

**DEPARTMENT OF MICROBIOLOGY**  
**COURSE CURRICULUM & MARKING SCHEME**

**B.Sc. I, II, III, IV Semester**  
**MICROBIOLOGY**  
**(Based on Choice Based Credit System)**

**SESSION : 2025-26**



**ESTD : 1958**

**GOVT. V.Y.T. PG AUTONOMOUS COLLEGE,**  
**DURG, 491001 (C.G.)**

**(Former Name – Govt. Arts & Science College, Durg)**

**NAAC Accredited Grade A<sup>+</sup>, College with CPE - Phase III (UGC), STAR COLLEGE (DBT)**

**Phone : 0788-2212030**

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**GOVT. V.Y.T. PG AUTONOMOUS COLLEGE DURG**  
**FOUR YEAR UNDERGRADUATE PROGRAM**  
**DEPARTMENT OF MICROBIOLOGY**  
**COURSE CURRICULUM 2025-26**

| DSC  |         |                                                    | DSE  |         |                                                               | GE       |          |                                                       |
|------|---------|----------------------------------------------------|------|---------|---------------------------------------------------------------|----------|----------|-------------------------------------------------------|
| Sem. | Code    | Title                                              | Sem. | Code    | Title                                                         | Sem.     | Code     | Title                                                 |
| I    | MBSC-01 | Introductory Microbiology and Microbial techniques | -    | -       | -                                                             | I        | MBGE-01  | Introductory Microbiology and Microbial techniques    |
| II   | MBSC-02 | Bacteriology, Virology and Protozoology            | -    | -       | -                                                             | II       | MBGE-02  | Bacteriology, Virology and Protozoology               |
| III  | MBSC-03 | Cell Biology and Biochemistry                      | III  | MBSE-01 | Microbial Enzyme Technology                                   |          | MBGE-03  | Cell Biology and Biochemistry                         |
| IV   | MBSC-04 | Bioinstrumentation and Biostatistics               | IV   | MBSE-02 | Industrial Microbiology                                       |          | MBGE-04  | Bioinstrumentation and Biostatistics                  |
| V    | BMB-501 | Food and Dairy Microbiology                        | V    | BMB-502 | Agriculture Microbiology                                      | V        | BMB-501  | Food and Dairy Microbiology                           |
|      |         |                                                    | V    | BMB-503 | Mycology and Plant Pathology                                  |          |          |                                                       |
| VI   | BMB-601 | Medical and Veterinary Microbiology                | VI   | BMB-602 | Clinical Microbiology                                         | VI       | BMB-601  | Medical and Veterinary Microbiology                   |
|      |         |                                                    | VI   | BMB-603 | Immunology                                                    |          |          |                                                       |
| VII  | BMB-701 | Bacteriology and Virology                          | VII  | BMB-702 | Structure and Functions of Biomolecules                       |          |          | SEC                                                   |
|      |         |                                                    | VII  | BMB-703 | Phycology and Mycology                                        |          | MBSEC-01 | Mushroom Cultivation                                  |
|      |         |                                                    | VII  | BMB-704 | Advanced Immunology                                           | I/II/III | BMBSC-02 | Microbial Products – Biofertilizers and Biopesticides |
|      |         |                                                    | VII  | BMB-705 | Fermentation Technology                                       |          |          |                                                       |
| VIII | BMB-801 | Microbial Physiology and Metabolism                | VIII | BMB-802 | Biostatistics and Computer Application                        |          |          | VAC                                                   |
|      |         |                                                    | VIII | BMB-803 | Cell and Molecular Biology                                    |          |          |                                                       |
|      |         |                                                    | VIII | BMB-804 | Microbial Genetics                                            |          | MBVAC-01 | Microbes and Human Health                             |
|      |         |                                                    | VIII | BMB-805 | Metagenomics, Bioinformatics and Intellectual Property Rights |          |          |                                                       |

**Name and Signatures Chairperson/ HOD- Dr. Pragma Kulkarni**  
**Subject Expert - Dr. Anita Mahiswar**  
**Subject Expert - Dr. Sonal Mishra**  
**V/C Nominee - Dr. Prakash Saluja**  
**Member of Other Department- Dr. G.S. Thakur**

**Industrial Representative- Shri Amitesh Mishra**  
**Student Nominee – Ms. Yogita Lokhande**  
**Departmental members**  
**Mrs. Rekha Gupta**  
**Mrs. Neetu Das**  
**Ms. Mrinalini Soni**  
**Ms. K.K. Yashoda**

**FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)**  
**DEPARTMENT OF MICROBIOLOGY**  
**COURSE CURRICULUM**

| <b>PART – A: Introduction</b>                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                       |
|-------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|
| <b>Program: Bachelor in Life Science<br/>(Certificate/Diploma/Degree/Honors)</b>          |                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>Semester - I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                       |
| <b>Session: 2025-26</b>                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                       |
| <b>1</b>                                                                                  | <b>Course Code</b>                                                                                                                                                                                                                                                                                                                                                                                                              | <b>MBSC- 01 T</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                       |
| <b>2</b>                                                                                  | <b>Course Title</b>                                                                                                                                                                                                                                                                                                                                                                                                             | <b>Introductory Microbiology and Microbial techniques</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                       |
| <b>3</b>                                                                                  | <b>Course Type</b>                                                                                                                                                                                                                                                                                                                                                                                                              | <b>Discipline Specific Core (DSC)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                       |
| <b>4</b>                                                                                  | <b>Prerequisite (If Any)</b>                                                                                                                                                                                                                                                                                                                                                                                                    | <b>As per program</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                       |
| <b>5</b>                                                                                  | <b>Course Learning Outcomes (CLO)</b>                                                                                                                                                                                                                                                                                                                                                                                           | <b>At the end of this course, the students will be able to –</b> <ul style="list-style-type: none"> <li>➤ relate the development and scope of Microbiology</li> <li>➤ illustrate the contributions made by prominent scientists including Indian Vedic Knowledge on microbiology</li> <li>➤ demonstrate the nomenclature and characteristics of different types of microorganisms</li> <li>➤ identify the basic techniques in microbiology</li> <li>➤ explain the methods of microbial control</li> </ul> |                                                       |
| <b>6</b>                                                                                  | <b>Credit Value</b>                                                                                                                                                                                                                                                                                                                                                                                                             | <b>03 Credits</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>Credit = 15 Hours - Learning &amp; Observation</b> |
| <b>7</b>                                                                                  | <b>Total Marks</b>                                                                                                                                                                                                                                                                                                                                                                                                              | <b>Max. Marks: 100</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>Minimum Passing marks: 40</b>                      |
| <b>PART – B: Content of the Course</b>                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                       |
| <b>Total No. of Teaching-Learning Periods (01 Hr. per period) - 45 Periods (45 Hours)</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                       |
| <b>Unit</b>                                                                               | <b>Topics (Course contents)</b>                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>No. of Period</b>                                  |
| <b>I</b>                                                                                  | <b>History and scope of microbiology</b> – History, development and Scope of Microbiology, Golden era of microbiology, Contributions of Anton von Leeuwenhoek, Louis Pasteur, Robert Koch, Alexander Fleming and Edward Jenner, The Forgotten Past of Microbiology in Indian Vedic Knowledge.                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>12</b>                                             |
| <b>II</b>                                                                                 | <b>Systems of classification</b> – Binomial nomenclature, principles of microbial classification, Whittaker's five kingdom and Carl Woese's three domain classification systems and their utility, Major groups of microorganisms; General features and structure of bacteria, virus, fungi, algae and protozoa.                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>11</b>                                             |
| <b>III</b>                                                                                | <b>Microbial culture and staining techniques</b> – Obtaining pure culture by streaking, serial dilution and plating; types of culture media, maintenance and preservation/stocking of pure cultures; cultivation of anaerobic bacteria, cultivation of fungi, actinomycetes and algae. Principle, procedure and applications of Simple staining, negative staining; Differential staining- Gram's staining, acid fast staining. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>11</b>                                             |
| <b>IV</b>                                                                                 | <b>Microbial control</b> – Sterilization: Physical Agents - Heat: Boiling, Tyndallization, Steam under pressure (Autoclave), incineration, hot air Oven. Radiations: Ionizing and non-ionizing radiations. Filtration, Chemical agents - Disinfection, Antiseptic, Germicide, Sanitizer, Principle and application of Laminar airflow, Biological agents - Antibiotics                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>11</b>                                             |
| <b>Key Words</b>                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>History and scope, Nomenclature, Pure culture technique, Microbial control</b>                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                       |

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## Part – C: Learning Resources

### Text Books, Reference Books and Others

#### Text Books Recommended:

1. Microbiology: P. D. Sharma, Rastogi Publications.
2. A textbook of Microbiology: R. C. Dubey and Maheshwari, S Chand publications.
3. General Microbiology, Vol. II, C. B. Powar and Dagainawala
4. Fundamentals of Microbiology and Immunology, Ajit Kr. Banerjee and Nirmalya Banerji, Central publication.

#### Reference Books:

1. Microbiology: Pelczar, MJ Chan ECS and Krieg NR, McGraw-Hill.
2. Microbiology: 5th Edition Prescott, M.J., Harley, J.P. and Klein, D.A. WCB Mc Graw Hill, New York.
3. Microbiology: An Introduction: Pearson Education Tortora, G.J., Funke, B.R. and Case, C.L., Singapore.
4. Fundamentals of Microbiology: VI Edition Alcomo, I.E., Jones and Bartlett Publishers. Sudbury. Massachusetts, (2001).

### Online Resources – e-Resources/ e-Books and e- learning portals

- <https://www.jsscacs.edu.in/sites/default/files/Department%20Files/History%20of%20Microbiology.pdf>
- <https://www.britannica.com/science/microbiology>
- <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7810802/>
- <https://www.slideshare.net/HarinathaReddyA/methods-for-isolation-of-pure-culture>
- <https://microbenotes-com.webpkgcache.com/doc/-/s/microbenotes.com/sterilization-physical-and-chemical-methods/>

## Part – D: Assessment and Evaluation

### Suggested Continuous Evaluation Methods:

Maximum Marks: 100 Marks

Continuous Internal Assessment (CIA): 30 Marks

End Semester Exam (ESE): 70 Marks

|                                                                     |                                                                                                                                                                                                            |                                                                                                                  |
|---------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|
| <b>Continuous Internal Assessment (CIA):</b><br>(By Course Teacher) | Internal Test / Quiz – (2): 20+20                                                                                                                                                                          | Better marks out of the two Test/ Quiz<br>+ obtained marks in Assignment shall be<br>considered against 30 Marks |
|                                                                     | Assignment/ Seminar – 10                                                                                                                                                                                   |                                                                                                                  |
|                                                                     | Total Marks – 30                                                                                                                                                                                           |                                                                                                                  |
| <b>End Semester Exam (ESE):</b>                                     | <b>Two Section – A &amp; B</b><br>Section A: Q1. Objective 10 X 1 = 10 Mark; Q2. Short answer type – 5X4= 20 Marks<br>Section B: Descriptive answer type qts., 1 out of 2 from each unit – 4X10 = 40 Marks |                                                                                                                  |

