

**B.Sc., BOTANY(HONORS)**  
**(as per NEP - 2020)**

**SYLLABUS**  
**(2026-2027 onwards)**

**Department of Biology**  
**THE GANDHIGRAM RURAL INSTITUTE**  
**(Deemed to be University)**  
**Gandhigram, Dindigul**  
**Tamil Nadu, India**

## **B.Sc., BOTANY HONORS - (AS PER NEP - 2020)**

### **OBE ELEMENTS**

#### **PROGRAMME EDUCATIONAL OBJECTIVES (PEO)**

**PEO1:** To gain technical aptitude and in-depth knowledge in the respective field.

**PEO2:** To independently carry out practical projects and interpret the results scientifically.

**PEO3:** To utilize the skills developed for gainful employment.

**PEO4:** To update knowledge periodically to match international standards.

**PEO5:** To enhance the intellectual foundation and prepare for life in a complex, dynamic, and technological world.

**PEO6:** To preserve, add to, and transmit knowledge in the respective discipline.

#### **PROGRAMME OUTCOME (PO)**

**PO1:** Become knowledgeable in the respective discipline and apply its principles to the needs of the Employer, Institution, Enterprise, or Society.

**PO2:** Gain analytical skills in science and technology.

**PO3:** Be able to execute experiments with an emphasis on the operation of relevant sophisticated instruments.

**PO4:** Comprehend and interpret various facets of Botany, including the importance and utilization of plant resources.

**PO5:** Prepare and execute projects with professional ethics.

#### **PROGRAMME SPECIFIC OUTCOME (PSO)**

**The students of B.Sc., Botany (Honors) should be able to:**

**PSO1:** Apply knowledge in the domain of traditional and modern techniques in plant science.

**PSO2:** Utilize techniques and resources relevant to botanical research in the laboratory or field.

**PSO3:** Design scientific experiments to address various issues in botany.

**PSO4:** Extend knowledge and critically evaluate the sustainable exploitation of medicinal, economically important, and endangered plants as per the National Biodiversity Act.

**PSO5:** Relate scientific knowledge to research, perform experimentation, and collect, analyze, and present data. Follow the concepts of professional ethics and bioethics norms for practicing the value of the plant kingdom.

### **B.Sc., BOTANY HONORS PROGRAMME 2026-2027 (AS PER NEP - 2020)**

| Name of the Programme                         | B.Sc., BOTANY HONORS PROGRAMME |    |     |    |      |    |      |      |     |    |       |
|-----------------------------------------------|--------------------------------|----|-----|----|------|----|------|------|-----|----|-------|
| Year of Introduction                          | 20262027                       |    |     |    | 2028 |    | 2029 |      | Nil |    |       |
| Semester-wise Courses and Credit distribution | I                              | II | III | IV | V    | VI | VII  | VIII | IX  | X  | Total |
| No. of Courses                                | 9                              | 10 | 9   | 8  | 8    | 8  | 6    | 4    | --  | -- | 62    |
| No. of Credits                                | 21                             | 23 | 23  | 21 | 20   | 24 | 20   | 20   | --  | -- | 172   |

Progressive Certificate, Diploma, Bachelor's Degree or Bachelor's Degree with Honors provided at the end of each year of exit of the four-years Undergraduate Programme.

| S. No | EXIT OPTIONS                                                                                                                                                                      | CREDITS REQUIRED |
|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| 1.    | <b>Certificate</b> upon the successful completion of the First Year (Two Semesters) of the multidisciplinary Four-year Undergraduate Programme.                                   | <b>44</b>        |
| 2.    | A diploma upon the successful completion of the Second Year (Four Semesters) of the multidisciplinary four-year undergraduate Programme.                                          | <b>88</b>        |
| 3.    | <b>Basic Bachelor's Degree</b> upon successful completion of the Third Year (Six Semesters) of the multidisciplinary Four-year Undergraduate Programme                            | <b>132</b>       |
| 4.    | <b>Bachelor's Degree with Honors</b> in a Discipline at the Successful Completion of the Fourth Year (Eight Semesters) of the multidisciplinary four-year Undergraduate Programme | <b>172</b>       |

**B.Sc., BOTANY (HONORS) PROGRAMME**  
**SCHEME OF EXAMINATION**

| Scheme of Examination            |                                          |                                                         |                   |                        |                     |           |     |       |
|----------------------------------|------------------------------------------|---------------------------------------------------------|-------------------|------------------------|---------------------|-----------|-----|-------|
| Category                         | Course Code                              | Course Title                                            | Number of Credits | Lecture Hours per week | Exam Duration (Hrs) | Max Marks |     |       |
|                                  |                                          |                                                         |                   |                        |                     | CFA       | ESE | Total |
| Semester-I                       |                                          |                                                         |                   |                        |                     |           |     |       |
| Core-Major-1                     | 26BTUC1101                               | Plant Diversity I                                       | 3                 | 3                      | 3                   | 40        | 60  | 100   |
|                                  | 26BTUC1102                               | Practical I: Plant Diversity I                          | 1                 | 3                      | 3                   | 60        | 40  | 100   |
| Core-Minor-1                     | 26BTUB1101                               | Zoology-I                                               | 3                 | 3                      | 3                   | 40        | 60  | 100   |
|                                  | 26BTUB1102                               | ZoologyPractical- I                                     | 1                 | 3                      | 3                   | 60        | 40  | 100   |
| Multidisciplinary-1              | 26BT111XX                                | Multidisciplinary-I                                     | 3                 | 3                      | 3                   | 40        | 60  | 100   |
| Ability Enhancement Course (AEC) | 24ENUA1101                               | Essential English: Basic                                | 3                 | 3                      | 3                   | 40        | 60  | 100   |
| Skill Enhancement Course         | 24TAUS1101/<br>24MLUS1101/<br>24HIUS1101 | Indian language (Tamil/ Malayalam/ Hindi)-I             | 3                 | 3                      | 3                   | 40        | 60  | 100   |
| Value Added Course VAC-1         | 24FSUV1001                               | Environmental Education                                 | 2                 | 2                      | -                   | 50        | -   | 50    |
| Value Added Course VAC-2         | 24FAUV1001<br>24GTUV1002                 | Heritage and cultural history of India(Or) Shanthi Sena | 2                 | 2                      | -                   | 50        | -   | 50    |
|                                  | Total                                    |                                                         | 21                | 25                     |                     |           |     |       |

