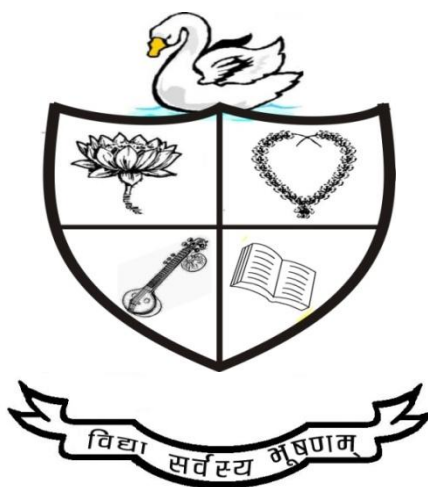


# **SYLLABUS FOR THE FOUR-YEAR UNDERGRADUATE PROGRAMME (FYUGP)**

As per provisions of NEP\_2020 to be implemented from  
academic year 2022 onwards.

|                         |                          |
|-------------------------|--------------------------|
| Semester: <b>V</b>      | Session: <b>2026-27</b>  |
| Course Type: <b>DSC</b> | Title: <b>Enzymology</b> |



**Department of Biotechnology**  
**GOVT. DIGVIJAY AUTONOMOUS POST GRADUATE  
COLLEGE, RAJNANDGAON (C.G.)**



**GOVT. DIGVIJAY AUTONOMOUS P.G. COLLEGE, RAJNANDGAON (C.G.)**  
**FYUGP (NEP 2020 Course)**

| <b>Part A: Introduction</b>                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                             |                           |
|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|
| Program: Bachelor in Life Sciences<br>(Degree/Honors)                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Semester: <b>V Sem</b>                                                                                                                                                                                                                                                                                                      | Session: <b>2026-2027</b> |
| 1                                                                                 | Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>BTSC-05-T</b>                                                                                                                                                                                                                                                                                                            |                           |
| 2                                                                                 | Course Title                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>Enzymology</b>                                                                                                                                                                                                                                                                                                           |                           |
| 3                                                                                 | Course Type                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Core Course                                                                                                                                                                                                                                                                                                                 |                           |
| 4                                                                                 | Pre-requisite<br>(if any)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | As per program                                                                                                                                                                                                                                                                                                              |                           |
| 5                                                                                 | Course Learning Outcomes (CLO)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | After completing this course, the students will be able to - <ul style="list-style-type: none"> <li>• Develop competency in enzymatic mechanism.</li> <li>• To explore the mechanistic process of enzymes.</li> <li>• Develop industrial application of enzymes.</li> <li>• Develop skills for entrepreneurship.</li> </ul> |                           |
| 6                                                                                 | Credit Value                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 03 Credits (Credit = 15 Hours - learning & observation)                                                                                                                                                                                                                                                                     |                           |
| 7                                                                                 | Total Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Max. Marks: 100                                                                                                                                                                                                                                                                                                             | Min Passing Marks: 40     |
| <b>Part B: Content of Course (Theory)</b>                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                             |                           |
| Total No. of Teaching-learning Periods (01 Hr. per period)- 45 Periods (45 Hours) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                             |                           |
| Unit                                                                              | Topic (Course content)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | No. of Period                                                                                                                                                                                                                                                                                                               |                           |
| I                                                                                 | <b>Basics of enzymes and their action</b> <ol style="list-style-type: none"> <li>1. Isolation, crystallization, and purification of enzymes, a test of homogeneity of enzyme preparation, methods of enzyme analysis.</li> <li>2. Enzyme classification (rationale, overview, and specific examples) zymogens and their activation (proteases and prothrombin).</li> <li>3. Enzyme substrate complex: the concept of E-S complex, binding sites, active site, specificity, kinetics of enzyme activity, Michaelis-Menten equation and its derivation.</li> <li>4. Different plots for the determination of <math>K_m</math> and <math>V_{max}</math> and their physiological significance, factors affecting initial rate, E, S, temperature &amp; pH. Collision and transition state theories, significance of activation energy and free energy.</li> </ol> | 12 (12 Hrs)                                                                                                                                                                                                                                                                                                                 |                           |
| II                                                                                | <b>Enzyme action mechanism</b> <ol style="list-style-type: none"> <li>1. Two substrate reactions (Random, ordered, and ping-pong mechanism)</li> <li>2. Enzyme inhibition types of inhibition, determination of <math>K_i</math>, suicide inhibitor.</li> <li>3. Mechanism of enzyme action: General mechanistic principle, factors associated with catalytic efficiency: proximity, orientation, distortion of strain, acid-base, nucleophilic and covalent catalysis.</li> <li>4. Techniques for studying mechanisms of action, chemical modification of active site groups, specific examples-: chymotrypsin, lysozyme,</li> </ol>                                                                                                                                                                                                                         | 11 (11 Hrs)                                                                                                                                                                                                                                                                                                                 |                           |