### Name and Signatures

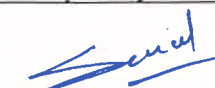
|                                                    |                                                       |
|----------------------------------------------------|-------------------------------------------------------|
| <b>Chairperson/ HOD-</b> Dr. Pragya Kulkarni       | <b>Industrial Representative-</b> Shri Amitesh Mishra |
| <b>Subject Expert -</b> Dr. Anita Mahiswar         | <b>Student Nominee –</b> Ms. Yogita Lokhande          |
| <b>Subject Expert -</b> Dr. Sonal Mishra           | <b>Departmental members</b>                           |
| <b>VC Nominee –</b> Dr. Prakash Saluja             | 1. Mrs. Rekha Gupta                                   |
| <b>Member of Other Department-</b> Dr. G.S. Thakur | 2. Mrs. Neetu Das                                     |
|                                                    | 3. Ms. Mrinalini Soni                                 |
|                                                    | 4. Ms. K.K. Yashoda                                   |

**FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)**  
**DEPARTMENT OF MICROBIOLOGY**  
**COURSE CURRICULUM**

| PART – A: Introduction                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                 |                                                           |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|
| Program: Bachelor in Life Science<br>(Certificate/Diploma/Degree/Honors)                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Semester I                                                                                                                                                                                                                                                                                                      | Session: 2025-26                                          |
| 1                                                                                                                                                                                                                                       | Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | MBSC- 01 P                                                                                                                                                                                                                                                                                                      |                                                           |
| 2                                                                                                                                                                                                                                       | Course Title                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Lab. Course – MBSC-01                                                                                                                                                                                                                                                                                           |                                                           |
| 3                                                                                                                                                                                                                                       | Course Type                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Laboratory Course                                                                                                                                                                                                                                                                                               |                                                           |
| 4                                                                                                                                                                                                                                       | Prerequisite (If Any)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | As per program                                                                                                                                                                                                                                                                                                  |                                                           |
| 5                                                                                                                                                                                                                                       | Course Learning Outcomes (CLO)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | At the end of this course, the students will be able to –<br>➤ define the basic laboratory practices and safety measures<br>➤ explain the principle, working and applications of Instruments<br>➤ select the proper culture media for microbial growth<br>➤ identify different microorganisms in the laboratory |                                                           |
| 6                                                                                                                                                                                                                                       | Credit Value                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 1 Credit                                                                                                                                                                                                                                                                                                        | Credit = 30 Hours. Laboratory or Field learning/ Training |
| 7                                                                                                                                                                                                                                       | Total Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Max. Marks: 50                                                                                                                                                                                                                                                                                                  | Min. Passing marks: 20                                    |
| PART – B: Content of the Course                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                 |                                                           |
| Total No. of learning-Training/ Performance Periods: 30 Periods (30 Hours)                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                 |                                                           |
| Module                                                                                                                                                                                                                                  | Topics (Course contents)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                 | No. of Period                                             |
| Lab./ Field Training/ Experiment contents of Course                                                                                                                                                                                     | 1. Good Laboratory Practices and Bio-safety in Microbiology.<br>2. To study the principle and applications of autoclave, incubator, BOD incubator, hot air oven, laminar air flow, light microscope.<br>3. Preparation of culture media (liquid & solid), sterilization and assessment of sterility<br>4. Isolation of microorganisms from environment by pour plate, streak plate and spread plate technique.<br>5. Observation of microorganisms - cyanobacteria, protozoa, fungi, yeasts and algae from natural habitats.<br>6. Observation of bacteria by Gram staining technique.<br>7. Study of common fungi, algae and protozoan using temporary / permanent mounts. |                                                                                                                                                                                                                                                                                                                 | 30                                                        |
| PART – C: Learning Resources                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                 |                                                           |
| Text Books, Reference Books and Others                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                 |                                                           |
| Text Books Recommended:<br>1. Experiments in microbiology, plant pathology and biotechnology: K R Aneja<br>2. Practical microbiology: R C Dubey and D K Maheshwari.                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                 |                                                           |
| Online Resources:<br>• <a href="https://www.youtube.com/watch?v=IIndcMvuEXs">https://www.youtube.com/watch?v=IIndcMvuEXs</a><br>• <a href="https://www.youtube.com/watch?v=CbMGr9wFV2w">https://www.youtube.com/watch?v=CbMGr9wFV2w</a> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                 |                                                           |
| PART – D: Assessment and Evaluation                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                 |                                                           |
| Suggested Continuous Evaluation Methods:                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                 |                                                           |
| Maximum Marks:                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 50 Marks                                                                                                                                                                                                                                                                                                        |                                                           |
| Continuous Internal Assessment (CIA):                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 15 Marks                                                                                                                                                                                                                                                                                                        |                                                           |
| End Semester Exam (ESE):                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 35 Marks                                                                                                                                                                                                                                                                                                        |                                                           |
| Continuous Internal Assessment (CIA):<br>(By Course Teacher)                                                                                                                                                                            | Internal Test/ Quiz – (2): 10 & 10<br>Assignment/ Seminar + Attendance: 05<br>Total Marks: 15                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Better Marks out of the two Test/ Quiz + obtained marks in Assignment shall be considered against 15 Marks                                                                                                                                                                                                      |                                                           |
| End Semester Exam (ESE):                                                                                                                                                                                                                | Laboratory/ Field Skill Performance: On spot Assessment<br>A. Performed the Task based on lab. work – 20 Marks<br>B. Spotting based on tools & technology (written) - 10 Marks<br>C. Viva-voce (based on principle/ technology) – 05 Marks                                                                                                                                                                                                                                                                                                                                                                                                                                  | Managed by course teacher as per lab. status                                                                                                                                                                                                                                                                    |                                                           |

Name and Signatures








**FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)**  
**DEPARTMENT OF MICROBIOLOGY**  
**COURSE CURRICULUM**

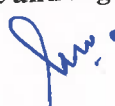
| <b>PART – A: Introduction</b>                                                   |                                | <b>Semester - II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>Session: 2025-26</b>                    |
|---------------------------------------------------------------------------------|--------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|
| <b>Program: Bachelor in Life Science</b><br>(Certificate/Diploma/Degree/Honors) |                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                            |
| 1                                                                               | Course Code                    | MBSC-02 T                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                            |
| 2                                                                               | Course Title                   | Bacteriology, Virology and Protozoology                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                            |
| 3                                                                               | Course Type                    | Discipline Specific Core (DSC)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                            |
| 4                                                                               | Prerequisite (If Any)          | As per program                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                            |
| 5                                                                               | Course Learning Outcomes (CLO) | At the end of this course, the students will be able to – <ul style="list-style-type: none"> <li>➤ recall the ultrastructure of bacteria</li> <li>➤ relate ecological distribution of microorganism and their significances for society</li> <li>➤ illustrate the essential and current knowledge of bacteria</li> <li>➤ identify virus, protozoa and archaebacteria with their special characteristics</li> <li>➤ outline the beneficial &amp; harmful behavior of viruses, bacteria, protozoan and other microbes</li> </ul> |                                            |
| 6                                                                               | Credit Value                   | 03 Credits                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Credit = 15 Hours - Learning & Observation |
| 7                                                                               | Total Marks                    | Max. Marks: 100                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Minimum Passing marks: 40                  |

**PART – B: Content of the Course**

**Total No. of Teaching-Learning Periods (01 Hr. per period) - 45 Periods (45 Hours)**

| UNIT                                                                        | TOPIC (Course Contents)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | No. of Period |
|-----------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| I                                                                           | <b>Morphology and Ultra structure of Bacteria:</b> Cell size, shape and arrangements. Composition, structure and function of cell membrane, cell wall of gram-positive, gram-negative bacteria, capsule, flagella, pili, ribosomes, inclusions, nucleoid, plasmids. Structure and stages of spore formation.                                                                                                                                                                                                                                                                                                                                                                                                                                  | 12            |
| II                                                                          | <b>Gram negative, positive bacteria &amp; Archaebacteria:</b> Gram negative and positive bacteria; characteristics and examples - Gram negative (non-proteobacteria– <i>Deinococcus</i> , <i>Spirochetes</i> . Alpha proteobacteria, <i>Rhizobium</i> , <i>Agrobacterium</i> . Gamma proteo-bacteria– <i>Escherichia</i> , <i>Pseudomonas</i> ). Gram positive low G+C; <i>Bacillus</i> , <i>Clostridium</i> , <i>Staphylococcus</i> . High G+C: <i>Streptomyces</i> , <i>Frankia</i> . General characteristics, <b>Ecological significance and economic importance of Archaea:</b> Methanogens, thermophiles ( <i>Thermococcus</i> , <i>pyrococcus</i> , <i>thermoplasma</i> ) and halophiles ( <i>halobacteria</i> and <i>halococcus</i> ). | 11            |
| III                                                                         | <b>Morphology, ultrastructure, Classification &amp; multiplication of viruses:</b> General introduction, morphology and ultra- structure of viruses, capsid, envelopes. Types of Viral genome. Viral related forms -virions, viroids, virusoids, and prions. Classification of viruses. Salient features and life cycle of viruses: Bacteriophages (T4 & Lambda), Plant (TMV & CMV), Animal (Adenovirus & Pox virus).                                                                                                                                                                                                                                                                                                                         | 11            |
| IV                                                                          | <b>Introduction to protozoa;</b> Occurrence and classification of protozoa. Structure, reproduction, life cycle and diseases caused by important protozoans - <i>Entamoeba</i> , <i>Giardia</i> , <i>Leishmania</i> , <i>Trypanosoma</i> and <i>Plasmodium</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 11            |
| <b>Key Words</b> Bacteria, Archaea, Virus, Bacteriophage, Prions, Protozoan |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |               |

Name and Signatures








## Part – C: Learning Resources

### Text Books, Reference Books and Others

#### Text Books Recommended:

1. General Microbiology; Vol I & II, Powar C.B. and Dagainawala H. I., Himalay Pub. House, Bombay.
2. A Text Book of Microbiology; Dubey & Maheshwari.
3. A Text Book of Microbiology; R. P. Singh.
4. Fundamentals of Microbiology and Immunology, Ajit Kr. Banerjee and Nirmalya Banerji, Central publication.
5. Parasitology; H.S. Singh and P. Rastogi, First Edition, Rastogi Publications.

#### Reference Books:

6. Prescott's Microbiology. Wiley J M, Sherwood L M and Woolverton C J.
7. Microbiology. Pelczar M J, Chan E C S and Krieg N R.
8. General Microbiology. Stanier R Y, Ingraham J L, Wheelis M L, and Painter P R.
9. Microbiology: An Introduction. Tortora G J, Funke B R and Case C L.