| Category                         | Course Code                               | Course Title                                  | Number of Credits | Lecture Hours per week | Exam Duration (Hrs) | Max Marks |      |       |
|----------------------------------|-------------------------------------------|-----------------------------------------------|-------------------|------------------------|---------------------|-----------|------|-------|
|                                  |                                           |                                               |                   |                        |                     | CFA       | ES E | Total |
| Semester-II                      |                                           |                                               |                   |                        |                     |           |      |       |
| Core-Major-2                     | 26BTUC1203                                | Plant Diversity II                            | 3                 | 3                      | 3                   | 40        | 60   | 100   |
|                                  | 26BTUC1204                                | Practical II: Plant Diversity II              | 1                 | 3                      | 3                   | 60        | 40   | 100   |
| Core-Minor-2                     | 26BTUB1203                                | Zoology-II                                    | 3                 | 3                      | 3                   | 40        | 60   | 100   |
|                                  | 26BTUB1204                                | Zoology Practical- II                         | 1                 | 3                      | 3                   | 60        | 40   | 100   |
| Multidisciplinary-2              | --                                        | Multidisciplinary-II: Computational Skills    | 3                 | 3                      | 3                   | 40        | 60   | 100   |
| Ability Enhancement Course (AEC) | 24ENUA1202                                | Essential English: Intermediate               | 3                 | 3                      | 3                   | 40        | 60   | 100   |
| Skill Enhancement Course         | 24TAUS1202/<br>24MLUS1202/<br>24HIUS1202  | Indian Language (Tamil/ Malayalam/ Hindi) -II | 3                 | 3                      | 3                   | 40        | 60   | 100   |
| Value Added Course VAC-3         | 24PEUV1001                                | Yoga and fitness                              | 2                 | 2                      | -                   | 50        | -    | 50    |
| Value Added Course VAC-4         | 24GTUV1001                                | Let us know Gandhi                            | 2                 | 2                      | -                   | 50        | -    | 50    |
| Skill Enhancement Course         | 24TAUF0004/<br>24MLUF0004/<br>24HIU F0004 | Functional Tamil/ Malayalam/ Hindi            | 2                 | 2                      | -                   | 50        | -    | 50    |
|                                  | Total                                     |                                               | 23                | 27                     |                     |           |      |       |

| Category                         | Course Code                              | Course Title                                                                    | Number of Credits | Lecture Hours per week | Exam Duration (Hrs) | Max Marks |     |       |
|----------------------------------|------------------------------------------|---------------------------------------------------------------------------------|-------------------|------------------------|---------------------|-----------|-----|-------|
|                                  |                                          |                                                                                 |                   |                        |                     | CFA       | ESE | Total |
| Semester-III                     |                                          |                                                                                 |                   |                        |                     |           |     |       |
| Core-Major-3<br>Core-Major-4     | 26BTUC2105                               | Plant Physiology and Plant Biochemistry                                         | 3                 | 3                      | 3                   | 40        | 60  | 100   |
|                                  | 26BTUC2106                               | Palaeobotany and Evolution                                                      | 4                 | 4                      | 3                   | 40        | 60  | 100   |
|                                  | 26BTUC2107                               | Practical III: Plant Physiology, Plant Biochemistry and Palaeobotany& Evolution | 1                 | 3                      | 3                   | 60        | 40  | 100   |
| Core-Minor-5                     | 24CHUB2105                               | Chemistry-I                                                                     | 3                 | 3                      | 3                   | 40        | 60  | 100   |
|                                  | 24CHUB2106                               | Chemistry- Practical- I                                                         |                   |                        |                     |           |     |       |
| Multidisciplinary-3              | MOOC/NPTL                                | Multidisciplinary-III (Online Course)                                           | 3                 | 3                      | 3                   | 40        | 60  | 100   |
| Ability Enhancement Course (AEC) | 24ENUA2103                               | Essential English: Advanced                                                     | 3                 | 3                      | 3                   | 40        | 60  | 100   |
| Skill Enhancement Course         | 24TAUS2103/<br>24HIUS2103/<br>24MLUS2103 | Indian Language (Tamil/ Hindi/Malayalam)-III                                    | 3                 | 3                      | 3                   | 40        | 60  | 100   |
| Extension                        | 24EXUE2101                               | Village Placement Programme                                                     | 2                 | 2                      | -                   | 50        | -   | 50    |
|                                  | Total                                    |                                                                                 | 23                | 27                     |                     |           |     |       |

| Category                                     | Course Code | Course Title                                                                                   | Numbe<br>r of<br>Credits | Lecture<br>Hours per<br>week | Exam<br>Duration<br>(Hrs) | Max Marks |     |       |
|----------------------------------------------|-------------|------------------------------------------------------------------------------------------------|--------------------------|------------------------------|---------------------------|-----------|-----|-------|
|                                              |             |                                                                                                |                          |                              |                           | CFA       | ESE | Total |
| Semester-IV                                  |             |                                                                                                |                          |                              |                           |           |     |       |
| Core-Major-5<br>Core-Major-6<br>Core-Major-7 | 26BTUC2208  | Plant Ecology                                                                                  | 4                        | 4                            | 3                         | 40        | 60  | 100   |
|                                              | 26BTUC2209  | Cell and Molecular Biology                                                                     | 3                        | 3                            | 3                         | 40        | 60  | 100   |
|                                              | 26BTUC2210  | Anatomy and Embryology of Angiosperms                                                          | 4                        | 4                            | 3                         | 40        | 60  | 100   |
|                                              | 26BTUC2211  | Practical IV: Plant Ecology, Cell and Molecular Biology &Anatomy and Embryology of Angiosperms | 1                        | 3                            | 3                         | 60        | 40  | 100   |
| Core-Minor-4                                 | 24CHUB2207  | Chemistry-II                                                                                   | 3                        | 3                            | 3                         | 40        | 60  | 100   |
|                                              | 24CHUB2208  | Chemistry- Practical- II                                                                       | 1                        | 3                            | 3                         | 60        | 40  | 100   |
| Ability Enhancement Course (AEC)             | 24BTUA220X  | AEC (Core Elective)                                                                            | 3                        | 3                            | 3                         | 40        | 60  | 100   |
| Extension                                    | 24EXUE2201  | Community Engagement                                                                           | 2                        | 2                            | -                         | 50        | -   | 50    |
|                                              | Total       |                                                                                                | 21                       | 25                           |                           |           |     |       |

| Category                                      | Course Code | Course Title                                                                                 | Number of Credits | Lecture Hours per week | Exam Duration (Hrs) | Max Marks |     |       |
|-----------------------------------------------|-------------|----------------------------------------------------------------------------------------------|-------------------|------------------------|---------------------|-----------|-----|-------|
|                                               |             |                                                                                              |                   |                        |                     | CFA       | ESE | Total |
| Semester-V                                    |             |                                                                                              |                   |                        |                     |           |     |       |
| Core-Major-8<br>Core-Major-9<br>Core-Major-10 | 26BTUC3112  | Taxonomy of Angiosperms                                                                      | 3                 | 3                      | 3                   | 40        | 60  | 100   |
|                                               | 26BTUC3113  | Practical V: Taxonomy of Angiosperms                                                         | 1                 | 3                      | 3                   | 60        | 40  | 100   |
|                                               | 26BTUC3114  | Microbiology and Plant Pathology                                                             | 3                 | 3                      | 3                   | 40        | 60  | 100   |
|                                               | 26BTUC3115  | Plant Biotechnology and Genetic Engineering                                                  | 4                 | 4                      | 3                   | 40        | 60  | 100   |
|                                               | 26BTUC3116  | Practical VI: Microbiology & Plant Pathology and Plant Biotechnology and Genetic Engineering | 1                 | 3                      | 3                   | 60        | 40  | 100   |
| Core-Minor-5                                  | 26BTUB3109  | Herbal Technology                                                                            | 4                 | 4                      | 3                   | 40        | 60  | 100   |
| Core-Major-11                                 | 26BTUC3117  | Internship                                                                                   | 2                 | -                      | -                   | 50        | -   | 50    |
| Extension                                     | 26BTUE3101  | Field Study / Visit                                                                          | 2                 | 2                      | -                   | 50        | -   | 50    |
|                                               | Total       |                                                                                              | 20                | 22                     |                     |           |     |       |