|          |                                                                                                                                                                                                                                                                                                                                                                                                                                                  |             |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
|          | GPDH, aldolase, RNase, Carboxypeptidase, and alcohol dehydrogenase.                                                                                                                                                                                                                                                                                                                                                                              |             |
| III      | <b>Regulation of enzymes</b> <ol style="list-style-type: none"> <li>1. Enzyme regulation: Product inhibition, feedback control, covalent modification</li> <li>2. Allosteric enzymes with special reference to aspartate transcarbamoylase and phosphofructokinase.</li> <li>3. Qualitative description of concerted and sequential models. Negative cooperativity and half-site reactivity.</li> <li>4. Enzyme - Enzyme interaction.</li> </ol> | 11 (11 Hrs) |
| IV       | <b>Enzyme variations</b> <ol style="list-style-type: none"> <li>1. Protein-ligand binding, measurements analysis of binding isotherm, cooperativity, Hill and Scatchard plots, and the kinetics of allosteric enzymes.</li> <li>2. Isoenzymes– multiple forms of enzymes with special reference to lactate dehydrogenase.</li> <li>3. Multienzyme complexes. Multifunctional enzyme-eg Fatty Acid synthase.</li> <li>4. Ribozymes</li> </ol>     | 11 (11 Hrs) |
| Keywords | Enzyme action, Enzyme Kinetics, Enzyme Regulation, Isoenzymes.                                                                                                                                                                                                                                                                                                                                                                                   |             |

**Department: Biotechnology**

|                                                                                                                                                                                                                                                                                                                                            |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>• Part C - Learning Resource</b>                                                                                                                                                                                                                                                                                                        |
| <b>Text Books, Reference Books, Other Resources -</b>                                                                                                                                                                                                                                                                                      |
| Text book- Biochemistry- U Stayanarayana<br>Modern enzymology- Dr. Vinod Ramkrishna Ragade and Dr. B.B. Sharma                                                                                                                                                                                                                             |
| <ul style="list-style-type: none"> <li>• Lehninger Principles of Biochemistry; Nelson &amp; Cox.</li> <li>• Biochemistry; Voet &amp; Pratt.</li> <li>• Principles of Enzymology; Price &amp; Stevens.</li> <li>• Enzyme Biocatalysis, Principle &amp; Applications; Andres Illanes.</li> <li>• Enzyme Kinetics; Hans Bisswanger</li> </ul> |
| Online resources- <a href="https://onlinecourses.nptel.ac.in/noc23_bt05/preview">https://onlinecourses.nptel.ac.in/noc23_bt05/preview</a><br><a href="https://onlinecourses.swayam2.ac.in/cec20_bt20/preview">onlinecourses.swayam2.ac.in/cec20_bt20/preview</a>                                                                           |

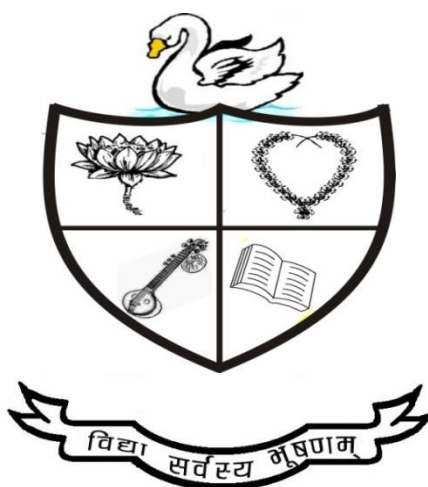
| Part D: Assessment and Evaluation                       |                                                                                                                                                                                                                                          |                                                                                                                    |
|---------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|
| <b>Suggested Continuous Evaluation Methods:</b>         |                                                                                                                                                                                                                                          |                                                                                                                    |
| <b>Maximum Marks: 100 Marks</b>                         |                                                                                                                                                                                                                                          |                                                                                                                    |
| <b>Continuous Internal Assessment (CIA): 30 Marks</b>   |                                                                                                                                                                                                                                          |                                                                                                                    |
| <b>End Semester Exam (ESE): 70 Marks</b>                |                                                                                                                                                                                                                                          |                                                                                                                    |
| <b>Continuous Assessment (CIA) (By course teacher):</b> | <b>Internal</b><br>Internal Test / Quiz-(2): <b>20 +20</b><br>Assignment / Seminar - <b>10</b><br>Total Marks - <b>30</b>                                                                                                                | Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against <b>30 Marks</b> |
| <b>End Semester Exam (ESE):</b>                         | <b>Two section – A &amp; B</b><br>Section A: <b>Q1.</b> Objective – <b>10 x1= 10 Mark; Q2.</b> Short answer type- <b>5x4 =20 Marks</b><br>Section B: Descriptive answer type qts., <b>1out of 2</b> from each unit- <b>4x10=40 Marks</b> |                                                                                                                    |

| Approval of the Board of Studies |                                                                                                                                |                |                  |                               |                    |                                                                                       |
|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------|----------------|------------------|-------------------------------|--------------------|---------------------------------------------------------------------------------------|
| <b>Date: 20-06-2026</b>          |                                                                                                                                |                |                  |                               |                    |                                                                                       |
| Name                             | Prof. S. K. Jadhav                                                                                                             | Sabiha Naz     | Dr. Shubha Diwan | Shri Sanjay Bhagwat           | Ku. Varsha Meshram | Dr. Pramod Kumar Mahish                                                               |
| Designation                      | VC Nominee                                                                                                                     | Subject Expert | Subject Expert   | Employment/ Industrial Member | Merit Alumni       | Chairman/ HOD                                                                         |
| Signature                        | Joined by Google Meet on 20-06-2026<br><a href="https://meet.google.com/nzg-cntq-zbc">https://meet.google.com/nzg-cntq-zbc</a> |                |                  |                               |                    |  |