### Online Resources – e-Resources/ e-Books and e- learning portals

- <https://www.ncbi.nlm.nih.gov/books/NBK8477/>
- <https://www.britannica.com/science/archaea>
- <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7150055/>
- <https://nios.ac.in/media/documents/dmlt/Microbiology/Lesson-53.pdf>
- <http://ecoursesonline.iasri.res.in/Courses/Agricultural%20Microbiology/>

## Part- D: Assessment and Evaluation

### Suggested Continuous Evaluation Methods:

Maximum Marks: 100 Marks

Continuous Internal Assessment (CIA): 30 Marks

End Semester Exam (ESE): 70 Marks

|                                                                            |                                                                                                                                                                                                                     |                                                                                                                   |
|----------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|
| <b>Continuous Internal Assessment (CIA):</b><br><b>(By Course Teacher)</b> | Internal Test / Quiz – (2): 20+20                                                                                                                                                                                   | Better marks out of the two Test/ Quiz + obtained marks in Assignment shall be considered against <b>30</b> Marks |
|                                                                            | Assignment/ Seminar – 10                                                                                                                                                                                            |                                                                                                                   |
|                                                                            | Total Marks – 30                                                                                                                                                                                                    |                                                                                                                   |
| <b>End Semester Exam (ESE):</b>                                            | <b>Two Section – A &amp; B</b>                                                                                                                                                                                      |                                                                                                                   |
|                                                                            | Section A: <b>Q1.</b> Objective <b>10 X 1 = 10 Mark</b> ; <b>Q2.</b> Short answer type – <b>5X4= 20 Marks</b><br>Section B: Descriptive answer type qts., <b>1 out of 2</b> from each unit – <b>4X10 = 40 Marks</b> |                                                                                                                   |

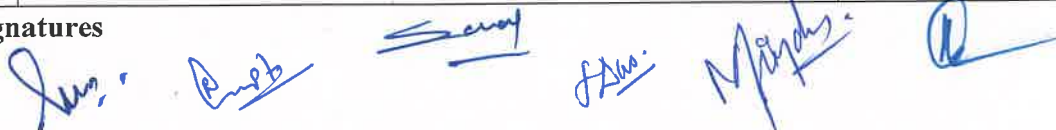
### Name and Signatures

|                                             |                                                |
|---------------------------------------------|------------------------------------------------|
| Chairperson/ HOD- Dr. Pragya Kulkarni       | Industrial Representative- Shri Amitesh Mishra |
| Subject Expert - Dr. Anita Mahiswar         | Student Nominee – Ms. Yogita Lokhande          |
| Subject Expert - Dr. Sonal Mishra           | Departmental members                           |
| VC Nominee – Dr. Prakash Saluja             | 1. Mrs. Rekha Gupta                            |
| Member of Other Department- Dr. G.S. Thakur | 2. Mrs. Neetu Das                              |
|                                             | 3. Ms. Mrinalini Soni                          |
|                                             | 4. Ms. K.K. Yashoda                            |

**FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)**  
**DEPARTMENT OF MICROBIOLOGY**  
**COURSE CURRICULUM**

| PART – A: Introduction                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                    |                                                           |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|
| Program: Bachelor in Life Science<br>(Certificate/Diploma/Degree/Honors)                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Semester - II                                                                                                                                                                                                                                                                                                                      |                                                           |
|                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Session: 2025-26                                                                                                                                                                                                                                                                                                                   |                                                           |
| 1                                                                                                                                                                                                                      | Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | MBSC-02 P                                                                                                                                                                                                                                                                                                                          |                                                           |
| 2                                                                                                                                                                                                                      | Course Title                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Lab. Course – MBSC-02                                                                                                                                                                                                                                                                                                              |                                                           |
| 3                                                                                                                                                                                                                      | Course Type                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Laboratory Course                                                                                                                                                                                                                                                                                                                  |                                                           |
| 4                                                                                                                                                                                                                      | Prerequisite (If Any)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | As per program                                                                                                                                                                                                                                                                                                                     |                                                           |
| 5                                                                                                                                                                                                                      | Course Learning Outcomes (CLO)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | At the end of this course, the students will be able to –<br>➤ culture microorganisms and get the knowledge about their morphological features<br>➤ illustrate different staining procedures<br>➤ identify bacteria and protozoa from different samples<br>➤ get practice of identification of colonies on different culture media |                                                           |
| 6                                                                                                                                                                                                                      | Credit Value                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 1 Credit                                                                                                                                                                                                                                                                                                                           | Credit = 30 Hours. Laboratory or Field learning/ Training |
| 7                                                                                                                                                                                                                      | Total Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Max. Marks: 50                                                                                                                                                                                                                                                                                                                     | Min. Passing marks: 20                                    |
| PART – B: Content of the Course                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                    |                                                           |
| Total No. of learning-Training/ Performance Periods: 30 Periods (30 Hours)                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                    |                                                           |
| Module                                                                                                                                                                                                                 | Topics (Course contents)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                    | No. of Period                                             |
| Lab./ Field Training/ Experiment contents of Course                                                                                                                                                                    | 1. Isolation and characterization of bacteria by colony characteristics.<br>2. Growth on simple media – Nutrient agar and Nutrient broth<br>3. Growth on complex media – Blood agar, Chocolate agar, Macconkey’s, and EMB agar.<br>4. Differential Staining Techniques: Gram staining and acid-fast staining<br>5. Special Staining Techniques: Negative staining and Endospore staining<br>6. Study of cytopathic effects of viruses using photographs.<br>7. Observation of protozoa from different samples. |                                                                                                                                                                                                                                                                                                                                    | 30                                                        |
| Key Words                                                                                                                                                                                                              | Isolation, Identification, Staining Techniques, Cytopathic effects, Protozoa                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                    |                                                           |
| PART – C: Learning Resources                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                    |                                                           |
| Text Books, Reference Books and Others                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                    |                                                           |
| Text Books Recommended:<br>1. Laboratory Manual of Microbiology and Biotechnology: Aneja K. R<br>2. Practical Microbiology: R. C. Dubey and D. K. Maheshwari.<br>3. Laboratory Manual in Microbiology: P. Gunasekaran. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                    |                                                           |
| Online Resources:<br>• <a href="https://books.google.co.in/books?id=Wh9OTbjcsfUC&amp;printsec=age&amp;q&amp;f=false">https://books.google.co.in/books?id=Wh9OTbjcsfUC&amp;printsec=age&amp;q&amp;f=false</a>           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                    |                                                           |
| PART – D: Assessment and Evaluation                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                    |                                                           |
| Suggested Continuous Evaluation Methods:                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                    |                                                           |
| Maximum Marks:                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 50 Marks                                                                                                                                                                                                                                                                                                                           |                                                           |
| Continuous Internal Assessment (CIA):                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 15 Marks                                                                                                                                                                                                                                                                                                                           |                                                           |
| End Semester Exam (ESE):                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 35 Marks                                                                                                                                                                                                                                                                                                                           |                                                           |
| Continuous Internal Assessment (CIA):<br>(By Course Teacher)                                                                                                                                                           | Internal Test/ Quiz – (2): 10 & 10<br>Assignment/ Seminar + Attendance: 05<br>Total Marks – 15                                                                                                                                                                                                                                                                                                                                                                                                                 | Better Marks out of the two Test/ Quiz + obtained marks in Assignment shall be considered against 15 Marks                                                                                                                                                                                                                         |                                                           |
| End Semester Exam (ESE):                                                                                                                                                                                               | Laboratory/ Field Skill Performance: On spot Assessment<br>A. Performed the Task based on lab. work – 20 Marks<br>B. Spotting based on tools & technology (written) – 10 Marks<br>C. Viva-voce (based on principle/ technology) – 05 Marks                                                                                                                                                                                                                                                                     | Managed by course teacher as per lab. status                                                                                                                                                                                                                                                                                       |                                                           |

Name and Signatures



**FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)**  
**DEPARTMENT OF MICROBIOLOGY**  
**COURSE CURRICULUM**

| <b>PART – A: Introduction</b>                                    |                                | <b>Semester - III</b>                                                                                                                                                                                                                                                                                                                                                                                                | <b>Session: 2025-26</b>                    |
|------------------------------------------------------------------|--------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|
| <b>Program: Bachelor in Life Science (Diploma/Degree/Honors)</b> |                                |                                                                                                                                                                                                                                                                                                                                                                                                                      |                                            |
| 1                                                                | Course Code                    | MBSC-03 T                                                                                                                                                                                                                                                                                                                                                                                                            |                                            |
| 2                                                                | Course Title                   | Cell Biology and Biochemistry                                                                                                                                                                                                                                                                                                                                                                                        |                                            |
| 3                                                                | Course Type                    | Discipline Specific Core (DSC)                                                                                                                                                                                                                                                                                                                                                                                       |                                            |
| 4                                                                | Prerequisite (If Any)          | As per program                                                                                                                                                                                                                                                                                                                                                                                                       |                                            |
| 5                                                                | Course Learning Outcomes (CLO) | <b>At the end of this course, the student will able to –</b> <ul style="list-style-type: none"> <li>➤ illustrate the structural organization of eukaryotic and prokaryotic cells</li> <li>➤ interpret cell division</li> <li>➤ classify the biomolecules and compare their characteristics</li> <li>➤ relate structure and functions of nucleic acids</li> <li>➤ interpret the mechanism of enzyme action</li> </ul> |                                            |
| 6                                                                | Credit Value                   | 03 Credits                                                                                                                                                                                                                                                                                                                                                                                                           | Credit = 15 Hours - Learning & Observation |
| 7                                                                | Total Marks                    | Max. Marks: 100                                                                                                                                                                                                                                                                                                                                                                                                      | Minimum Passing marks: 40                  |

**PART – B: Content of the Course**

**Total No. of Teaching-Learning Periods (01 Hr. per period) - 45 Periods (45 Hours)**

| Unit             | Topics (Course contents)                                                                                                                                                                                                                                                                                                                          | No. of Period                                                     |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|
| I                | <b>History of Cell Biology:</b> Contribution of Indian Cell biologists and Biochemists: Ramakrishnan Nagaraj, Joyoti Basu, Veena Krishnaji Parnaik.<br><b>Cell Structure:</b> Prokaryotic and Eukaryotic cell, cellular organelles; Plasma membrane, Mitochondria, Golgi body, Nucleus, Ribosome, Lysosome, Endoplasmic reticulum. Cell division. | 12                                                                |
| II               | <b>Carbohydrate:</b> Structure, properties & classification of carbohydrates; Monosaccharides, Disaccharides and Polysaccharides.<br><b>Proteins:</b> Structure, properties & classification of amino acids. Structure & Classification of Protein- Primary, secondary; salient of $\alpha$ helix, $\beta$ sheet, tertiary and quaternary.        | 11                                                                |
| III              | <b>Lipid:</b> Structure, properties and classification of lipids.<br><b>Nucleic acids:</b> Structure of purine and pyrimidine bases, nucleoside and nucleotide; DNA structure and types: A, B, Z form; RNA - Structure, types and functions.                                                                                                      | 11                                                                |
| IV               | <b>Enzymes:</b> Classification of enzymes, mechanisms of enzyme action; Lock and key hypothesis, induced fit hypothesis. Active site and activation energy, coenzyme, Isoenzyme, metal cofactors.; Allosteric enzymes. Enzyme inhibition; competitive, noncompetitive, uncompetitive.                                                             | 11                                                                |
| <b>Key Words</b> |                                                                                                                                                                                                                                                                                                                                                   | Cell structure, Carbohydrates, Protein, Lipids, Enzymes, DNA, RNA |

**Name and Signatures**

|                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Chairperson/ HOD-</b> Dr. Pragya Kulkarni<br><b>Subject Expert -</b> Dr. Anita Mahiswar<br><b>Subject Expert -</b> Dr. Sonal Mishra<br><b>VC Nominee –</b> Dr. Prakash Saluja<br><b>Member of Other Department-</b> Dr. G.S. Thakur | <b>Industrial Representative-</b> Shri Amitesh Mishra<br><b>Student Nominee –</b> Ms. Yogita Lokhande<br><b>Departmental members</b><br>1. Mrs. Rekha Gupta<br>2. Mrs. Neetu Das<br>3. Ms. Mrinalini Soni<br>4. Ms. K.K. Yashoda |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

## Part – C: Learning Resources

### Text Books, Reference Books and Others

#### Text Books Recommended:

1. Cell and molecular biology; P. K. Gupta
2. Cell biology; C B Pawar
3. Biochemistry; U Satyanarayan and U Chakrapani
4. Fundamentals of Biochemistry; J L Jain, Sanjay Jain and Nitin Jain