| Category                                                         | Course Code | Course Title                                                                                                     | Number of Credits | Lecture Hours per week | Exam Duration (Hrs) | Max Marks |        |       |
|------------------------------------------------------------------|-------------|------------------------------------------------------------------------------------------------------------------|-------------------|------------------------|---------------------|-----------|--------|-------|
|                                                                  |             |                                                                                                                  |                   |                        |                     | CFA       | ESE    | Total |
| Semester-VI                                                      |             |                                                                                                                  |                   |                        |                     |           |        |       |
| Core-Major-12<br>Core-Major-13<br>Core-Major-14<br>Core-Major-15 | 26BTUC3218  | Genetics and Biostatistics                                                                                       | 3                 | 3                      | 3                   | 40        | 60     | 100   |
|                                                                  | 26BTUC3219  | Horticulture and Forestry                                                                                        | 4                 | 4                      | 3                   | 40        | 60     | 100   |
|                                                                  | 26BTUC3220  | Instrumentation Techniques in Plant Science                                                                      | 4                 | 4                      | 3                   | 40        | 60     | 100   |
|                                                                  | 26BTUC3221  | Phytomedicine and Therapeutics                                                                                   | 4                 | 4                      | 3                   | 40        | 60     | 100   |
|                                                                  | 26BTUC3222  | Practical VII: Genetics Biostatistics& Horticulture and Forestry and Instrumentation Techniques in Plant Science | 1                 | 3                      | 3                   | 60        | 40     | 100   |
| Core-Minor-6                                                     | 26BTUB3210  | Plant Resources Utilisation and Biodiversity Conservation                                                        | 4                 | 4                      | 3                   | 40        | 60     | 100   |
| Core-Major-16                                                    | 26BTUC3223  | Industrial Botany                                                                                                | 4                 | 4                      | 3                   | 40        | 60     | 100   |
|                                                                  |             | Project*                                                                                                         |                   |                        | -                   | 40        | 40 +20 | 100   |
|                                                                  | Total       |                                                                                                                  | 24                | 26                     |                     | -         | -      | -     |

**B.Sc., Botany (Honors) 4<sup>th</sup> year**  
**\*(Eligibility- Minimum 75% and above without arrears up to 6<sup>th</sup> semesters)**

| Category                                        | Course Code | Course Title                                                | Number of Credits | Lecture Hours per week | Exam Duration (Hrs) | Max Marks |      |       |
|-------------------------------------------------|-------------|-------------------------------------------------------------|-------------------|------------------------|---------------------|-----------|------|-------|
|                                                 |             |                                                             |                   |                        |                     | CF A      | ES E | Total |
| Semester-VII                                    |             |                                                             |                   |                        |                     |           |      |       |
| Core-Major-17<br>Core-Major-18<br>Core-Major-19 | 26BTUC4124  | Algal Culture Technology                                    | 4                 | 4                      | 3                   | 40        | 60   | 100   |
|                                                 | 26BTUC4125  | Genomics and Proteomics                                     | 4                 | 4                      | 3                   | 40        | 60   | 100   |
|                                                 | 26BTUC4126  | Applied Mycology                                            | 3                 | 3                      | 3                   | 40        | 60   | 100   |
|                                                 | 26BTUC4127  | Practical VIII: Algal Culture Technology & Applied Mycology | 1                 | 3                      | 3                   | 60        | 40   | 100   |
| Core-Minor-07                                   | 26BTUC4211  | Plant tissue and organ Culture Techniques                   | 4                 | 4                      | 3                   | 40        | 60   | 100   |
| Core-Minor-08                                   | 26BTUC4112  | Advances in Plant Sciences                                  | 4                 | 4                      | 3                   | 40        | 60   | 100   |
|                                                 | Total       |                                                             | 20                | 22                     |                     |           |      |       |

| Category      | Course Code | Course Title                             | Number of Credits | Lecture Hours per week | Exam Duration (Hrs) | Max Marks |         |       |
|---------------|-------------|------------------------------------------|-------------------|------------------------|---------------------|-----------|---------|-------|
|               |             |                                          |                   |                        |                     | CFA       | ESE     | Total |
| Semester-VIII |             |                                          |                   |                        |                     |           |         |       |
| Core-Major-20 | 26BTUC4228  | Advanced Molecular Biological Techniques | 4                 | 4                      | 3                   | 40        | 60      | 100   |
| Core-Major-21 | 26BTUC 4229 | Forensic Botany                          | 3                 | 3                      | 3                   | 40        | 60      | 100   |
|               | 26BTUC 4230 | Artificial Intelligence in Plant Science | 1                 | 3                      | 3                   | 60        | 40      | 100   |
| Core-Major-22 | 26BTUC4231  | Project**                                | 12                | 12                     | -                   | 120       | 120+ 60 | 300   |
|               |             | Total                                    | 20                | 22                     |                     |           |         |       |

\*40 marks for Internal evaluation, 40 marks for External evaluation, and 20 for Joint viva-voce.

\*\*120 marks for Internal evaluation; 120 marks for External evaluation and 60 marks for Joint viva-voce.

**LIST OF MULTIDISCIPLINARY COURSES**

| Course Code | Course Title                              | Credits |
|-------------|-------------------------------------------|---------|
|             | <b>First Semester</b>                     |         |
| 26BTI1101   | Phytochemical Techniques                  | 3       |
|             | <b>Second Semester</b>                    |         |
| 26CSUI1201  | Computational Botany                      | 3       |
|             | <b>Third Semester</b>                     |         |
| 26BTI2101   | Smart Farming and Agricultural Techniques | 3       |

**LIST OF ABILITY ENHANCEMENT COURSES**

| Course Code | Course Title                 | Credits |
|-------------|------------------------------|---------|
|             | <b>Fourth Semester</b>       |         |
| 24BTUA2201  | Biofertilizer Technology     | 3       |
| 24BTUA2202  | Mushroom Culture Technology  | 3       |
| 24BTUA2202  | Plant Propagation Techniques | 3       |
| 24BTUA2202  | Bioinformatics               | 3       |
| 24BTUA2202  | Plant Tissue Culture         | 3       |

