment of microorganisms**

- 3.1 Microenvironment and niche
- 3.2 Biofilms and microbial mats
- 3.3 Microorganisms and ecosystems
- 3.4 Microorganism movement between ecosystems

### **Unit:4 Biogeochemical cycling**

- 4.1 Carbon cycle
- 4.2 Nitrogen cycle

4.3 Phosphorus cycle

4.4 Sulfur cycle

### **Unit:5 Microbial interactions: Mutualism**

5.1 Microorganism-insect mutualism

5.2 Zooxanthellae

5.3 Sulfide-based mutualisms

5.4 Methane-based mutualisms

5.5 Rumen ecosystem

### **Unit:6 Other Microbial interactions**

6.1 Cooperation

6.2 Coemmensalism

6.3 Predation

6.4 Parasitism

6.5 Amensalism and Competition

### **Unit:7 Microorganism association with vascular plants**

7.1 Phyllosphere, rhizosphere and rhizoplane microorganisms

7.2 Mycorrhizae

7.3 Symbiotic nitrogen fixation: Rhizobia

7.4 Symbiotic nitrogen fixation: Actinorhiza and stem-nodulating bacteria

### **Unit:8 Other associations with plants**

8.1 Fungal and bacterial endophytes

8.2 Agrobacterium

8.3 Other plant pathogens

8.4 Tri-partite and Tetra-partite associations

### **References Books:**

- Atlas RM, Bartha R. Microbial ecology: fundamentals and applications. The Benjamin. Cummings Publ., Menlo Park. 1987. 978-8131713846

- Willey J, Sherwood L, Woolverton CJ. Prescott's microbiology. McGraw-Hill, New York, NY. 2013. 978-0071313674

**List of Practicals:**

1. Demonstration of presence of bacteroids in root nodules and isolation of *Rhizobium* from it.
2. Isolation of plant pathogenic fungi from sugarcane red rot.  
Study of lichens using permanent slides.