#### Reference Books:

1. Lehninger's principles of Biochemistry; M.M. Cox, D. L. Nelson and W H Freeman.
2. Quick Review Biochemistry; Arun Kumar Singhal, AITBS Pub. India

#### Online Resources – e-Resources/ e-Books and e- learning portals

- <https://www.khanacademy.org/science/biology/structure-of-a-cell>
- <https://microbenotes-com.webpkgcache.com/doc/-/s/microbenotes.com/carbohydrates-classification-structure-functions/>
- <https://microbenotes.com/carbohydrates-structure-properties-classification-and-functions/>
- <https://www.onlinebiologynotes.com/classification-of-protein-on-the-basis-of-structure-composition-and-function/>

## Part- D: Assessment and Evaluation

### Suggested Continuous Evaluation Methods:

Maximum Marks: 100 Marks

Continuous Internal Assessment (CIA): 30 Marks

End Semester Exam (ESE): 70 Marks

Continuous Internal Assessment (CIA):  
(By Course Teacher)

|                             |       |
|-----------------------------|-------|
| Internal Test / Quiz – (2): | 20+20 |
| Assignment/ Seminar –       | 10    |
| Total Marks –               | 30    |

Better marks out of the two Test/ Quiz + obtained marks in Assignment shall be considered against 30 Marks

End Semester Exam (ESE):

Two Section – A & B

Section A: Q1. Objective 10 X 1 = 10 Mark; Q2. Short answer type – 5X4= 20 Marks  
Section B: Descriptive answer type qts., 1 out of 2 from each unit – 4X10 = 40 Marks

### Name and Signatures

Chairperson/ HOD- Dr. Pragya Kulkarni

Subject Expert - Dr. Anita Mahiswar

Subject Expert - Dr. Sonal Mishra

VC Nominee – Dr. Prakash Saluja

Member of Other Department- Dr. G.S. Thakur

Industrial Representative- Shri Amitesh Mishra

Student Nominee – Ms. Yogita Lokhande

Departmental members

1. Mrs. Rekha Gupta

2. Mrs. Neetu Das

3. Ms. Mrinalini Soni

4. Ms. K.K. Yashoda

**FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)**  
**DEPARTMENT OF MICROBIOLOGY**  
**COURSE CURRICULUM**

| <b>PART – A: Introduction</b>                                    |                                |                                                                                                                                                                                                                                                                                                                                                         |
|------------------------------------------------------------------|--------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Program: Bachelor in Life Science (Diploma/Degree/Honors)</b> |                                | <b>Semester III</b>                                                                                                                                                                                                                                                                                                                                     |
|                                                                  |                                | <b>Session: 2025-26</b>                                                                                                                                                                                                                                                                                                                                 |
| 1                                                                | Course Code                    | MBSC - 03 P                                                                                                                                                                                                                                                                                                                                             |
| 2                                                                | Course Title                   | Lab. Course – MBSC-03                                                                                                                                                                                                                                                                                                                                   |
| 3                                                                | Course Type                    | Laboratory Course                                                                                                                                                                                                                                                                                                                                       |
| 4                                                                | Prerequisite (If Any)          | As per program                                                                                                                                                                                                                                                                                                                                          |
| 5                                                                | Course Learning Outcomes (CLO) | At the end of this course, students will be able to – <ul style="list-style-type: none"> <li>➤ identify the various stages of cell division</li> <li>➤ quantify the carbohydrates and protein in any sample</li> <li>➤ determine the Vmax and Km value of enzymes</li> <li>➤ analyse the effect of environmental factors on enzyme activity.</li> </ul> |
| 6                                                                | Credit Value                   | 1 Credit      Credit = 30 Hours. Laboratory or Field learning/ Training                                                                                                                                                                                                                                                                                 |
| 7                                                                | Total Marks                    | Max. Marks: 50      Min. Passing marks: 20                                                                                                                                                                                                                                                                                                              |

**PART – B: Content of the Course**

**Total No. of learning-Training/ Performance Periods: 30 Periods (30 Hours)**

| Module                                              | Topics (Course contents)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | No. of Period |
|-----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| Lab./ Field Training/ Experiment contents of Course | <ol style="list-style-type: none"> <li>1. Identification of different stages of mitosis in onion root tips.</li> <li>2. Staining and visualisation of mitochondria by Janus green stain.</li> <li>3. Qualitative tests for carbohydrates, reducing sugars, non-reducing sugars.</li> <li>4. Qualitative tests for lipids and proteins.</li> <li>5. Quantitative estimation of proteins by Folin Lawry method.</li> <li>6. Study of protein secondary and tertiary structures with the help of models.</li> <li>7. Study of enzyme kinetics – calculation of Vmax, Km values.</li> <li>8. Study effect of temperature, pH and heavy metals on enzyme activity.</li> </ol> | 30            |

**PART – C: Learning Resources**

**Text Books, Reference Books and Others**

**Books Recommended:**

1. Practical microbiology: R C Dubey and D K Maheshwari.
2. An introduction to practical biochemistry: David T Plummer.
3. Basic concepts in clinical Biochemistry: A practical guide: Vijay Kumar, Kiran Dip Gill

**Online Resources:**

- <https://www.youtube.com/watch?v=hqbt7wtznrs>
- <https://www.youtube.com/watch?v=QacQmS3aaTI>

**PART – D: Assessment and Evaluation**

**Suggested Continuous Evaluation Methods:**

**Maximum Marks: 50 Marks**

**Continuous Internal Assessment (CIA): 15 Marks**

**End Semester Exam (ESE): 35 Marks**

|                                                              |                                                                                                                                                                                                                                         |                                                                                                            |
|--------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|
| Continuous Internal Assessment (CIA):<br>(By Course Teacher) | Internal Test/ Quiz – (2): 10 & 10<br>Assignment/ Seminar + Attendance: 05<br>Total Marks – 15                                                                                                                                          | Better Marks out of the two Test/ Quiz + obtained marks in Assignment shall be considered against 15 Marks |
| End Semester Exam (ESE):                                     | Laboratory/ Field Skill Performance: On spot Assessment<br>A. Performed the Task based on lab. work – 20 Marks<br>B. Spotting based on tools & technology (written) - 10 Marks<br>Viva-voce (based on principle/ technology) – 05 Marks | Managed by course teacher as per lab. status                                                               |

Name and Signatures

*[Handwritten signatures of faculty members]*

**FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)**  
**DEPARTMENT OF MICROBIOLOGY**  
**COURSE CURRICULUM**

| <b>PART – A: Introduction</b>                                    |                                |                                                                                                                                                                                                                                                                                                                                                                                                                           |                                            |
|------------------------------------------------------------------|--------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|
| <b>Program: Bachelor in Life Science (Diploma/Degree/Honors)</b> |                                | <b>Semester - III</b>                                                                                                                                                                                                                                                                                                                                                                                                     |                                            |
|                                                                  |                                | <b>Session: 2025-26</b>                                                                                                                                                                                                                                                                                                                                                                                                   |                                            |
| 1                                                                | Course Code                    | MBSE-01 T                                                                                                                                                                                                                                                                                                                                                                                                                 |                                            |
| 2                                                                | Course Title                   | Microbial Enzyme Technology                                                                                                                                                                                                                                                                                                                                                                                               |                                            |
| 3                                                                | Course Type                    | Discipline Specific Elective Course (DSE)                                                                                                                                                                                                                                                                                                                                                                                 |                                            |
| 4                                                                | Prerequisite (If Any)          | As per Program                                                                                                                                                                                                                                                                                                                                                                                                            |                                            |
| 5                                                                | Course Learning Outcomes (CLO) | <b>At the end of this course, the students will be able to –</b> <ul style="list-style-type: none"> <li>➤ learn the fundamentals of enzymes, enzyme-action and metabolic reactions</li> <li>➤ explain the mechanism of enzyme action</li> <li>➤ relate enzyme modifications</li> <li>➤ identify the applications of enzymes in various fields</li> <li>➤ attain knowledge about various biochemical techniques</li> </ul> |                                            |
| 6                                                                | Credit Value                   | 03 Credits                                                                                                                                                                                                                                                                                                                                                                                                                | Credit = 15 Hours - Learning & Observation |
| 7                                                                | Total Marks                    | Max. Marks: 100                                                                                                                                                                                                                                                                                                                                                                                                           | Minimum Passing marks: 40                  |

**PART – B: Content of the Course**

**Total No. of Teaching-Learning Periods (01 Hr. per period) - 45 Periods (45 Hours)**

| Unit      | Topics (Course contents)                                                                                                                                                                                                                                                                                                      | No. of Period |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| I         | <b>Basic concept of enzymes:</b> Nomenclature, classification, methods for determination of enzyme activity. Enzyme kinetics: Michaelis-Menten equation, effect of pH, substrate concentration, temperature and inhibitors. Iso-enzymes and allosteric enzymes. Enzyme inhibition-competitive and non-competitive inhibition. | 12            |
| II        | <b>Mechanism of enzyme action:</b> Action of ribonuclease, chymotrypsin and trypsin. Coenzyme catalysis. Mechanism of action of thiamine pyrophosphate enzyme. Control and regulation of enzyme activity and feedback mechanisms. Metabolic compartmentalization in relation to enzyme, enzymes and secondary metabolites.    | 11            |
| III       | <b>Enzyme engineering &amp; applications of microbial enzymes:</b> Chemical modification and site-directed mutagenesis structure & function relationship of industrially important enzymes. Microbial enzymes in textile, leather, wood industries and detergents.                                                            | 11            |
| IV        | <b>Biochemical techniques:</b> Determination of molecular weights, purity, General methods of extraction-salting out, use of organic solvents; Purification; analysis of proteins - mass determination- GC-MS; structure determination-X-ray diffraction.                                                                     | 11            |
| Key Words | <b>Enzyme, Enzyme action, Enzyme inhibition, Enzyme engineering, Biochemical techniques,</b>                                                                                                                                                                                                                                  |               |

**Name and Signatures**

|                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                       |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Chairperson/ HOD- Dr. Pragya Kulkarni</b><br><b>Subject Expert - Dr. Anita Mahiswar</b><br><b>Subject Expert - Dr. Sonal Mishra</b><br><b>VC Nominee – Dr. Prakash Saluja</b><br><b>Member of Other Department- Dr. G.S. Thakur</b> | <b>Industrial Representative- Shri Amitesh Mishra</b><br><b>Student Nominee – Ms. Yogita Lokhande</b><br><b>Departmental members</b> <ol style="list-style-type: none"> <li>Mrs. Rekha Gupta</li> <li>Mrs. Neetu Das</li> <li>Ms. Mrinalini Soni</li> <li>Ms. K.K. Yashoda</li> </ol> |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

## Part – C: Learning Resources

### Text Books, Reference Books and Others

#### Text Books Recommended:

1. A Text Book of Microbiology: R. C. Dubey & D. K. Maheshwari
2. A text book of Industrial Microbiology. 2<sup>nd</sup> edition. Panima Publishing Company, New Delhi.
3. Industrial Microbiology: Patel A H. (1996). 1<sup>st</sup> edition. MacMillan India Limited Publishing Company Ltd. New Delhi, India.
4. Fundamentals of Biochemistry; Dr. J.L. Jain, Dr. Sanjay Jain, Nitin Jain, S. Chand Publication

#### Reference Books:

1. Principles of Biochemistry and molecular biology: Wilson & Walker
2. Lehninger Principles of Biochemistry, 8<sup>th</sup> Edition, David L. Nelson, Micheal M. Cox
3. Biotechnology: Crueger Wand Crueger A. (2000).