## SEMESTER I

| SEMESTER                                      | FIRST                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | COURSECODE                                  | 26BTUC1101 |
|-----------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|------------|
| Course Title                                  | PLANT DIVERSITY- I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                             |            |
| No. of Credits                                | 03                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | No. of contact hours per Week               | 03         |
| New Course/<br>Revised Course                 | New Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | If revised, Percentage of Revision effected | -          |
| Category                                      | Core Major-1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                             |            |
| Scope of the Course<br>(may be more than one) | Students will be able to develop their knowledge of plant diversity<br>Students will be able to identify algae, fungi, lichen and bryophytes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                             |            |
| Cognitive Levels<br>addressed by the Course   | K-1: Understanding the basic Concepts in Plant Diversity<br>K-2: Understanding the structure of selected species of algae.<br>K-3: Gain knowledge on the characteristics of fungi.<br>K-4: Get a thorough knowledge of the classification of Bryophytes.<br>K-5: Evaluate the evolution of the sporophyte in Bryophytes.<br>K-6: Create knowledge on the economic importance of Bryophytes.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                             |            |
| Course Objectives                             | The Course aims to: <ul style="list-style-type: none"> <li>Enhance the students' knowledge of thallus organization in algae</li> <li>Know about the life cycle of the selected algal genus.</li> <li>Give an overview of the economic importance of fungi.</li> <li>Make the students knowledgeable about the characteristics of bryophytes.</li> <li>Acquire an overall knowledge of the economic importance of bryophytes.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                             |            |
| Unit                                          | Content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                             | No.ofhours |
| I                                             | <b>Algae</b><br>Classification of Algae by F.E. Fritsch (1935); General characteristics of all classes of Algae; Distribution, habitat, thallus organization, reproduction (vegetative, asexual, sexual) of Algae; Habit and habitats of freshwater, marine and terrestrial algae. Pigmentation and Reserve food in algae. Economic importance of Algae                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                             | 10         |
| II                                            | <b>Algae – detailed study</b><br>A detailed study of the structure, reproduction and life cycle of the following genera: <i>Oscillatoria</i> , <i>Chlamydomonas</i> , <i>Sargassum</i> , and <i>Polysiphonia</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                             | 09         |
| III                                           | <b>Fungi &amp; Lichens</b><br>Classification of Fungi by C.J. Alexopoulos (1962); General characteristics of all classes of fungi; Distribution, habitat, reproduction (vegetative, asexual, sexual) and lifecycle of <i>Rhizopus</i> and <i>Agaricus</i> . Economic importance of Fungi. General characteristics of Lichens. Brief account on structure and reproduction in Ascolichens, Basidiolichens and Deuterolichens.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                             | 10         |
| IV                                            | <b>Bryophytes</b><br>General characteristics. Occurrence, Distribution and Classification (Rothmaler, 1951) of Bryophytes. Evolution of sporophytes in Bryophytes. A detailed study of the structure, reproduction, and life cycles of <i>Riccia</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                             | 09         |
| V                                             | <b>Bryophytes -detailed study</b><br>A detailed study of the Structure, Reproduction and life cycles of the following genera, <i>Anthoceros</i> , <i>Marchantia</i> and <i>Funaria</i> . Economic importance of Bryophytes.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                             | 10         |
| Refer<br>ences                                | <b>Text Books:</b> <ol style="list-style-type: none"> <li>Annie R, Kumaresan V &amp; Arumugam N (2014). Algae and Bryophytes. Saras Publication; I Edition, Nagercoil, Tamilnadu.</li> <li>Kumar, HD (1999). Introductory Phycology. 2nd edition. Affiliated East-West Press Pvt. Ltd. Delhi.</li> <li>Pandey, BP (1994). Algae. S. Chand &amp; Company Ltd. New Delhi.</li> <li>Sharma, OP (2011). Algae. Tata McGraw Hill Education Private Ltd. New Delhi.</li> <li>Vashishta, BR, Sinha AK, and Singh, VP (2011). Botany for Degree Students-Algae. S. Chand Pub. New Delhi</li> <li>Parihar, NS (1991). An introduction to Embryophyta. Vol. I. Bryophyta. Central Book Depot, Allahabad.</li> <li>Sharma, OP (2013). Bryophytes. McGraw Hill education (India) Pvt. Ltd. New Delhi.</li> <li>Vashishta, PC (1999). Bryophyta. S. Chand &amp; Company, New Delhi.</li> <li>Vashishta, &amp; Sinha AK (2011). Bryophytes. S. Chand &amp; Company Ltd. New Delhi.</li> </ol> |                                             |            |
|                                               | <b>Reference Books:</b> <ol style="list-style-type: none"> <li>Bold, HC &amp; Wynne, MJ (1985). Introduction to the Algae. Prentice Hall of India. New Delhi.</li> <li>Chapman, VJ &amp; Chapman DJ. The Algae. Macmillan Publication. New York.</li> <li>Fritsch, FE (1945). Structure and reproduction of Algae. Cambridge University press. Cambridge, UK.</li> <li>Lee, RD (2008). Phycology 4th Edition, Cambridge University Press, New York. Round,</li> <li>Fery (1984). The Ecology of Algae. Cambridge University Press.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                             |            |

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|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                        | 6. Cavers, F (1971). The interrelationship of Bryophyta. Dawsons of Pall Mall, London<br>7. PremPuri (1981). Bryophytes: Morphology, Growth and Differentiation. Atma Ram and Sons, New Delhi.<br>8. Rashid, A (1998). An Introduction to Bryophyta. Vikas Pub. Ltd. New Delhi.<br>9. Smith, AJE (1982). Bryophyta: Ecology. Chapman and Hall. London.<br>10. Watson, EV (1968). British Mosses and Liverworts. Hutchinson and Co., London.<br>11. Watson, EV (1970). Structure and life of Bryophytes. Hutchinson and Co., London.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|                        | <b>E-resources</b> <ul style="list-style-type: none"> <li><a href="https://www.bing.com/search?q=structure+and+reproduction+of+algae+ppt&amp;FORM=AWRE">https://www.bing.com/search?q=structure+and+reproduction+of+algae+ppt&amp;FORM=AWRE</a></li> <li><a href="https://www.bing.com/search?q=structure%20and%20reproduction%20of%20fungi%20ppt&amp;qsn&amp;form=QBR&amp;sp=-1&amp;lq=0&amp;pq=structure%20and%20reproduction%20of%20fungippt&amp;sc=12-38&amp;sk=&amp;cvid=E768173258324D68BB9F0BD21897F714">https://www.bing.com/search?q=structure%20and%20reproduction%20of%20fungi%20ppt&amp;qsn&amp;form=QBR&amp;sp=-1&amp;lq=0&amp;pq=structure%20and%20reproduction%20of%20fungippt&amp;sc=12-38&amp;sk=&amp;cvid=E768173258324D68BB9F0BD21897F714</a></li> <li><a href="https://www.bing.com/ck/a?!&amp;&amp;p=7bc155ec382acfb7cec121d55ae0fc5e2841c6ed64d94b58ea26b5229277b4JmltdHM9MTc3MzI3MzYwMA&amp;pptn=3&amp;ver=2&amp;hsh=4&amp;fclid=3ea3adfd-4bda-6cf7-3d52-bb484a3d6d4c&amp;psq=structure+and+reproduction+of+lichen+ppt&amp;u=a1aHR0cHM6Ly93d3cuc2xpZGVzaGFyZS5uZXQvc2xpZGVzaG93L2xpY2hlnbMtcHB0LzUwNDEzNDE5&amp;ntb=1">bing.com/ck/a?!&amp;&amp;p=7bc155ec382acfb7cec121d55ae0fc5e2841c6ed64d94b58ea26b5229277b4JmltdHM9MTc3MzI3MzYwMA&amp;pptn=3&amp;ver=2&amp;hsh=4&amp;fclid=3ea3adfd-4bda-6cf7-3d52-bb484a3d6d4c&amp;psq=structure+and+reproduction+of+lichen+ppt&amp;u=a1aHR0cHM6Ly93d3cuc2xpZGVzaGFyZS5uZXQvc2xpZGVzaG93L2xpY2hlnbMtcHB0LzUwNDEzNDE5&amp;ntb=1</a></li> </ul> |
| <b>Course Outcomes</b> | On completion of the course, students should be able to:<br>CO 1: Discuss characteristics of algae<br>CO2: Describe the structure of algal genus.<br>CO3: Identify fungi and lichens<br>CO4: Explain the distribution of bryophytes.<br>CO5: Assess the economic importance of bryophytes.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