# **SYLLABUS FOR THE FOUR-YEAR UNDERGRADUATE PROGRAMME (FYUGP)**

As per provisions of NEP\_2020 to be implemented from  
academic year 2022 onwards.

|                                   |                          |
|-----------------------------------|--------------------------|
| Semester: <b>V</b>                | Session: <b>2026-27</b>  |
| Course Type: <b>DSC Practical</b> | Title: <b>Enzymology</b> |



**Department of Biotechnology**  
**GOVT. DIGVIJAY AUTONOMOUS POST GRADUATE  
COLLEGE, RAJNANDGAON (C.G.)**

**FYUGP (NEP 2020 Course)****Department: Biotechnology****Four Year Undergraduate Program (2024-28)****Department of Biotechnology****Course Curriculum**

| <b>Part A: Introduction</b>                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                           |                       |
|---------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| Program: Bachelor in Life Sciences (Degree/Honors)                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Semester: V Sem                                                                                                                                                                                                                                                                                                           | Session:2026-2027     |
| 1                                                                         | Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>BTSC-05-P</b>                                                                                                                                                                                                                                                                                                          |                       |
| 2                                                                         | Course Title                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>Enzymology</b>                                                                                                                                                                                                                                                                                                         |                       |
| 3                                                                         | Course Type                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Core Course                                                                                                                                                                                                                                                                                                               |                       |
| 4                                                                         | Pre-requisite (if any)                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | As per program.                                                                                                                                                                                                                                                                                                           |                       |
| 5                                                                         | Course Learning Outcomes (CLO)                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | After completing this practical course, the students will be able to - <ul style="list-style-type: none"> <li>Analyses factors affecting enzymatic activity.</li> <li>Determine enzymatic activity.</li> <li>Purify and estimate kinetics of enzymes.</li> <li>Immobilize enzymes for industrial applications.</li> </ul> |                       |
| 6                                                                         | Credit Value                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 01 Credits Credit =30 Hours Laboratory or Field learning/Training                                                                                                                                                                                                                                                         |                       |
| 7                                                                         | Total Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Max. Marks: 50                                                                                                                                                                                                                                                                                                            | Min Passing Marks: 20 |
| <b>Part B: Content of Course</b>                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                           |                       |
| Total No. of learning-Training/performance Periods: 30 Periods (30 Hours) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                           |                       |
| Module                                                                    | Topic (Course content)                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | No. of Period                                                                                                                                                                                                                                                                                                             |                       |
| Lab./Field Training/<br>Experiment<br>Contents<br>of Course               | <ol style="list-style-type: none"> <li>Effect of pH and temperature on the action of salivary amylase.</li> <li>Determination of the activity of amylase enzyme (crude) extracted from sweet potato.</li> <li>Determination of the specific activity of the enzyme.</li> <li>Determine Vmax and Km in of enzyme.</li> <li>Protein electrophoresis – native and denaturing conditions.</li> <li>Enzyme purification and kinetic analysis.</li> <li>Method for immobilization of enzyme.</li> </ol> | 30                                                                                                                                                                                                                                                                                                                        |                       |
| Keywords                                                                  | Enzyme action, Enzyme Kinetics, Enzyme Regulation, Isoenzymes.                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                           |                       |

- Part C - Learning Resource**

**Text Books, Reference Books, Other Resources -**

Text book- Biochemistry- U Stayanarayana

Modern enzymology- Dr. Vinod Ramkrishna Ragade and Dr. B.B. Sharma

- Lehninger Principles of Biochemistry; Nelson & Cox.
- Biochemistry; Voet & Pratt.
- Principles of Enzymology; Price & Stevens.
- Enzyme Biocatalysis, Principle & Applications; Andres Illanes.
- Enzyme Kinetics; Hans Bisswanger

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[onlinecourses.swayam2.ac.in/cec20\\_bt20/preview](https://onlinecourses.swayam2.ac.in/cec20_bt20/preview)