#### Online Resources – e-Resources/ e-Books and e- learning portals

- <https://www.britannica.com/science/enzyme>
- [https://sist.sathyabama.ac.in/sist\\_coursematerial/uploads/SBB2204.pdf](https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SBB2204.pdf)
- <https://www.khanacademy.org/science/ap-biology/cellular-energetics/environmental-impacts-on-enzyme-function/a/basics-of-enzyme-kinetics-graphs>
- <https://microbeonline.com/maldi-tof-ms-principle-applications-microbiology/>
- <https://www.technologynetworks.com/analysis/articles/gc-ms-principle-instrument-and-analyses-and-gc-msms-362513>

## Part – D: Assessment and Evaluation

### Suggested Continuous Evaluation Methods:

Maximum Marks: 100 Marks

Continuous Internal Assessment (CIA): 30 Marks

End Semester Exam (ESE): 70 Marks

|                                                              |                                   |                                                                                                                  |
|--------------------------------------------------------------|-----------------------------------|------------------------------------------------------------------------------------------------------------------|
| Continuous Internal Assessment (CIA):<br>(By Course Teacher) | Internal Test / Quiz – (2): 20+20 | Better marks out of the two Test/ Quiz<br>+ obtained marks in Assignment shall<br>be considered against 30 Marks |
|                                                              | Assignment/ Seminar – 10          |                                                                                                                  |
|                                                              | Total Marks – 30                  |                                                                                                                  |

|                          |                                                                                                                                                                          |
|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| End Semester Exam (ESE): | Two Section – A & B                                                                                                                                                      |
|                          | Section A: Q1. Objective 10 X 1 = 10 Mark; Q2. Short answer type – 5X4= 20 Marks<br>Section B: Descriptive answer type qts., 1 out of 2 from each unit – 4X10 = 40 Marks |

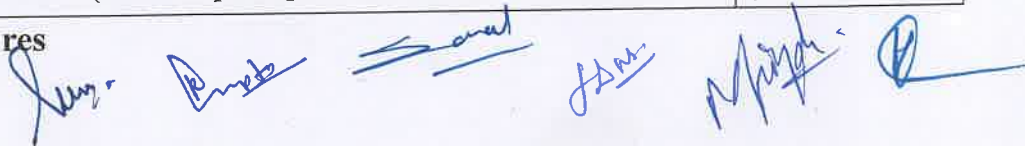
### Name and Signatures

|                                             |                                                |
|---------------------------------------------|------------------------------------------------|
| Chairperson/ HOD- Dr. Pragya Kulkarni       | Industrial Representative- Shri Amitesh Mishra |
| Subject Expert - Dr. Anita Mahiswar         | Student Nominee – Ms. Yogita Lokhande          |
| Subject Expert - Dr. Sonal Mishra           | Departmental members                           |
| VC Nominee – Dr. Prakash Saluja             | 1. Mrs. Rekha Gupta                            |
| Member of Other Department- Dr. G.S. Thakur | 2. Mrs. Neetu Das                              |
|                                             | 3. Ms. Mrinalini Soni                          |
|                                             | 4. Ms. K.K. Yashoda                            |

**FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)**  
**DEPARTMENT OF MICROBIOLOGY**  
**COURSE CURRICULUM**

| PART – A: Introduction                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                         |                                                           |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|
| Program: Bachelor in Life Science<br>(Diploma/Degree/Honors)                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                       | Semester - III                                                                                                                                                                                                                                                                          | Session: 2025-26                                          |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                | Course Code                                                                                                                                                                                                                                                                                                                                           | MBSE-01 P                                                                                                                                                                                                                                                                               |                                                           |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                | Course Title                                                                                                                                                                                                                                                                                                                                          | Lab. Course - MBSE-01                                                                                                                                                                                                                                                                   |                                                           |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                | Course Type                                                                                                                                                                                                                                                                                                                                           | Laboratory Course                                                                                                                                                                                                                                                                       |                                                           |
| 4                                                                                                                                                                                                                                                                                                                                                                                                                | Prerequisite (If Any)                                                                                                                                                                                                                                                                                                                                 | As per Program                                                                                                                                                                                                                                                                          |                                                           |
| 5                                                                                                                                                                                                                                                                                                                                                                                                                | Course Learning Outcomes (CLO)                                                                                                                                                                                                                                                                                                                        | At the end of this course, the students will be able to –<br>➤ show the enzyme production by microorganisms<br>➤ demonstrate the actions of different enzymes<br>➤ determine various parameters of enzyme action<br>➤ examine various biochemical techniques used for enzyme technology |                                                           |
| 6                                                                                                                                                                                                                                                                                                                                                                                                                | Credit Value                                                                                                                                                                                                                                                                                                                                          | 1 Credit                                                                                                                                                                                                                                                                                | Credit = 30 Hours. Laboratory or Field learning/ Training |
| 7                                                                                                                                                                                                                                                                                                                                                                                                                | Total Marks                                                                                                                                                                                                                                                                                                                                           | Max. Marks: 50                                                                                                                                                                                                                                                                          | Min. Passing marks: 20                                    |
| PART – B: Content of the Course                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                         |                                                           |
| Total No. of learning-Training/ Performance Periods: 30 Periods (30 Hours)                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                         |                                                           |
| Module                                                                                                                                                                                                                                                                                                                                                                                                           | Topics (Course contents)                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                         | No. of Period                                             |
| Lab./ Field Training/ Experiment contents of Course                                                                                                                                                                                                                                                                                                                                                              | 1. Screening of amylase producing microorganisms.<br>2. Demonstrations of enzyme activity: Phosphatase and Catalase<br>3. Determination of kinetic constant of enzyme: Amylase activity, Vmax. Km.<br>4. Effect of pH and temperature on amylase activity.<br>5. Effect of inhibitors on amylase activity.<br>6. Effect of UV absorption on proteins. |                                                                                                                                                                                                                                                                                         | 30                                                        |
| Key Words                                                                                                                                                                                                                                                                                                                                                                                                        | Enzyme, Enzyme activity, Enzyme inhibition, Biochemical techniques                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                         |                                                           |
| PART – C: Learning Resources                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                         |                                                           |
| Text Books, Reference Books and Others                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                         |                                                           |
| Text Books Recommended:                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                         |                                                           |
| 1. Laboratory Manual of Microbiology and Biotechnology. By Aneja K. R<br>2. Practical Microbiology, R. C. Dubey and D. K. Maheshwari.<br>3. Laboratory Manual in Microbiology. By P. Gunasekaran.                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                         |                                                           |
| Online Resources:                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                         |                                                           |
| • <a href="https://books.google.co.in/books?id=Wh9OTbjcsfUC&amp;printsec=age&amp;q&amp;f=false">https://books.google.co.in/books?id=Wh9OTbjcsfUC&amp;printsec=age&amp;q&amp;f=false</a><br>• <a href="https://books.google.co.in/books/about/Practical_Microbiology.html?id=Wh9OTbjcsfUC&amp;redir_esc=v">https://books.google.co.in/books/about/Practical_Microbiology.html?id=Wh9OTbjcsfUC&amp;redir_esc=v</a> |                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                         |                                                           |
| PART – D: Assessment and Evaluation                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                         |                                                           |
| Suggested Continuous Evaluation Methods:                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                         |                                                           |
| Maximum Marks:                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                       | 50 Marks                                                                                                                                                                                                                                                                                |                                                           |
| Continuous Internal Assessment (CIA):                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                       | 15 Marks                                                                                                                                                                                                                                                                                |                                                           |
| End Semester Exam (ESE):                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                       | 35 Marks                                                                                                                                                                                                                                                                                |                                                           |
| Continuous Internal Assessment (CIA):<br>(By Course Teacher)                                                                                                                                                                                                                                                                                                                                                     | Internal Test/ Quiz – (2): 10 & 10<br>Assignment/ Seminar + Attendance: 05<br>Total Marks: 15                                                                                                                                                                                                                                                         | Better Marks out of the two Test/ Quiz + obtained marks in Assignment shall be considered against 15 Marks                                                                                                                                                                              |                                                           |
| End Semester Exam (ESE):                                                                                                                                                                                                                                                                                                                                                                                         | Laboratory/ Field Skill Performance: On spot Assessment<br>A. Performed the Task based on lab. work – 20 Marks<br>B. Spotting based on tools & technology (written) - 10 Marks<br>C. Viva-voce (based on principle/ technology) – 05 Marks                                                                                                            | Managed by course teacher as per lab. status                                                                                                                                                                                                                                            |                                                           |

**Name and Signatures**



**FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)**

**DEPARTMENT OF MICROBIOLOGY**

**COURSE CURRICULUM**

| <b>PART – A: Introduction</b>                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                       |
|-------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|
| <b>Program: Bachelor in Life Science (Diploma/Degree/Honors)</b>                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>Semester - IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>Session: 2025-26</b>                               |
| <b>1</b>                                                                                  | <b>Course Code</b>                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>MBSC – 04 T</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                       |
| <b>2</b>                                                                                  | <b>Course Title</b>                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>Bioinstrumentation and Biostatistics</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                       |
| <b>3</b>                                                                                  | <b>Course Type</b>                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>Discipline Specific Core (DSC)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                       |
| <b>4</b>                                                                                  | <b>Prerequisite (If Any)</b>                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>As per Program</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                       |
| <b>5</b>                                                                                  | <b>Course Learning Outcomes (CLO)</b>                                                                                                                                                                                                                                                                                                                                                                                                               | <b>At the end of this course the student will able to –</b> <ul style="list-style-type: none"> <li>➤ recall the principle of microscopy and compare the types of microscopes for specialized viewing</li> <li>➤ identify the basic analytical instruments for performing microbiological manipulations</li> <li>➤ relate the techniques used for processing the microbial samples</li> <li>➤ recognize the basics of radiobiology and its applications</li> <li>➤ illustrate basic concept of Biostatistics and develop their application</li> </ul> |                                                       |
| <b>6</b>                                                                                  | <b>Credit Value</b>                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>03 Credits</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>Credit = 15 Hours - Learning &amp; Observation</b> |
| <b>7</b>                                                                                  | <b>Total Marks</b>                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>Max. Marks: 100</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>Minimum Passing marks: 40</b>                      |
| <b>PART – B: Content of the Course</b>                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                       |
| <b>Total No. of Teaching-Learning Periods (01 Hr. per period) - 45 Periods (45 Hours)</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                       |
| <b>UNIT</b>                                                                               | <b>TOPIC (Course Contents)</b>                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>No. of Periods</b>                                 |
| <b>I</b>                                                                                  | <b>Microscopy:</b> Principle, Mechanism and application of different types of microscopes- Bright field, Dark field and Phase Contrast microscope; Fluorescence microscopy, Confocal microscopy, Scanning and Transmission Electron Microscopy (SEM & TEM).<br><b>Micrometry</b><br><b>pH metry:</b> Principle, Types of electrodes, factors affecting pH measurement, application of pH meter.                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>12</b>                                             |
| <b>II</b>                                                                                 | <b>Centrifugation:</b> Principle and Types of Centrifugal Machines, Analytical, Preparatory, differential, Rate zonal and ultracentrifugation and their applications.<br><b>Chromatography:</b> Principle and techniques with applications of Partition, ion-exchange, exclusion and affinity chromatography.<br><b>Electrophoresis:</b> Principle of Agarose and Polyacrylamide Gel Electrophoresis, Components, working and applications.         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>11</b>                                             |
| <b>III</b>                                                                                | <b>Spectrophotometry:</b> Electromagnetic spectrum, Basic principles and Law of absorption; principle, mechanism and applications of Visible and UV spectrophotometer.<br><b>Radiobiology:</b> Radioactivity, forms of radioactive emissions, biological effects of radiation exposure, characters of radioisotopes and their applications, Principles and methods of radioactive detection, GM counter, Scintillation counter and Autoradiography. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>11</b>                                             |
| <b>IV</b>                                                                                 | <b>Biostatistics:</b> Definitions, Basic concepts, sample and population, Measurement scales, Statistical inference and parameters, methods of sampling, Classification of Data, Tabulation, Frequency distribution, diagrammatic and Graphical presentation of data, Data analysis- Central Tendencies (Mean, Median and Mode). Deviation (Variance, SD and SE).                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>11</b>                                             |
| <b>Key Words</b>                                                                          | <b>Microscope, Centrifuge, pH meter, Chromatography, Electrophoresis, Spectrophotometer, Radiobiology, Biostatistics</b>                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                       |