#### Mapping of COs with PSOs:

| CO \ PSO | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|----------|------|------|------|------|------|
| CO1      | 3    | 1    | 1    | 3    | 3    |
| CO2      | 3    | 3    | 1    | 3    | 3    |
| CO3      | 3    | 2    | 1    | 3    | 3    |
| CO4      | 3    | 3    | 1    | 3    | 3    |
| CO5      | 3    | 3    | 3    | 3    | 3    |

| SEMESTER                                      | FIRST                                                                                                                                                                                                                                                                                                                                                                                                   | COURSE CODE                                 | 26BTUC1102   |
|-----------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|--------------|
| Course Title                                  | <b>PRACTICAL- I: PLANT DIVERSITY- I</b>                                                                                                                                                                                                                                                                                                                                                                 |                                             |              |
| No. of Credits                                | 01                                                                                                                                                                                                                                                                                                                                                                                                      | No. of contact hours per Week               | 03           |
| New Course/<br>Revised Course                 | New Course                                                                                                                                                                                                                                                                                                                                                                                              | If revised, Percentage of Revision effected | -            |
| Category                                      | Core Major-1                                                                                                                                                                                                                                                                                                                                                                                            |                                             |              |
| Scope of the Course<br>(may be more than one) | Students will be able to develop their skills in Plant Diversity<br>Students will be able to develop employability skills across various botanical fields.                                                                                                                                                                                                                                              |                                             |              |
| Cognitive Levels addressed by the Course      | K-1: Remember Basic Concepts in Plant Diversity<br>K-2: Understanding the plant breeding and selection techniques.<br>K-3: Apply to know plant diversity and classification<br>K-4: Analyse various plant groups<br>K-5: Evaluate the micro preparation of lower group plants<br>K-6: Create knowledge on Plant Diversity                                                                               |                                             |              |
| Course Objectives                             | The Course aims to:<br>Enhance the students' knowledge of the microscopic analysis of lower group plants<br>Know about the micro-preparation technique<br>Give an overview of vegetative and floral characters of selected algal members<br>Make the students knowledgeable about the vegetative characters of fungi<br>Acquire an overall knowledge of the characteristics and features of Bryophytes. |                                             |              |
| Sl.No                                         | Content                                                                                                                                                                                                                                                                                                                                                                                                 |                                             | No. Of hours |
| 1.                                            | Micro preparation and detailed microscopic analysis of vegetative and reproductive parts of the following Algae – <i>Oscillatoria</i> , <i>Chlamydomonas</i> ,                                                                                                                                                                                                                                          |                                             | 10           |
| 2.                                            | Micro preparation and detailed microscopic analysis of vegetative and reproductive parts <i>Sargassum</i> , and <i>Polysiphonia</i>                                                                                                                                                                                                                                                                     |                                             | 6            |

|                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |   |
|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
| 3.             | Micro preparation and detailed microscopic analysis of vegetative and reproductive parts of <i>Rhizopus</i> and <i>Agaricus</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 6 |
| 4.             | Micro preparation and detailed microscopic analysis of vegetative and reproductive parts of the following Fungi: Ascolichens, Basidiolichens                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 6 |
| 5.             | Micro preparation and detailed microscopic analysis of vegetative and reproductive parts of the following: Deuterolichens                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 6 |
| 6.             | Micro preparation and detailed microscopic analysis of vegetative and reproductive parts of the following Bryophytes: <i>Marchantia</i> , <i>Anthoceros</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 6 |
| 7.             | Micro preparation and detailed microscopic analysis of vegetative and reproductive parts of the following: <i>Marsilea</i> and <i>Polytrichum</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 5 |
| 8.             | Field trips to collect the specimens and preparation of the herbarium of Algae, Fungi, Lichens and Bryophytes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | - |
| Refer<br>ences | <b>Text Books:</b> <ol style="list-style-type: none"> <li>Annie R, Kumaresan V &amp; Arumugam N .2014. Algae and Bryophytes. Saras Publication; I Edition, Nagercoil, Tamilnadu.</li> <li>Kumar, HD .1999. Introductory Phycology. 2nd edition. Affiliated East-West Press Pvt. Ltd. Delhi.</li> <li>Pandey, BP .1994. Algae. S. Chand &amp; Company Ltd. New Delhi.</li> <li>Sharma, OP.2011. Algae. Tata McGraw Hill Education Private Ltd. New Delhi.</li> <li>Vashishta, BR, Sinha AK, and Singh, VP .2011. Botany for Degree Students-Algae. S. Chand Pub. New Delhi .</li> <li>Parihar, NS .1991. An introduction to Embryophyta. Vol. I. Bryophyta. Central Book Depot, Allahabad.</li> <li>Sharma, OP .2011. Bryophytes. McGraw Hill education (India) Pvt. Ltd. New Delhi.</li> <li>Vashishta, PC .1999. Bryophyta. S. Chand &amp; Company, New Delhi.</li> <li>Vashishta, &amp; Sinha AK .2011. Bryophytes. S. Chand &amp; Company Ltd. New Delhi.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |   |
|                | <b>Reference Books:</b> <ol style="list-style-type: none"> <li>Bold, HC &amp; Wynne, MJ .1985. Introduction to the Algae. Prentice Hall of India. New Delhi.</li> <li>Chapman, VJ &amp; Chapman DJ. The Algae. Macmillan Publication. New York.</li> <li>Fritsch, FE. 1945. Structure and reproduction of Algae. Cambridge University press. Cambridge, UK.</li> <li>Lee, R.D. 2008. Phycology 4th Edition, Cambridge University Press, New York.</li> <li>Round, FE. 1984. The Ecology of Algae. Cambridge University Press.</li> <li>Cavers, F. 1971. The interrelationship of Bryophyta. Dawsons of Pall Mall, London</li> <li>PremPuri .1981. Bryophytes: Morphology, Growth and Differentiation. Atma Ram and Sons, New Delhi.</li> <li>Rashid, A. 1998. An Introduction to Bryophyta. Vikas Pub. Ltd. New Delhi.</li> <li>Smith, AJE .1982. Bryophyta: Ecology. Chapman and Hall. London.</li> <li>Watson, E.V. 1968. British Mosses and Liverworts. Hutchinson and Co., London.</li> <li>Watson, EV .1970. Structure and life of Bryophytes. Hutchinson and Co., London.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                     |   |
|                | <b>E sources</b> <ul style="list-style-type: none"> <li><a href="https://www.bing.com/search?q=structure+and+reproduction+of+algae+ppt&amp;FORM=AWRE">https://www.bing.com/search?q=structure+and+reproduction+of+algae+ppt&amp;FORM=AWRE</a></li> <li><a href="https://www.bing.com/search?q=structure%20and%20reproduction%20of%20fungi%20ppt&amp;qsn&amp;form=QBR&amp;sp=-1&amp;lq=0&amp;pq=structure%20and%20reproduction%20of%20fungippt&amp;sc=12-38&amp;sk=&amp;cvid=E768173258324D68BB9F0BD21897F714">https://www.bing.com/search?q=structure%20and%20reproduction%20of%20fungi%20ppt&amp;qsn&amp;form=QBR&amp;sp=-1&amp;lq=0&amp;pq=structure%20and%20reproduction%20of%20fungippt&amp;sc=12-38&amp;sk=&amp;cvid=E768173258324D68BB9F0BD21897F714</a></li> <li><a href="https://www.bing.com/ck/a?!&amp;p=7bc155ec382acfb7cec121d55ae0fc5e2841c6ed64d94b58ea26b5229277b4JmltdHM9MTc3MzI3MzYwMA&amp;pptn=3&amp;ver=2&amp;hsh=4&amp;fclid=3ea3adfd-4bda-6cf7-3d52-bb484a3d6d4c&amp;psq=structure+and+reproduction+of+lichen+ppt&amp;u=a1aHR0cHM6Ly93d3cuc2xpZGVzaGFyZS5uZXQvc2xpZGVzaG93L2xpY2hlnbMtcHB0LzUwNDEzNDE5&amp;ntb=1">bing.com/ck/a?!&amp;p=7bc155ec382acfb7cec121d55ae0fc5e2841c6ed64d94b58ea26b5229277b4JmltdHM9MTc3MzI3MzYwMA&amp;pptn=3&amp;ver=2&amp;hsh=4&amp;fclid=3ea3adfd-4bda-6cf7-3d52-bb484a3d6d4c&amp;psq=structure+and+reproduction+of+lichen+ppt&amp;u=a1aHR0cHM6Ly93d3cuc2xpZGVzaGFyZS5uZXQvc2xpZGVzaG93L2xpY2hlnbMtcHB0LzUwNDEzNDE5&amp;ntb=1</a></li> </ul> |   |
|                | <b>Course Outcomes</b><br>On completion of the course, students should be able to:<br>CO 1: Discuss important characteristics of the lower group of plants<br>CO2: Describe the morphology and anatomy of the lower group plants<br>CO3: Identify key structures and their functions<br>CO4: Perform dissection of morphological and anatomical structures in lower plants<br>CO5: Assess the diversity of algae, fungi and bryophytes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |   |