#### 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

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

#### Approval of the Board of Studies

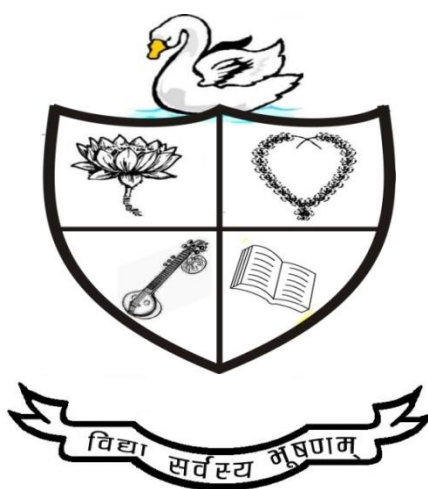
Date: 20-06-2026

|             |                                                                                                                                |                |                  |                               |                    |                                                                                       |
|-------------|--------------------------------------------------------------------------------------------------------------------------------|----------------|------------------|-------------------------------|--------------------|---------------------------------------------------------------------------------------|
| Name        | Prof. S. K. Jadhav                                                                                                             | Sabiha Naz     | Dr. Shubha Diwan | Shri Sanjay Bhagwat           | Ku. Varsha Meshram | Dr. Pramod Kumar Mahish                                                               |
| Designation | VC Nominee                                                                                                                     | Subject Expert | Subject Expert   | Employment/ Industrial Member | Merit Alumni       | Chairman/ HOD                                                                         |
| Signature   | Joined by Google Meet on 20-06-2026<br><a href="https://meet.google.com/nzg-cntq-zbc">https://meet.google.com/nzg-cntq-zbc</a> |                |                  |                               |                    |  |

# **SYLLABUS FOR THE FOUR-YEAR UNDERGRADUATE PROGRAMME (FYUGP)**

As per provisions of NEP\_2020 to be implemented from  
academic year 2022 onwards.

|                         |                                        |
|-------------------------|----------------------------------------|
| Semester: <b>V</b>      | Session: <b>2026-27</b>                |
| Course Type: <b>DSE</b> | Title: <b>Industrial Biotechnology</b> |



**Department of Biotechnology**  
**GOVT. DIGVIJAY AUTONOMOUS POST GRADUATE  
COLLEGE, RAJNANDGAON (C.G.)**



GOVT. DIGVIJAY AUTONOMOUS P.G. COLLEGE, RAJNANDGAON (C.G.)

## FYUGP (NEP 2020 Course)

Department: Biotechnology

### Course Curriculum

| Part A: Introduction                                                              |                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                          |                       |
|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| Program: Bachelor in Life Sciences (Degree/Honors)                                |                                                                                                                                                                                                                                                                                                                                                                                                    | Semester: V Sem                                                                                                                                                                                                                                                                                                                                                                                          | Session: 2026-2027    |
| 1                                                                                 | Course Code                                                                                                                                                                                                                                                                                                                                                                                        | <b>BTSE-03</b>                                                                                                                                                                                                                                                                                                                                                                                           |                       |
| 2                                                                                 | Course Title                                                                                                                                                                                                                                                                                                                                                                                       | <b>Industrial Biotechnology</b>                                                                                                                                                                                                                                                                                                                                                                          |                       |
| 3                                                                                 | Course Type                                                                                                                                                                                                                                                                                                                                                                                        | Elective course                                                                                                                                                                                                                                                                                                                                                                                          |                       |
| 4                                                                                 | Pre-requisite (if any)                                                                                                                                                                                                                                                                                                                                                                             | As per program                                                                                                                                                                                                                                                                                                                                                                                           |                       |
| 5                                                                                 | Course Learning Outcomes (CLO)                                                                                                                                                                                                                                                                                                                                                                     | After completing this course, the students will be able to – <ul style="list-style-type: none"> <li>• Understand about mutants for significant industrial production.</li> <li>• Develop skills in physical and chemical methods for industrial products.</li> <li>• Develop skills in the fermentation process for industrial products.</li> <li>• Understand economics and quality control.</li> </ul> |                       |
| 6                                                                                 | Credit Value                                                                                                                                                                                                                                                                                                                                                                                       | 03 Credits (Credit = 15 Hours - learning & observation)                                                                                                                                                                                                                                                                                                                                                  |                       |
| 7                                                                                 | Total Marks                                                                                                                                                                                                                                                                                                                                                                                        | Max. Marks: 100                                                                                                                                                                                                                                                                                                                                                                                          | Min Passing Marks: 40 |
| Part B: Content of Course (Theory)                                                |                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                          |                       |
| Total No. of Teaching-learning Periods (01 Hr. per period)- 45 Periods (45 Hours) |                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                          |                       |
| Unit                                                                              | Topic (Course content)                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                          | No. of Period         |
| I                                                                                 | <b>Industrial mutants</b> <ol style="list-style-type: none"> <li>1. Selection of mutants producing improved levels of primary metabolites with suitable examples.</li> <li>2. Isolation of mutants that do not produce feedback inhibitors or repressors.</li> <li>3. Mutants that do not recognize the presence of inhibitors or repressors.</li> <li>4. Modification of permeability.</li> </ol> |                                                                                                                                                                                                                                                                                                                                                                                                          | 12 (12 Hrs)           |
| II                                                                                | <b>Industrial methodologies</b> <ol style="list-style-type: none"> <li>1. Removal and recovery of cell mass (precipitation, filtration, and centrifugation)</li> <li>2. Cell disruption - Physical and chemical methods.</li> <li>3. Purification of product liquid-liquid extraction: solvent recovery.</li> <li>4. Chromatography: Adsorption, ion-exchange, HPLC</li> </ol>                     |                                                                                                                                                                                                                                                                                                                                                                                                          | 11 (11 hrs)           |
| III                                                                               | <b>Industrial bioneesds</b> <ol style="list-style-type: none"> <li>1. Fermentation processes: Microorganisms involved, inoculum preparation, the medium used and product recovery.</li> <li>2. Enzyme: Protease, pectinase.</li> <li>3. Organic acid and vitamins: Citric acid, vitamin B12 and vitamin B2.</li> <li>4. Antibiotics: Penicillin, erythromycin.</li> </ol>                          |                                                                                                                                                                                                                                                                                                                                                                                                          | 11 (11 hrs)           |
| IV                                                                                | <b>Testing and quality control</b>                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                          | 11 (11)               |