**Name and Signatures**

|                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                   |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Chairperson/ HOD- Dr. Pragya Kulkarni</b><br><b>Subject Expert - Dr. Anita Mahiswar</b><br><b>Subject Expert - Dr. Sonal Mishra</b><br><b>VC Nominee – Dr. Prakash Saluja</b><br><b>Member of Other Department- Dr. G.S. Thakur</b> | <b>Industrial Representative- Shri Amitesh Mishra</b><br><b>Student Nominee – Ms. Yogita Lokhande</b><br><b>Departmental members</b> <ol style="list-style-type: none"> <li><b>Mrs. Rekha Gupta</b></li> <li><b>Mrs. Neetu Das</b></li> <li><b>Ms. Mrinalini Soni</b></li> <li><b>Ms. K.K. Yashoda</b></li> </ol> |
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## Part – C: Learning Resources

### Text Books, Reference Books and Others

#### Text Books Recommended:

1. Biophysical Chemistry, Principles and Techniques – A. Upadhyay, K. Upadhyay & N. Nath, Himalaya Pub.
2. Biotechniques: Theory and Practice – S.V.S. Rana, Rastogi Pub.
3. Analytical Chemistry – G. Chatwal and Anand, Himalaya Pub.
4. Statistical Methods; S.P. Gupta
5. Fundamentals of Biostatistics; Khan and Khanum, Ukaaz Publications, Hyderabad.

#### Reference Books:

1. Fundamental of light Microscopy & Electron Imaging. 1<sup>st</sup> Edition. Murphy D.B.
2. Fundamentals and techniques of biophysics and molecular biology (2016) Pranav Kumar.
3. Techniques and methods in biology PHI publication (2011) K L Ghatak.
4. Biostatistics; Sunder Rao
5. Fundamentals of Biostatistics, Seventh Edition, Bernard Rosner, Harvard University.

### Online Resources – e-Resources/ e-Books and e- learning portals

- <https://www.sathyabama.ac.in/sites/default/files/course-material/2020-10/SCY2.pdf>
- [https://faculty.ksu.edu.sa/sites/default/files/instrumental\\_chemical\\_analysis.pdf](https://faculty.ksu.edu.sa/sites/default/files/instrumental_chemical_analysis.pdf)
- [https://www.academia.edu/31125635/Biotechniques\\_Theory\\_and\\_Practice\\_eBook](https://www.academia.edu/31125635/Biotechniques_Theory_and_Practice_eBook)
- [https://cbpbu.ac.in/userfiles/file/2020/STUDY\\_MAT/ZOO/PK%20\(2\).pdf](https://cbpbu.ac.in/userfiles/file/2020/STUDY_MAT/ZOO/PK%20(2).pdf)

## Part- D: Assessment and Evaluation

### Suggested Continuous Evaluation Methods:

Maximum Marks: 100 Marks

Continuous Internal Assessment (CIA): 30 Marks

End Semester Exam (ESE): 70 Marks

|                                                                     |                                   |                                                                                                            |
|---------------------------------------------------------------------|-----------------------------------|------------------------------------------------------------------------------------------------------------|
| <b>Continuous Internal Assessment (CIA):</b><br>(By Course Teacher) | Internal Test / Quiz – (2): 20+20 | Better marks out of the two Test/ Quiz + obtained marks in Assignment shall be considered against 30 Marks |
|                                                                     | Assignment/ Seminar – 10          |                                                                                                            |
|                                                                     | Total Marks – 30                  |                                                                                                            |

|                                 |                                                                                      |  |
|---------------------------------|--------------------------------------------------------------------------------------|--|
| <b>End Semester Exam (ESE):</b> | <b>Two Section – A &amp; B</b>                                                       |  |
|                                 | Section A: Q1. Objective 10 X 1 = 10 Mark; Q2. Short answer type – 5X4= 20 Marks     |  |
|                                 | Section B: Descriptive answer type qts., 1 out of 2 from each unit – 4X10 = 40 Marks |  |

### Name and Signatures

|                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Chairperson/ HOD- Dr. Pragya Kulkarni</b><br><b>Subject Expert - Dr. Anita Mahiswar</b><br><b>Subject Expert - Dr. Sonal Mishra</b><br><b>VC Nominee – Dr. Prakash Saluja</b><br><b>Member of Other Department- Dr. G.S. Thakur</b> | <b>Industrial Representative- Shri Amitesh Mishra</b><br><b>Student Nominee – Ms. Yogita Lokhande</b><br><b>Departmental members</b><br>1. Mrs. Rekha Gupta<br>2. Mrs. Neetu Das<br>3. Ms. Mrinalini Soni<br>4. Ms. K.K. Yashoda |
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**FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)**  
**DEPARTMENT OF MICROBIOLOGY**  
**COURSE CURRICULUM**

| PART – A: Introduction                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                             |                                                           |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|
| Program: Bachelor in Life Science<br>(Diploma/Degree/Honors)                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Semester IV                                                                                                                                                                                                                                                                 | Session: 2025-26                                          |
| 1                                                                                                                                                                                                                                                                                                                                                              | Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | MBSC - 04 P                                                                                                                                                                                                                                                                 |                                                           |
| 2                                                                                                                                                                                                                                                                                                                                                              | Course Title                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Lab. Course – MBSC-04                                                                                                                                                                                                                                                       |                                                           |
| 3                                                                                                                                                                                                                                                                                                                                                              | Course Type                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Laboratory Course                                                                                                                                                                                                                                                           |                                                           |
| 4                                                                                                                                                                                                                                                                                                                                                              | Prerequisite (If Any)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | As per Program                                                                                                                                                                                                                                                              |                                                           |
| 5                                                                                                                                                                                                                                                                                                                                                              | Course Learning Outcomes<br>(CLO)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | At the end of this course the student will able to –<br>➤ identify microorganisms on the basis of microscopic features<br>➤ relate common analytical techniques in microbiology<br>➤ infer the concept of Biostatistics<br>➤ explain the significance of central tendencies |                                                           |
| 6                                                                                                                                                                                                                                                                                                                                                              | Credit Value                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 1 Credit                                                                                                                                                                                                                                                                    | Credit = 30 Hours. Laboratory or Field learning/ Training |
| 7                                                                                                                                                                                                                                                                                                                                                              | Total Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Max. Marks: 50                                                                                                                                                                                                                                                              | Min. Passing marks: 20                                    |
| PART – B: Content of the Course                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                             |                                                           |
| Total No. of learning-Training/ Performance Periods: 30 Periods (30 Hours)                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                             |                                                           |
| Module                                                                                                                                                                                                                                                                                                                                                         | Topics (Course contents)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                             | No. of Period                                             |
| Lab./ Field Training/<br>Experiment contents of Course                                                                                                                                                                                                                                                                                                         | 1. Study of different parts of microscope.<br>2. Determination of $\lambda$ max of given coloured solution and Confirmation of Beer’s law.<br>3. Separation of components of a given mixture using a laboratory scale centrifuge.<br>4. Separation of Ink components/ chlorophyll / Amino acids by Paper Chromatography.<br>5. Separation of Amino acids by Thin Layer Chromatography.<br>6. Demonstration of Gel Filtration Chromatography.<br>7. Measurement of pH of water and soil samples and maintenance of required pH.<br>8. Demonstration of SDS-PAGE and Submarine Gel Electrophoresis.<br>9. Preparation of Tables, Bar diagrams and Histograms from given data.<br>10. Calculation of Mean, Median and Mode from grouped and ungrouped data. |                                                                                                                                                                                                                                                                             | 30                                                        |
| Key Words                                                                                                                                                                                                                                                                                                                                                      | Microscopy, Spectrophotometry, Chromatography, Centrifugation, Electrophoresis, Presentation of Data, Calculation of Central Tendencies                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                             |                                                           |
| PART – C: Learning Resources                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                             |                                                           |
| Text Books, Reference Books and Others                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                             |                                                           |
| Text Books Recommended:                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                             |                                                           |
| 1. An Introduction to practical Biochemistry; McGraw Hill Publication 1987. D.T Plummer.<br>2. Principles and Techniques in Practical Biochemistry; Wilson & Walker.<br>3. Biotechniques: Theory and Practice; S.V.S. Rana, Rastogi Pub.<br>4. Statistical Methods; S.P. Gupta                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                             |                                                           |
| Online Resources:                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                             |                                                           |
| • <a href="https://books.google.co.in/books?id=Wh9OTbjcsfUC&amp;printsec=age&amp;q&amp;f=false">https://books.google.co.in/books?id=Wh9OTbjcsfUC&amp;printsec=age&amp;q&amp;f=false</a><br>• <a href="https://www.academia.edu/31125635/Biotechniques_Theory_and_Practice_eBook">https://www.academia.edu/31125635/Biotechniques_Theory_and_Practice_eBook</a> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                             |                                                           |
| PART – D: Assessment and Evaluation                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                             |                                                           |
| Suggested Continuous Evaluation Methods:                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                             |                                                           |
| Maximum Marks:                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 50 Marks                                                                                                                                                                                                                                                                    |                                                           |
| Continuous Internal Assessment (CIA):                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 15 Marks                                                                                                                                                                                                                                                                    |                                                           |
| End Semester Exam (ESE):                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 35 Marks                                                                                                                                                                                                                                                                    |                                                           |
| Continuous Internal Assessment (CIA):<br>(By Course Teacher)                                                                                                                                                                                                                                                                                                   | Internal Test/ Quiz – (2): 10 & 10<br>Assignment/ Seminar + Attendance: 05<br>Total Marks: 15                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Better Marks out of the two Test/ Quiz + obtained marks in Assignment shall be considered against 15 Marks                                                                                                                                                                  |                                                           |
| End Semester Exam (ESE):                                                                                                                                                                                                                                                                                                                                       | Laboratory/ Field Skill Performance: On spot Assessment<br>A. Performed the Task based on lab. work – 20 Marks<br>B. Spotting based on tools & technology (written) - 10 Marks<br>C. Viva-voce (based on principle/ technology) – 05 Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Managed by course teacher as per lab. status                                                                                                                                                                                                                                |                                                           |