#### Mapping of COs with PSOs:

| CO \ PSO | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|----------|------|------|------|------|------|
| CO1      | 3    | 1    | 1    | 3    | 3    |
| CO2      | 3    | 3    | 1    | 3    | 3    |
| CO3      | 3    | 2    | 1    | 3    | 3    |
| CO4      | 3    | 3    | 1    | 3    | 3    |
| CO5      | 3    | 3    | 3    | 3    | 3    |

## SEMESTER II

| SEMESTER                                      | SECOND                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | COURSECODE                                  | 26BTUC1203   |
|-----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|--------------|
| Course Title                                  | PLANT DIVERSITY II                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                             |              |
| No. of Credits                                | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | No. of contact hours per Week               | 3            |
| New Course/<br>Revised Course                 | New Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | If revised, Percentage of Revision effected | -            |
| Category                                      | Core Major-2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                             |              |
| Scope of the Course<br>(may be more than one) | <ul style="list-style-type: none"> <li>Students will be able to develop their skills in the classification of Pteridophytes and Gymnosperms</li> <li>Students will be able to develop employability in various botanical fields.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                             |              |
| Cognitive Levels addressed by the Course      | K-1: Life forms and distribution of Pteridophytes<br>K-2: Understanding the general characteristics and classification of Gymnosperms<br>K-3: Apply to know the diversity and threats of Pteridophytes<br>K-4: Analyze the structure and development of the gametophyte in Pteridophytes<br>K-5: Evaluate the ecological importance of Gymnosperms                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                             |              |
| Course Objectives                             | The Course aims to: <ul style="list-style-type: none"> <li>Enhance the students' knowledge of key characters of Pteridophytes</li> <li>Know about the ecological and economic importance of Pteridophytes</li> <li>Give an overview of stellar evolution in Pteridophytes</li> <li>Make the students knowledgeable about the classification of Gymnosperms</li> <li>Acquire an overall knowledge of the life cycle of <i>Cycas</i> and <i>Pinus</i></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                             |              |
| Unit                                          | Content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                             | No. Of hours |
| I                                             | <b>General introduction and classification of Pteridophytes</b><br>Introduction, general characters and classification of Pteridophytes by K.R. Sporne (1962). Morphological diversity of sporophytes (stems, leaves, roots). Morphology, vegetative and reproductive structure and life cycle of Pteridophytes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                             | 10           |
| II                                            | <b>Morphology and life cycle of Pteridophytes</b><br>Detailed study about the distribution, morphology, anatomy, reproduction, and life cycle of the following Pteridophytes: Psilophyta - <i>Psilotum</i> ; Lycophyta - <i>Selaginella</i> ; Pterophyta - <i>Marsilea</i> ; Polypodiophyta - <i>Adiantum</i> . Ecological and economic importance of Pteridophytes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                             | 09           |
| III                                           | <b>General account of Pteridophytes</b><br>Stellar evolution in Pteridophytes; Sporangial organization – Homospory, Heterospory and seed habit. Apospory and Apogamy. Anatomy of vegetative and reproductive organs. Gametophyte structure and development.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                             | 10           |
| IV                                            | <b>General introduction and classification of Gymnosperms</b><br>Introduction, general characters and classification of Gymnosperms by K.R. Sporne (1965). Morphological structure, anatomy (leaflet), reproduction and life cycle of Gymnosperms.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                             | 09           |
| V                                             | <b>Morphology, lifecycle and Economic importance of Gymnosperms</b><br>Distribution, morphology, anatomy, reproduction and life cycle of the following Gymnosperms: Cycadopsida - <i>Cycas</i> ; Coniferopsida - <i>Pinus</i> ; Gnetopsida - <i>Gnetum</i> . Economic importance of Gymnosperms.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                             | 10           |
| References                                    | <b>Text Books:</b> <ol style="list-style-type: none"> <li>Vashista, P.C. (1997). Botany for Degree Students Pteridophyta. S. Chand and Company Ltd., New Delhi.</li> <li>Pandey et al., (1998). A Text Book of Botany Vol. II. S. Chand &amp; Co. Ltd.</li> <li>Pandey, B.P. (1977). A Text book of Bryophyta, Pteridophyta and Gymnosperms. K. Nath and Co. Meerut.</li> <li>Parihar, N.S. (1977). An introduction to Embryophyta. Vol-II. Pteridophyta and Gymnosperms.</li> <li>Vasishta PC, Sinha AK &amp; Anilkumar. (2005). Botany for degree students: Pteridophytes. S Chand, New Delhi.</li> <li>Vasishta PC, Sinha AK &amp; Anilkumar. (2005). Botany for degree students: Gymnosperms. S Chand and Company Ltd., New Delhi.</li> </ol> <b>Reference Books:</b> <ol style="list-style-type: none"> <li>Chamberlin, C.J. (1934). Gymnosperms: structure and Evolution. Chicago reprinted 1950. New York.</li> <li>Smith, G.M. (1935). Cryptogamic Botany. Vol-III, Tata McGraw Hill Publishing Co., New Delhi.</li> <li>Eames, A.J. (1936). Morphology of lower vascular plants. Tata McGraw Hill Publishing Co., New Delhi.</li> <li>Smith, G.M. (1955). Cryptogamic Botany Vol. II Bryophytes and Pteridophytes (2nd edn.). Tata McGraw Hill Publishing Co., New Delhi.</li> <li>Sporne, K.R. (1967). The Morphology of Gymnosperms, Hutchinson &amp; Co., London.</li> <li>Sporne, K.R. (1970). The Morphology of Pteridophytes (The Structure of Ferns and Allied Plants). Hutchinson University Library, London.</li> <li>Sporne, K.R. (1975). The Morphology of Pteridophytes, Hutchinson &amp; Co., London.</li> </ol> |                                             |              |