|          |                                                                                                                                                                                                                                                                                                |      |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
|          | 1. Testing- Sterility, pyrogen, carcinogenicity, and toxicity.<br>2. Fermentation economics- Cost estimates, process design, capital cost estimates, operating cost.<br>3. Concept of quality control and quality assurance.<br>4. Good laboratory practices and good manufacturing practices. | hrs) |
| Keywords | Mutants, removal and recovery, fermentation process, fermentation economics.                                                                                                                                                                                                                   |      |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| • Part C - Learning Resource                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |  |
| Text Books, Reference Books, Other Resources -                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |
| ➤ Text book- Industrial Biotechnology- D Das<br>➤ Industrial Microbiology- A.H. Patel.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |  |
| <ul style="list-style-type: none"> <li>• Peppler H.J and Perlman D - Microbial Technology, Vol I and II-Elsevier</li> <li>• Stanbury P.F., Whitaker A. and Hall S.J - Principles of Fermentation Technology- Elsevier</li> <li>• Prescott and Dunn's- Industrial Microbiology-CBS 7. Ed.</li> <li>• G. Subramaniam- Bioseparation&amp; Bioprocessing</li> <li>• Casida L.E - Industrial Microbiology- New Age</li> <li>• Crueger W and Crueger A - Biotechnology: A Textbook of Industrial Microbiology-Panima Publishing</li> <li>• Patel A.H. - Industrial Microbiology, Macmillan</li> </ul> |  |
| Online resources- <a href="https://archive.nptel.ac.in/courses/102/105/102105058/">https://archive.nptel.ac.in/courses/102/105/102105058/</a><br><a href="http://www.ndl.gov.in/he_document/nptel/downloads_new_lecturenotes_102105058_102105058">http://www.ndl.gov.in/he_document/nptel/downloads_new_lecturenotes_102105058_102105058</a>                                                                                                                                                                                                                                                    |  |

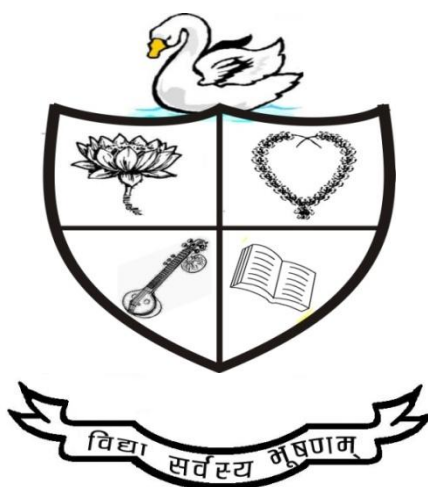
| Part D: Assessment and Evaluation                            |                                                                                                                                                                                           |                                                                                                             |
|--------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|
| 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<br>Assignment / Seminar - 10<br>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<br>Section A: Q1. Objective – 10 x1= 10 Mark; Q2. Short answer type- 5x4 =20 Marks<br>Section B: Descriptive answer type qts., 1out of 2 from each unit-4x10=40 Marks |                                                                                                             |

| Approval of the Board of Studies |                                                                                                                                |                |                  |                               |                    |                                                                                       |
|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------|----------------|------------------|-------------------------------|--------------------|---------------------------------------------------------------------------------------|
| Date: 20-06-2026                 |                                                                                                                                |                |                  |                               |                    |                                                                                       |
| Name                             | Prof. S. K. Jadhav                                                                                                             | Sabiha Naz     | Dr. Shubha Diwan | Shri Sanjay Bhagwat           | Ku. Varsha Meshram | Dr. Pramod Kumar Mahish                                                               |
| Designation                      | VC Nominee                                                                                                                     | Subject Expert | Subject Expert   | Employment/ Industrial Member | Merit Alumni       | Chairman/ HOD                                                                         |
| Signature                        | Joined by Google Meet on 20-06-2026<br><a href="https://meet.google.com/nzg-cntq-zbc">https://meet.google.com/nzg-cntq-zbc</a> |                |                  |                               |                    |  |