Name and Signatures

**FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)**

**DEPARTMENT OF MICROBIOLOGY**

**COURSE CURRICULUM**

| <b>PART – A: Introduction</b>                                        |                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                       |
|----------------------------------------------------------------------|---------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|
| <b>Program: Bachelor in Life Science<br/>(Diploma/Degree/Honors)</b> |                                       | <b>Semester - IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>Session: 2025-26</b>                               |
| <b>1</b>                                                             | <b>Course Code</b>                    | <b>MBSE-02 T</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                       |
| <b>2</b>                                                             | <b>Course Title</b>                   | <b>Industrial Microbiology</b>                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                       |
| <b>3</b>                                                             | <b>Course Type</b>                    | <b>Discipline Specific Elective (DSE)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                       |
| <b>4</b>                                                             | <b>Prerequisite (If Any)</b>          | <b>As per Program</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                       |
| <b>5</b>                                                             | <b>Course Learning Outcomes (CLO)</b> | <b>At the end of this course, the students will be able to –</b> <ul style="list-style-type: none"> <li>➤ define the role of microorganism in industry</li> <li>➤ explain the processing of the best microbial strains for the industry</li> <li>➤ outline the fundamentals of fermenters and fermentation processes</li> <li>➤ relate metabolic pathways for industrial products</li> <li>➤ identify the production of various industrially important products</li> </ul> |                                                       |
| <b>6</b>                                                             | <b>Credit Value</b>                   | <b>03 Credits</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>Credit = 15 Hours - Learning &amp; Observation</b> |
| <b>7</b>                                                             | <b>Total Marks</b>                    | <b>Max. Marks: 100</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>Minimum Passing marks: 40</b>                      |

**PART – B: Content of the Course**

**Total No. of Teaching-Learning Periods (01 Hr. per period) - 45 Periods (45 Hours)**

| <b>Unit</b>      | <b>Topics (Course contents)</b>                                                                                                                                                                                                                                                                                                    | <b>No. of Period</b> |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| <b>I</b>         | <b>Multidisciplinary nature of Industrial microbiology:</b> Introduction, brief History, ancient Indian perspective, important characteristics of industrially useful microorganisms.<br><b>Upstream and Down-stream processing:</b> Detection and assay of the product, Recovery and Purification, storage and packaging methods. | <b>12</b>            |
| <b>II</b>        | <b>Scale up, Screening and Strain Development Strategies:</b> Industrial sterilization, Isolation, preservation and maintenance of industrial strains. Production Media and Raw materials, Fermenter design. Types of fermentation: Aerobic and anaerobic Batch, fed-batch and Continuous fermentation.                            | <b>11</b>            |
| <b>III</b>       | <b>Metabolic pathways:</b> Industrial production of citric acid, acetic acid, Lactic acid, Glutamic acid.<br><b>Vaccines and Hormones:</b> Hepatitis vaccine, Rabies vaccine, insulin.                                                                                                                                             | <b>11</b>            |
| <b>IV</b>        | <b>Production of industrial fermentation products:</b> Fermented food and beverages, Ethanol, Amylases, Penicillin, Single Cell Protein, Biofertilizers and Biopesticides                                                                                                                                                          | <b>11</b>            |
| <b>Key Words</b> | <b>Scale up, Fermenter, Fermentation, Downstream processing, Metabolic pathways, Fermented food</b>                                                                                                                                                                                                                                |                      |

**Name and Signatures**

|                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                   |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Chairperson/ HOD- Dr. Pragya Kulkarni</b><br><b>Subject Expert - Dr. Anita Mahiswar</b><br><b>Subject Expert - Dr. Sonal Mishra</b><br><b>VC Nominee – Dr. Prakash Saluja</b><br><b>Member of Other Department- Dr. G.S. Thakur</b> | <b>Industrial Representative- Shri Amitesh Mishra</b><br><b>Student Nominee – Ms. Yogita Lokhande</b><br><b>Departmental members</b> <ol style="list-style-type: none"> <li><b>Mrs. Rekha Gupta</b></li> <li><b>Mrs. Neetu Das</b></li> <li><b>Ms. Mrinalini Soni</b></li> <li><b>Ms. K.K. Yashoda</b></li> </ol> |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

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|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|
| <b>Part – C: Learning Resources</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                            |                                                                                                                  |
| <b>Text Books, Reference Books and Others</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                            |                                                                                                                  |
| <b>Text Books Recommended:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                            |                                                                                                                  |
| 1. Industrial Microbiology: Patel A. H. (1996). I edition, MacMillan India Limited publishing company Ltd New Delhi, India.<br>2. A Text Book of Microbiology: R. C. Dubey & D. K. Maheshwari<br>3. Industrial Microbiology by Prescott & Dunn, AVI Publishing Company Inc.<br>4. Biotechnology; V. Kumaresan, Saras Publications                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                            |                                                                                                                  |
| <b>Reference Books:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                            |                                                                                                                  |
| 1. Modern Industrial Microbiology and Biotechnology: Okafor N. (2007).1st edition. Bios Scientific Publishers Limited. USA.<br>2. Industrial Microbiology: Casida LE, New age International (P) Ltd.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                            |                                                                                                                  |
| <b>Online Resources – e-Resources/ e-Books and e- learning portals</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                            |                                                                                                                  |
| <ul style="list-style-type: none"> <li>• <a href="https://bookarchive.net/pdf/industrial-microbiology-by-i-e-casida-jr/">https://bookarchive.net/pdf/industrial-microbiology-by-i-e-casida-jr/</a></li> <li>• <a href="http://foodhaccp.com/foodsafetymicro/onlineindex.html">http://foodhaccp.com/foodsafetymicro/onlineindex.html</a></li> <li>• <a href="https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SMB2203.pdf">https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SMB2203.pdf</a></li> <li>• <a href="http://www.cpe.rutgers.edu/courses/current/If0401wa.html">http://www.cpe.rutgers.edu/courses/current/If0401wa.html</a></li> <li>• <a href="https://www.classcentral.com/course/swayam-food-microbiology-and-food-safety-17609">https://www.classcentral.com/course/swayam-food-microbiology-and-food-safety-17609</a></li> </ul> |                                                                                                                                                                                                            |                                                                                                                  |
| <b>Part – D: Assessment and Evaluation</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                            |                                                                                                                  |
| <b>Suggested Continuous Evaluation Methods:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                            |                                                                                                                  |
| <b>Maximum Marks: 100 Marks</b><br><b>Continuous Internal Assessment (CIA): 30 Marks</b><br><b>End Semester Exam (ESE): 70 Marks</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                            |                                                                                                                  |
| <b>Continuous Internal Assessment (CIA):<br/>(By Course Teacher)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Internal Test / Quiz – (2): 20+20<br>Assignment/ Seminar – 10<br>Total Marks – 30                                                                                                                          | Better marks out of the two Test/ Quiz<br>+ obtained marks in Assignment shall be<br>considered against 30 Marks |
| <b>End Semester Exam (ESE):</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>Two Section – A &amp; B</b><br>Section A: Q1. Objective 10 X 1 = 10 Mark; Q2. Short answer type – 5X4= 20 Marks<br>Section B: Descriptive answer type qts., 1 out of 2 from each unit – 4X10 = 40 Marks |                                                                                                                  |

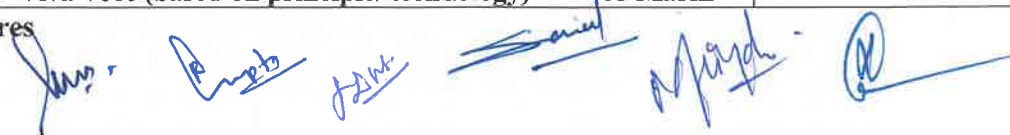
**Name and Signatures**

|                                                    |                                                       |
|----------------------------------------------------|-------------------------------------------------------|
| <b>Chairperson/ HOD- Dr. Pragya Kulkarni</b>       | <b>Industrial Representative- Shri Amitesh Mishra</b> |
| <b>Subject Expert - Dr. Anita Mahiswar</b>         | <b>Student Nominee – Ms. Yogita Lokhande</b>          |
| <b>Subject Expert - Dr. Sonal Mishra</b>           | <b>Departmental members</b>                           |
| <b>VC Nominee – Dr. Prakash Saluja</b>             | 1. Mrs. Rekha Gupta                                   |
| <b>Member of Other Department- Dr. G.S. Thakur</b> | 2. Mrs. Neetu Das                                     |
|                                                    | 3. Ms. Mrinalini Soni                                 |
|                                                    | 4. Ms. K.K. Yashoda                                   |

**FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)**  
**DEPARTMENT OF MICROBIOLOGY**  
**COURSE CURRICULUM**

| PART – A: Introduction                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                       |                                                                                                            |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|
| Program: Bachelor in Life Science<br>(Diploma/Degree/Honors)                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Semester IV                                                                                                                                                                                                                                                                                                                           | Session: 2025-26                                                                                           |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                 | Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                         | MBSE-02 P                                                                                                                                                                                                                                                                                                                             |                                                                                                            |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                 | Course Title                                                                                                                                                                                                                                                                                                                                                                                                                                        | Lab. Course - MBSE-02                                                                                                                                                                                                                                                                                                                 |                                                                                                            |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                                 | Course Type                                                                                                                                                                                                                                                                                                                                                                                                                                         | Laboratory course                                                                                                                                                                                                                                                                                                                     |                                                                                                            |
| 4                                                                                                                                                                                                                                                                                                                                                                                                                                 | Prerequisite (If Any)                                                                                                                                                                                                                                                                                                                                                                                                                               | As per Program                                                                                                                                                                                                                                                                                                                        |                                                                                                            |
| 5                                                                                                                                                                                                                                                                                                                                                                                                                                 | Course Learning Outcomes (CLO)                                                                                                                                                                                                                                                                                                                                                                                                                      | At the end of this course, the students will be able to –<br>➤ recall Laboratory discipline, instrumentation and techniques involved in industrial microbiology<br>➤ develop skill to culture and identify industrially important microbes<br>➤ relate about design of Fermenter<br>➤ experiment with the whole steps of Fermentation |                                                                                                            |
| 6                                                                                                                                                                                                                                                                                                                                                                                                                                 | Credit Value                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1 Credit                                                                                                                                                                                                                                                                                                                              | Credit = 30 Hours. Laboratory or Field learning/ Training                                                  |
| 7                                                                                                                                                                                                                                                                                                                                                                                                                                 | Total Marks                                                                                                                                                                                                                                                                                                                                                                                                                                         | Max. Marks: 50                                                                                                                                                                                                                                                                                                                        | Min. Passing marks: 20                                                                                     |
| PART – B: Content of the Course                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                       |                                                                                                            |
| Total No. of learning-Training/ Performance Periods: 30 Periods (30 Hours)                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                       |                                                                                                            |
| Module                                                                                                                                                                                                                                                                                                                                                                                                                            | Topics (Course contents)                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                       | No. of Period                                                                                              |
| Lab./ Field Training/ Experiment contents of Course                                                                                                                                                                                                                                                                                                                                                                               | 1. Study of Bioreactor used in large scale production.<br>2. Isolation and characterization of Industrial microorganisms.<br>3. Isolation of antibiotic producing microorganisms from soil.<br>4. Demonstration of production of Amylase/ Protease/ Cellulase by microorganisms.<br>5. Demonstration of Production of lipase by microorganisms.<br>6. Production of ethanol by Yeast.<br>7. Production of Citric acid by <i>Aspergillus niger</i> . |                                                                                                                                                                                                                                                                                                                                       | 30                                                                                                         |
| Key Words                                                                                                                                                                                                                                                                                                                                                                                                                         | Fermenter, Bioreactor, Industrial Microorganisms, Production, Preservation techniques                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                       |                                                                                                            |
| PART – C: Learning Resources                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                       |                                                                                                            |
| Text Books, Reference Books and Others                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                       |                                                                                                            |
| Text Books Recommended:<br>1. Practical Microbiology: Dubey, R.C. and Maheshwari. D.K. 2012., S. Chand & Company, Pvt. Ltd.<br>2. Experiments in Microbiology, Pathology and Tissue Culture: Aneja, K.R. 1993., Vishwa Prakashan.                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                       |                                                                                                            |
| Online Resources:<br>• <a href="http://www.onlinelabs.in">http://www.onlinelabs.in</a><br>• <a href="http://www.vlab.co.in">http://www.vlab.co.in</a><br>• <a href="http://asm.org/articles/2020/december/virtual-resources-to-teach-microiology-techniques">http://asm.org/articles/2020/december/virtual-resources-to-teach-microiology-techniques</a><br>• <a href="http://www.vlab.amrita.edu">http://www.vlab.amrita.edu</a> |                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                       |                                                                                                            |
| PART – D: Assessment and Evaluation                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                       |                                                                                                            |
| Suggested Continuous Evaluation Methods:                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                       |                                                                                                            |
| Maximum Marks:                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 50 Marks                                                                                                                                                                                                                                                                                                                              |                                                                                                            |
| Continuous Internal Assessment (CIA):                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 15 Marks                                                                                                                                                                                                                                                                                                                              |                                                                                                            |
| End Semester Exam (ESE):                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 35 Marks                                                                                                                                                                                                                                                                                                                              |                                                                                                            |
| Continuous Internal Assessment (CIA):<br>(By Course Teacher)                                                                                                                                                                                                                                                                                                                                                                      | Internal Test/ Quiz – (2):<br>Assignment/ Seminar + Attendance:<br>Total Marks:                                                                                                                                                                                                                                                                                                                                                                     | 10 & 10<br>05<br>15                                                                                                                                                                                                                                                                                                                   | Better Marks out of the two Test/ Quiz + obtained marks in Assignment shall be considered against 15 Marks |
| End Semester Exam (ESE):                                                                                                                                                                                                                                                                                                                                                                                                          | Laboratory/ Field Skill Performance: On spot Assessment<br>A. Performed the Task based on lab. work – 20 Marks<br>B. Spotting based on tools & technology (written) - 10 Marks<br>C. Viva-voce (based on principle/ technology) – 05 Marks                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                       | Managed by course teacher as per lab. status                                                               |