|                        |                                                                                                                                                                                                                                                                                                                                                                                                                          |
|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                        | 8. Sporne, K.R. (1991). The Morphology of Gymnosperms. B.I. publications Pvt., Mumbai.<br>9. Srivastava, H.N. (1998). Gymnosperms. Pradeep Publications, Jalandhar.<br>10. Pandey et al., 1998. A Text Book of Botany Vol. II. S. Chand & Co. Ltd.                                                                                                                                                                       |
|                        | <b>E-Resources:</b><br>1. <a href="https://swayam.gov.in/nd2_cec20_bt11/preview">https://swayam.gov.in/nd2_cec20_bt11/preview</a><br>2. <a href="https://www.youtube.com/watch?v=sEEVVCQKx68">https://www.youtube.com/watch?v=sEEVVCQKx68</a><br>3. <a href="https://www.doi.org/10.1111/jse.12229">https://www.doi.org/10.1111/jse.12229</a>                                                                            |
| <b>Course Outcomes</b> | On completion of the course, students should be able to:<br>CO 1: Discuss the morphological diversity of the sporophyte in Pteridophytes<br>CO2: Describe the morphology and life cycle of selected species of Pteridophytes<br>CO3: Identify the sporangial organisation in Pteridophytes<br>CO4: Perform classification of Gymnosperms based on key characters<br>CO5: Assess the ecological importance of Gymnosperms |

Mapping of COs with PSOs:

| CO \ PSO | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|----------|------|------|------|------|------|
| CO1      | 3    | 1    | 1    | 3    | 3    |
| CO2      | 3    | 2    | 1    | 3    | 3    |
| CO3      | 3    | 2    | 1    | 3    | 3    |
| CO4      | 3    | 3    | 1    | 3    | 3    |
| CO5      | 3    | 3    | 3    | 3    | 3    |

| SEMESTER                                      | SECOND                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | COURSECODE                                  | 264BTUC1204 |
|-----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|-------------|
| Course Title                                  | <b>PRACTICAL II – PLANT DIVERSITY II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                             |             |
| No. of Credits                                | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | No. of contact hours per Week               | 3           |
| New Course/<br>Revised Course                 | New Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | If revised, Percentage of Revision effected | -           |
| Category                                      | Core Major-2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                             |             |
| Scope of the Course<br>(may be more than one) | <ul style="list-style-type: none"> <li>Students will be able to develop their skills in reproductive and anatomical developments of Pteridophytes and Gymnosperms</li> <li>Students will be able to develop Employability in various botanical fields.</li> </ul>                                                                                                                                                                                                                                                           |                                             |             |
| Cognitive Levels addressed by the Course      | K-1: Remember the life forms and anatomy of Pteridophytes<br>K-2: Understanding the morphological features of Gymnosperm<br>K-3: Apply to know internal adaptations of Pteridophytes<br>K-4: Analyze the evolutionary significance of Pteridophytes and Gymnosperms<br>K-5: Evaluate the diversity of Pteridophytes and Gymnosperms                                                                                                                                                                                         |                                             |             |
| Course Objectives                             | The Course aims to: <ul style="list-style-type: none"> <li>Enhance the students' knowledge of the identification of Pteridophytes and Gymnosperms</li> <li>Know about the morphology of Pteridophytes and Gymnosperms</li> <li>Give an overview of the internal characters of Pteridophytes and Gymnosperms</li> <li>Make the students knowledgeable about the habitat adaptations in a selected genus.</li> <li>Acquire an overall knowledge of the diversity and distribution of Pteridophytes and Gymnosperms</li> </ul> |                                             |             |
| S. No.                                        | Content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | No. Of hours                                |             |
| 1.                                            | Study of the Habit, TS of leaf and Stem, Morphology of Reproductive structures of <i>Psilotum</i>                                                                                                                                                                                                                                                                                                                                                                                                                           | 6                                           |             |
| 2.                                            | Study of the Habit, TS of leaf and Stem, Morphology of Reproductive structures of <i>Selaginella</i> .                                                                                                                                                                                                                                                                                                                                                                                                                      | 6                                           |             |
| 3.                                            | Study of the Habit, TS of leaf and Stem, Morphology of Reproductive structures of <i>Adiantum</i>                                                                                                                                                                                                                                                                                                                                                                                                                           | 6                                           |             |
| 4.                                            | Study of the Habit, TS of leaf and Stem, Morphology of Reproductive structures of <i>Marsilea</i>                                                                                                                                                                                                                                                                                                                                                                                                                           | 6                                           |             |
| 5.                                            | Morphology of Reproductive structures of <i>Cycas</i> : male cone, microsporophyll, megasporophyll, T. S. of microsporophyll, L.S. of ovule.                                                                                                                                                                                                                                                                                                                                                                                | 4                                           |             |
| 6.                                            | Morphology and anatomical structures of <i>Cycas</i> : T.S. of coralloid root, TS of leaf and stem                                                                                                                                                                                                                                                                                                                                                                                                                          | 5                                           |             |
| 7.                                            | <i>Pinus</i> - male cone and female cone, T.S. of needle. T.S. of the stem, L.S. of the male cone and the female cone                                                                                                                                                                                                                                                                                                                                                                                                       | 6                                           |             |
| 8.                                            | <i>Gnetum</i> - Habit, Slides of the stem T.S., leaf T.S., male and female cones, and L.S. of the ovule and seed.                                                                                                                                                                                                                                                                                                                                                                                                           | 6                                           |             |

|                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |   |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
| 9.                     | Field trip to study the diversity, morphology and reproductive parts of Pteridophytes and Gymnosperms                                                                                                                                                                                                                                                                                                                                                                            | - |
| <b>References</b>      | <ol style="list-style-type: none"> <li>1. Vasishta PC, Sinha AK &amp; Anilkumar. (2005). Botany for degree students: Pteridophytes. S Chand, New Delhi.</li> <li>2. Vasishta PC, Sinha AK &amp; Anilkumar. (2005). Botany for degree students: Gymnosperms. S Chand and Company Ltd., New Delhi.</li> </ol>                                                                                                                                                                      |   |
| <b>Course Outcomes</b> | <p>On completion of the course, students should be able to:</p> <p>CO 1: Discuss important characters of Pteridophytes and Gymnosperms</p> <p>CO2: Describe the morphology and anatomy of Pteridophytes and Gymnosperms</p> <p>CO3: Identify the key function of Pteridophytes and Gymnosperms</p> <p>CO4: Perform dissection of morphological and anatomical structures in Pteridophytes and Gymnosperms</p> <p>CO5: Assess the diversity of Pteridophytes and Gymnosperms.</p> |   |

Mapping of COs with PSOs:

| CO \ PSO | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|----------|------|------|------|------|------|
| CO1      | 3    | 1    | 1    | 3    | 3    |
| CO2      | 3    | 3    | 1    | 3    | 3    |
| CO3      | 3    | 3    | 3    | 3    | 3    |
| CO4      | 3    | 3    | 1    | 3    | 3    |
| CO5      | 3    | 3    | 3    | 3    | 3    |