# **SYLLABUS FOR THE FOUR-YEAR UNDERGRADUATE PROGRAMME (FYUGP)**

As per provisions of NEP\_2020 to be implemented from  
academic year 2022 onwards.

|                                   |                                        |
|-----------------------------------|----------------------------------------|
| Semester: <b>V</b>                | Session: <b>2026-27</b>                |
| Course Type: <b>DSE Practical</b> | Title: <b>Industrial Biotechnology</b> |



**Department of Biotechnology**  
**GOVT. DIGVIJAY AUTONOMOUS POST GRADUATE  
COLLEGE, RAJNANDGAON (C.G.)**

**FYUGP (NEP 2020 Course)**

**Department: Biotechnology**

**Four Year Undergraduate Program (2024-28)**

**Department of Biotechnology**

**Course Curriculum**

| <b>Part A: Introduction</b>                                               |                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                     |                       |
|---------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| Program: Bachelor in Life Sciences<br>(Certificate/Diploma/Degree/Honors) |                                                                                                                                                                                                                                                                                                                                                                                                                           | Semester: V Sem                                                                                                                                                                                                                                                                                                                                                                                     | Session:2026-2027     |
| 1                                                                         | Course Code                                                                                                                                                                                                                                                                                                                                                                                                               | <b>BTSE-03-P</b>                                                                                                                                                                                                                                                                                                                                                                                    |                       |
| 2                                                                         | Course Title                                                                                                                                                                                                                                                                                                                                                                                                              | <b>Industrial Biotechnology</b>                                                                                                                                                                                                                                                                                                                                                                     |                       |
| 3                                                                         | Course Type                                                                                                                                                                                                                                                                                                                                                                                                               | Elective course (Practical)                                                                                                                                                                                                                                                                                                                                                                         |                       |
| 4                                                                         | Pre-requisite<br>(if any)                                                                                                                                                                                                                                                                                                                                                                                                 | As per program.                                                                                                                                                                                                                                                                                                                                                                                     |                       |
| 5                                                                         | Course Learning<br>Outcomes (CLO)                                                                                                                                                                                                                                                                                                                                                                                         | After completing this course, the students will be able to – <ul style="list-style-type: none"> <li>Isolation and maintenance of industrially significant microbes.</li> <li>Understand and develop concept of fermentation technology.</li> <li>Develop skills for industrially significant acid production.</li> <li>Develop skills for industrially significant nutrients production.</li> </ul> |                       |
| 6                                                                         | Credit Value                                                                                                                                                                                                                                                                                                                                                                                                              | 01 Credits Credit =30 Hours Laboratory or Field learning/Training                                                                                                                                                                                                                                                                                                                                   |                       |
| 7                                                                         | Total Marks                                                                                                                                                                                                                                                                                                                                                                                                               | Max. Marks: 70                                                                                                                                                                                                                                                                                                                                                                                      | Min Passing Marks: 20 |
| <b>Part B: Content of Course (Theory)</b>                                 |                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                     |                       |
| Total No. of learning-Training/performance Periods: 30 Periods (30 Hours) |                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                     |                       |
| Module                                                                    | Topic (Course content)                                                                                                                                                                                                                                                                                                                                                                                                    | No. of Period                                                                                                                                                                                                                                                                                                                                                                                       |                       |
| Lab./Field Training/<br>Experiment<br>Contents of Course                  | 1. Isolation and screening of industrially important microbes.<br>2. Isolation and identification of bacteria from milk and water samples.<br>3. Fermentative production, purification, and estimation of citric acid.<br>4. Fermentative production, purification, and estimation of alcohol.<br>5. Wine production and estimation of alcohol.<br>6. Production of cheese using different substrates and microorganisms. | 30                                                                                                                                                                                                                                                                                                                                                                                                  |                       |
| Keywords                                                                  | Mutants, removal and recovery, fermentation process, fermentation economics.                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                     |                       |

| <b>• Part C - Learning Resource</b>                                                                                                                                                                                          |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Text Books, Reference Books, Other Resources -</b>                                                                                                                                                                        |
| ➤ <b>Text book-</b> Industrial Biotechnology- D Das<br>➤ Industrial Microbiology- A.H. Patel.                                                                                                                                |
| <ul style="list-style-type: none"> <li>Peppler H.J and Perlman D - Microbial Technology, Vol I and II-Elsevier</li> <li>Stanbury P.F., Whitaker A. and Hall S.J - Principles of Fermentation Technology- Elsevier</li> </ul> |

- Prescott and Dunn's- Industrial Microbiology-CBS 7. Ed.
- G. Subramaniam- Bioseparation& Bioprocessing
- Casida L.E - Industrial Microbiology- New Age
- Crueger W and Crueger A - Biotechnology: A Textbook of Industrial Microbiology-Panima Publishing
- Patel A.H. - Industrial Microbiology, Macmillan