Name and Signatures



**Session 2025-26**  
**B.Sc. – Microbiology**  
**Skill Based Enhancement Course**  
**BMBSE 01 Microbiological Analysis of Air, Water & Soil to Pollution**  
**Control**

**Credits:02 (1Th +1Lab)**

**Total:15 Lectures + 30 Lab**

**Upon successful completion of the course students will be able to–**

**CO1** Established a very good understanding of air, water and soil inhabiting microorganisms

**CO2** Recognized the methods of analysis of air, water and soil and contribute to control of environmental pollution

**Aero-microbiology:** Bio aerosols, Air borne microorganisms, allergens (bacteria, Viruses, fungi) and their impact on human health and environment, significance in food and pharma industries and operation theatres.

**Water-microbiology:** Water borne pathogens; water borne diseases.

**Soil-microbiology:** Soil borne pathogens ;soil borne diseases.

**Sampling of Bioaerosol:** air samplers ,methods of analysis, CFU, culture media for bacteria and fungi, Identification characteristics.

**Sampling of Water:** methods to detect potability of water samples:(a) standard qualitative procedure; presumptive/MPN tests, confirmed and completed tests for faecal coli forms(b)Membrane filter technique and(c)Presence/absence tests

**Sampling of soil :** sample collection and analysis. Isolation and identification of pathogens. Soil testing methods.

**Control Measures:** Fate of bioaerosols, inactivation mechanisms – UV light, HEPA filters, desiccation, Incineration. Precipitation, chemical disinfection, filtration, high temperature, UV light. Soil treatment.

**Name and Signatures:**

**Chairperson/ HOD**

**Subject Expert**

**Subject Expert**

**VC Nominee**

**Industrial Representative**

**Member of Other Department**

**Student Nominee**

**Departmental members:**

## Reference Books-

1. Medigan, M. T., Martinko, J. M. and Parker, J. Brock Biology of Microorganisms. Pearson Education Inc. New York
2. Alexander, M. John. Microbial ecology. Wiley & Sons, Inc., New York.
3. Alexander, M. John. Introduction to soil microbiology. Wiley & Sons Inc., New York.
4. Barker, K. H., and Herson, D. S. Bioremediation. McCraw Hill Inc., New York.
5. Chapelle, F. H. Ground Water Microbiology and Geochemistry. New York: John Wiley & Sons, 2000.
6. Droste, R. L. Theory and Practice of Water and Wastewater Treatment. New York: John Wiley & Sons, 1996.
7. K. R. Aneja,  
Laboratory Manual of Microbiology and Biotechnology New Age Publications. 2014

## Name and Signatures:

Chairperson/ HOD

Subject Expert

Subject Expert

VC Nominee

Industrial Representative

Member of Other Department

Student Nominee

Departmental members:

**GOVT. V.Y.T.PG AUTONOMOUS COLLEGE DURG**  
**FOUR YEAR UNDERGRADUATE PROGRAM**  
**DEPARTMENT OF MICROBIOLOGY**  
**COURSE CURRICULUM 2025-26**

| <b>PART – A: Introduction</b>                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                               |
|-------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|
| <b>Program: B.Sc.</b>                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>Semester -IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                               |
|                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>Session: 2025-26</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                               |
| 1                                                                                         | Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | BMBSC-02                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                               |
| 2                                                                                         | Course Title                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Microbial Products – Biofertilizers and Biopesticides                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                               |
| 3                                                                                         | Course Type                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Skill Enhancement Course (SEC)                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                               |
| 4                                                                                         | Prerequisite (If Any)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | As per Program                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                               |
| 5                                                                                         | Course Learning Outcomes (CLO)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>At the end of this course, the students will be able to –</b> <ul style="list-style-type: none"> <li>➤ acquire very good understanding of microorganisms used as biofertilizers/ Biopesticides</li> <li>➤ familiar with the types of biofertilization</li> <li>➤ discuss the advantages of biofertilizers/ biopesticides</li> <li>➤ acquainted with the methods of the production of Biofertilizers/ bio pesticides/bioinsecticides</li> <li>➤ compare the field application results</li> </ul> |                                                                                               |
| 6                                                                                         | Credit Value                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 02 Credits<br>(1C +1C)                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Credit = 15 Hrs. Theoretical Learning and<br>= 30 Hrs. Laboratory or field learning/ Training |
| 7                                                                                         | Total Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Max. Marks: 50                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Minimum Passing marks: 20                                                                     |
| <b>PART – B: Content of the Course</b>                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                               |
| Total No. of Teaching-Learning Periods:                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                               |
| Theory – 15 Periods (15 Hrs.) and Lab. or Field Learning / Training 30 Periods (30 Hours) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                               |
| Module                                                                                    | Topics (Course Contents)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | No. of Period                                                                                 |
| Theory Contents                                                                           | <b>Bio fertilizers:</b> General account of the microbes used as bio fertilizers for various crop plants and their advantages over chemical fertilizers.<br><b>Symbiotic N<sub>2</sub> fixers:</b> <i>Rhizobium</i> -Characteristics, and field application, <i>Frankia</i> -Characteristics, <i>Cyanobacteria</i> - Characteristics, mass multiplication and field application.<br><b>Non - Symbiotic Nitrogen Fixers:</b> <i>Azospirillum</i> and <i>Azotobacter</i> -characteristics, mass production and field application.<br><b>Phosphate Solubilizers:</b> Characteristics, mass Inoculum production, field application. PGPR – Characteristics, mass production and application.<br><b>Mycorrhizal Bio-fertilizers:</b> Types of mycorrhizae, Mass inoculums production of VAM, field applications.<br><b>Biopesticides:</b> General account of microbes used as biopesticides and their advantages over synthetic pesticides, mass production and Field applications. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 15                                                                                            |
| Lab./Field Training Contents                                                              | 1. To know about important scientists in the field of biofertilizer and biopesticides<br>2. To isolate different microorganisms used as biofertilizer and study the characteristics<br>3. To study of terminology used in the field of biopesticides (entomopathogens, infectivity, pathogenicity, virulence, symptoms and syndrome, course of infection, incubation period)<br>4. To isolate entomopathogenic fungi/ bacteria and study pesticidal effects<br>5. To practice mass production of biofertilizers and biopesticides and check the biological efficiency of the products.<br>6. To identify important companies and units for production of biofertilizers and biopesticides.                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 30                                                                                            |

## Part – C: Learning Resources

### Text Books, Reference Books and Others

#### Text Books Recommended:

1. Mehrotra R S and Ashok Agrawal. Plant Pathology. Tata McGraw Hill, 6<sup>th</sup> reprint (2006).
2. K.S. Bilgrami, H.C.Dube A text book of modern pathology. 6<sup>th</sup> Edition, Vani Educational Books, a division of Vikas, (1984).
3. Shalini Suri. Biofertilizer and Biopesticide APH Publishing Corporation (2011)

#### Reference Books:

1. Eldor A. Paul. Soil Microbiology.
2. Eugene L. Madsen. Environmental Microbiology: From Genomes to Biogeochemistry. I Edition, Wiley-Blackwell Publishing. (2008).
3. Agrios, G.N. Plant pathology. Harcourt Asia Pvt. Ltd. (2000).

#### Online Resources – e-Resources/ e-Books and e-learning portals

- <https://www.manage.gov.in/nf/pptspdfs/Biofertilizers%20and%20Biopesticides-Balaraju.pdf>
- <https://www.slideshare.net/slideshow/final-practical-manual-elec-230convertedpdf/251597918>
- <https://www.tnu.in/wp-content/uploads/2021/09/biofertilizer-and-biocontrol.pdf>
- <https://rafflesuniversity.edu.in/pdf/2023/TLP/SOAS/TLP-AET-T-302-5-sem-Biopesticide%20and%20Biofertilizers.pdf>
- <https://eternaluniversity.edu.in/docs/ProductionTechnologyforBioagentsandBiofertilizers.pdf>

## PART: D ASSESSMENT AND EVALUATION

### Suggested Continuous Evaluation Methods:

Maximum Marks: 50 Marks

Continuous Internal Assessment (CIA): 15 Marks

End Semester Exam (ESE): 35 Marks

|                                                              |                                                                                                                                                                                                                                            |                                                                                                            |
|--------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|
| Continuous Internal Assessment (CIA):<br>(By Course Teacher) | Internal Test/ Quiz – (2): 10&10<br>Assignment/ Seminar + Attendance: 05<br>Total Marks: 15                                                                                                                                                | Better Marks out of the two Test/ Quiz + obtained marks in Assignment shall be considered against 15 Marks |
| End Semester Exam (ESE):                                     | Laboratory/ Field Skill Performance: On spot Assessment<br>A. Performed the Task based on lab. work – 20 Marks<br>B. Spotting based on tools & technology (written) - 10 Marks<br>C. Viva-voce (based on principle/ technology) – 05 Marks | Managed by Coordinator as per skilling                                                                     |