Online resources- <https://archive.nptel.ac.in/courses/102/105/102105058/>  
[http://www.ndl.gov.in/he\\_document/nptel/downloads\\_new\\_lecturenotes\\_102105058\\_102105058](http://www.ndl.gov.in/he_document/nptel/downloads_new_lecturenotes_102105058_102105058)

#### Part D: Assessment and Evaluation

##### Suggested Continuous Evaluation Methods:

**Maximum Marks: 50 Marks**

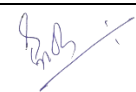
**Continuous Internal Assessment (CIA): 15 Marks**

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

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

#### Approval of the Board of Studies

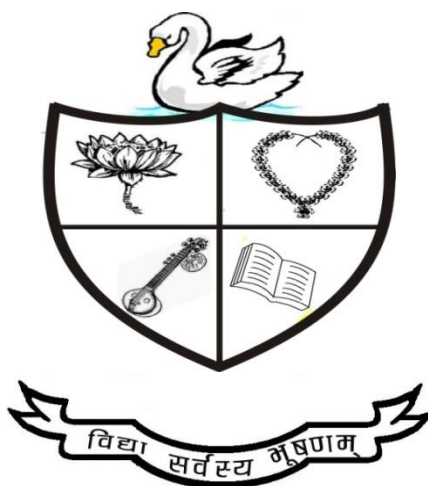
**Date: 20-06-2026**

|             |                                                                                                                                |                |                  |                                  |                    |                                                                                       |
|-------------|--------------------------------------------------------------------------------------------------------------------------------|----------------|------------------|----------------------------------|--------------------|---------------------------------------------------------------------------------------|
| Name        | Prof. S. K. Jadhav                                                                                                             | Sabiha Naz     | Dr. Shubha Diwan | Shri Sanjay Bhagwat              | Ku. Varsha Meshram | Dr. Pramod Kumar Mahish                                                               |
| Designation | VC Nominee                                                                                                                     | Subject Expert | Subject Expert   | Employment/<br>Industrial Member | Merit Alumni       | Chairman/ HOD                                                                         |
| Signature   | Joined by Google Meet on 20-06-2026<br><a href="https://meet.google.com/nzg-cntq-zbc">https://meet.google.com/nzg-cntq-zbc</a> |                |                  |                                  |                    |  |

# **SYLLABUS FOR THE FOUR-YEAR UNDERGRADUATE PROGRAMME (FYUGP)**

As per provisions of NEP\_2020 to be implemented from  
academic year 2022 onwards.

|                  |                                        |
|------------------|----------------------------------------|
| Semester: V      | Session: 2026-27                       |
| Course Type: SEC | Title: Biopesticides and Biofertilizer |



**Department of Biotechnology**  
**GOVT. DIGVIJAY AUTONOMOUS POST GRADUATE  
COLLEGE, RAJNANDGAON (C.G.)**



**GOVT. DIGVIJAY AUTONOMOUS P.G. COLLEGE, RAJNANDGAON (C.G.)**  
**FYUGP (NEP 2020 Course)**  
**Department: Biotechnology**

| <b>Part A: Introduction</b>                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                |                         |
|--------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| Program: Bachelor in Life Sciences<br>(Certificate/Diploma/Degree/Honors)                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Semester: <b>V Sem</b>                                                                                                                                                                                                                                                                                                                                                                                                                         | Session: <b>2026-27</b> |
| 1                                                                                                                              | Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>BTSEC-01</b>                                                                                                                                                                                                                                                                                                                                                                                                                                |                         |
| 2                                                                                                                              | Course Title                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>Biopesticides and Biofertilizer</b>                                                                                                                                                                                                                                                                                                                                                                                                         |                         |
| 3                                                                                                                              | Course Type                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Skill Enhancement Course                                                                                                                                                                                                                                                                                                                                                                                                                       |                         |
| 4                                                                                                                              | Pre-requisite<br>(if any)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | As per requirement.                                                                                                                                                                                                                                                                                                                                                                                                                            |                         |
| 5                                                                                                                              | Course Learning Outcomes (CLO)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | After completing this course, the students will be able to - <ul style="list-style-type: none"> <li>• Understand the basic concept of biofertilizers and biopesticides.</li> <li>• Understand the significance and applications of biofertilizers and biopesticides.</li> <li>• Develop skills for the production and application of biofertilizers.</li> <li>• Develop skills for the production and application of biopesticides.</li> </ul> |                         |
| 6                                                                                                                              | Credit Value                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 02 credits (1C + 1C)      Credit=15 hours- Theoretical learning<br>and = 30 hours laboratory or field learning/ training.                                                                                                                                                                                                                                                                                                                      |                         |
| 7                                                                                                                              | Total Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Max. Marks: 50                                                                                                                                                                                                                                                                                                                                                                                                                                 | Min Passing Marks: 20   |
| <b>Part B: Content of Course (Theory)</b>                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                |                         |
| Total No. of Teaching-learning Periods<br>Theory- 15 Periods (15 Hrs) and Lab or Field learning/Training 30 periods (30 Hours) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                |                         |
| Module                                                                                                                         | Topic (Course content)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                | No. of Period           |
| Theory Contents                                                                                                                | <b>Concept of biofertilizers and biopesticides</b> <ol style="list-style-type: none"> <li>1. Biofertilizers: classification and applications.</li> <li>2. Symbiotic and asymbiotic process for nitrogen fixation.</li> <li>3. Methods for production of biofertilizers.</li> <li>4. Study of VA-mycorrhiza and its application.</li> <li>5. Biopesticides: classification and applications.</li> <li>6. Process of production of biopesticides.</li> <li>7. Importance of <i>Trichoderma</i>, <i>Pseudomonas</i>, and <i>Bacillus</i> species as biocontrol agents.</li> <li>8. Factors responsible for the effectiveness of bioagents against seed-borne and soil-borne pathogens.</li> </ol> |                                                                                                                                                                                                                                                                                                                                                                                                                                                | 15                      |
| Lab/Field Training Contents                                                                                                    | <ol style="list-style-type: none"> <li>1. Media preparation to culture microorganisms.</li> <li>2. Collection and isolation of agriculturally important microorganisms.</li> <li>3. Identification and characterization of microorganisms.</li> <li>4. Screening of superior strains using in vitro techniques.</li> <li>5. Inoculum development.</li> <li>6. Preparation of carrier.</li> <li>7. Mixing of inoculum and carrier.</li> <li>8. Efficiency check of developed inoculant by using pot experiments.</li> </ol>                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                | 30                      |
| Keywords                                                                                                                       | Biofertilisers, biopesticides, bioagents.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                |                         |

|                                                                                                                                                                                                                                                                              |  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| • Part C - Learning Resource                                                                                                                                                                                                                                                 |  |
| <b>Text Books, Reference Books, Other Resources -</b>                                                                                                                                                                                                                        |  |
| <b>Text Book- Biofertilisers and biopesticides – K Acharya, S Sen, M Rai</b>                                                                                                                                                                                                 |  |
| <ul style="list-style-type: none"> <li>• S. Kannaiyan- Biofertiliser Technology-Scientific Publishers.</li> <li>• Environmental Biotechnology- Himalaya Publishing House.</li> </ul>                                                                                         |  |
| Reference Book-                                                                                                                                                                                                                                                              |  |
| <ul style="list-style-type: none"> <li>• Dr. Himadri Panda- The Complete Technology Book on Biofertilizer and Organic Farming- NPCS.</li> </ul>                                                                                                                              |  |
| Online resources- <a href="https://archive.nptel.ac.in/courses/126/105/126105024/">https://archive.nptel.ac.in/courses/126/105/126105024/</a><br><a href="https://archive.nptel.ac.in/courses/102/105/102105058/">https://archive.nptel.ac.in/courses/102/105/102105058/</a> |  |

| Part D: Assessment and Evaluation                                    |                                                                                                                                                                                                                                        |                                                                                                             |
|----------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|
| <b>Suggested Continuous Evaluation Methods:</b>                      |                                                                                                                                                                                                                                        |                                                                                                             |
| <b>Maximum Marks: 50 Marks</b>                                       |                                                                                                                                                                                                                                        |                                                                                                             |
| <b>Continuous Internal Assessment (CIA): 15 Marks</b>                |                                                                                                                                                                                                                                        |                                                                                                             |
| <b>End Semester Exam (ESE): 35 Marks</b>                             |                                                                                                                                                                                                                                        |                                                                                                             |
| <b>Continuous Internal Assessment (CIA)<br/>(By course teacher):</b> | 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 |
| <b>End Semester Exam (ESE):</b>                                      | <b>Laboratory/Field Skill Performance: On spot Assessment</b><br>A. Performed the task based on learned skill - 20 Marks<br>B. Spotting based on tools (written) – 10 Marks<br>C. Viva-voce (based on principle/technology) - 05 Marks | Managed by Coordinator as per skilling                                                                      |

| Approval of the Board of Studies |                                                                                                                                |                |                  |                                  |                    |                                                                                       |
|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------|----------------|------------------|----------------------------------|--------------------|---------------------------------------------------------------------------------------|
| <b>Date: 20-06-2026</b>          |                                                                                                                                |                |                  |                                  |                    |                                                                                       |
| Name                             | Prof. S. K. Jadhav                                                                                                             | Sabiha Naz     | Dr. Shubha Diwan | Shri Sanjay Bhagwat              | Ku. Varsha Meshram | Dr. Pramod Kumar Mahish                                                               |
| Designation                      | VC Nominee                                                                                                                     | Subject Expert | Subject Expert   | Employment/<br>Industrial Member | Merit Alumni       | Chairman/ HOD                                                                         |
| Signature                        | Joined by Google Meet on 20-06-2026<br><a href="https://meet.google.com/nzg-cntq-zbc">https://meet.google.com/nzg-cntq-zbc</a> |                |                  |                                  |                    |  |