**SEMESTER III**

| SEMESTER                                      | THREE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | COURSECODE                                  | 26BTUC2105   |
|-----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|--------------|
| Course Title                                  | <b>PLANT PHYSIOLOGY AND PLANT BIOCHEMISTRY</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                             |              |
| No. of Credits                                | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | No. of contact hours per Week               | 3            |
| New Course/<br>Revised Course                 | New Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | If revised, Percentage of Revision effected | -            |
| Category                                      | Core Major - 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                             |              |
| Scope of the Course<br>(may be more than one) | <ul style="list-style-type: none"> <li>Students will be able to understand fundamental physiological processes in plants</li> <li>Students will be able to apply theoretical knowledge through practical experiments</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                             |              |
| Cognitive Levels addressed by the Course      | <p>K-1: Recall basic terms, definitions, and key concepts in Plant Physiology.</p> <p>K-2: Understanding the mineral nutrition in plants</p> <p>K-3: Applying knowledge of the mechanism of photosynthesis</p> <p>K-4: Analysis through comparison, differentiation, and interpretation of physiological pathways.</p> <p>K-5: Evaluate the importance, significance, and outcomes of plant functions.</p> <p>K-6: Design experiments, models, or new ideas in plant physiology.</p>                                                                                                                                                                                                   |                                             |              |
| Course Objectives                             | <p>The Course aims to:</p> <ul style="list-style-type: none"> <li>Enhance students' knowledge of fundamental concepts and processes of plant physiology.</li> <li>Understand water relations, mineral nutrition, and mechanisms of transport in plants.</li> <li>Gain insight into photosynthesis and its factors</li> <li>Analyse the mechanism of respiration in plants</li> <li>Learn about plant hormones, growth regulators, and their roles in development.</li> <li>Explore photoreceptors, photoperiodism, and environmental influences on plant growth.</li> <li>Acquire practical knowledge of physiological experiments and their applications in plant science.</li> </ul> |                                             |              |
| Unit                                          | Content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                             | No. Of hours |
| I                                             | <b>Plant Water Relations</b><br>Properties of water, Permeability, Osmosis, Imbibition, Diffusion, Water potential & Osmotic potential; Mechanism of water absorption - passive and active absorption; Pathways of water movement - apoplast, symplast, transmembrane; Ascent of sap - Root pressure, Capillary force, Cohesion-tension theory (transpiration pull), Phloem transport: Composition of photo-assimilates, Mechanism of phloem transport, Transpiration: Types                                                                                                                                                                                                           |                                             | 8            |
| II                                            | <b>Photosynthesis &amp; Respiration</b><br>Light harvesting complexes, absorption/action spectrum; Light reactions - Cyclic & Non-cyclic photo phosphorylation, Dark reactions - C2, C3, C4, and CAM pathways; Factors affecting                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                             | 10           |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |    |
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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | photosynthesis. Aerobic & Anaerobic respiration; Aerobic respiration                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |    |
| III                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>Plant Biochemistry</b><br>Carbohydrates: importance, classification, structure and properties. Glycolysis, Krebs Cycle, Oxidative Phosphorylation, Glyoxylate, Oxidative Pentose Phosphate Pathway.<br>Lipids: importance, classification, structure and properties. Fatty acids- types. Biosynthesis of fatty acids (Palmitic acid).                                                                                                                                                                                                                                                                                                  | 10 |
| IV                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>Plant Biochemistry</b><br>Amino acids- structure classification and importance. and Proteins: structure classification and importance. Enzymes: nomenclature, classification and structure. Mechanism of enzyme action and enzyme inhibition                                                                                                                                                                                                                                                                                                                                                                                           | 10 |
| V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>Plant Growth and Development</b><br>Plant hormones: Auxins, Cytokinins, ABA, and Ethylene; Plant photoreceptors - (Phytochromes, Cryptochromes), Photoperiodism, Vernalization. Fruit ripening, Senescence and Abscission; Plant movements (Tropic and Nastic), Circadian rhythm and biological clock                                                                                                                                                                                                                                                                                                                                  | 8  |
| <b>Text Books:</b> <ol style="list-style-type: none"> <li>1. Taiz, L., Zeiger, E., Møller, I.M., &amp; Murphy, A. (2015). Plant Physiology and Development (6th ed.). Sinauer Associates, Sunderland, Massachusetts, USA.</li> <li>2. Buchanan, B.B., Gruissem, W., &amp; Jones, R.L. (2015). Biochemistry and Molecular Biology of Plants (2nd ed.). Wiley Blackwell, Hoboken, New Jersey, USA.</li> <li>3. Hopkins, W.G., &amp; Huner, N.P.A. (2009). Introduction to Plant Physiology (4th ed.). John Wiley &amp; Sons, Hoboken, New Jersey, USA.</li> <li>4. Salisbury, F.B., &amp; Ross, C.W. (2005). Plant Physiology (4th ed.). Wadsworth Publishing Company, Belmont, California, USA.</li> </ol> <b>Reference Books:</b> <ol style="list-style-type: none"> <li>1. Moore, T.C. (1989). Research Experience in Plant Physiology: A Laboratory Manual. Springer-Verlag, New York, USA.</li> <li>2. Noggle, G.R., &amp; Fritz, G.J. (1983). Introductory Plant Physiology. Prentice Hall, Englewood Cliffs, New Jersey, USA.</li> <li>3. Bidwell, R.G.S. (1979). Plant Physiology. Macmillan Publishing Corporation, New York, USA.</li> <li>4. Verma, V. (2016). Plant Physiology (2nd ed.). Athena Academic, London, UK. Pandey, S.N., &amp; Sinha, B.K. (2006). Plant Physiology. Vikas Publishing House Pvt. Ltd., New Delhi, India.</li> <li>5. Srivastava, H.S. (2005). Plant Physiology. Rastogi Publications, Meerut, India.</li> <li>6. Bajracharya, D. (1999). Experiments in Plant Physiology: A Laboratory Manual. Narosa Publishing House, New Delhi, India.</li> <li>7. Taiz, L., &amp; Zeiger, E. (2012). Plant Physiology (5th ed.). Sinauer Associates, Sunderland, Massachusetts, USA.</li> <li>8. Mukherji, S., &amp; Ghosh, A.K. (2009). Plant Physiology (1st ed.). New Central Book Agency Pvt. Ltd., Kolkata, India.</li> </ol> <b>E-Resources:</b> <ol style="list-style-type: none"> <li>1. NPTEL Online Course – Plant Hormones module: <a href="http://nptel.ac.in/courses/102103012/27">http://nptel.ac.in/courses/102103012/27</a></li> <li>2. <a href="https://www.bing.com/search?q=water%20translocation%20in%20plants%20ppt&amp;q=n&amp;form=QBRE&amp;sp=-1&amp;ghc=1&amp;lq=0&amp;pq=water%20translocation%20in%20plants%20pp&amp;sc=12-32&amp;sk=&amp;cvid=083D449B3DE24BA4985944AF21FF0B8C">https://www.bing.com/search?q=water%20translocation%20in%20plants%20ppt&amp;q=n&amp;form=QBRE&amp;sp=-1&amp;ghc=1&amp;lq=0&amp;pq=water%20translocation%20in%20plants%20pp&amp;sc=12-32&amp;sk=&amp;cvid=083D449B3DE24BA4985944AF21FF0B8C</a></li> <li>3. <a href="https://www.bing.com/search?q=photosynthesis%20in%20plants%20ppt&amp;q=n&amp;form=QBRE&amp;sp=-1&amp;lq=0&amp;pq=photosynthesis%20in%20plants%20ppt&amp;sc=12-28&amp;sk=&amp;cvid=651E9C1DD4614EA49D8CC122B1C7AA7C">https://www.bing.com/search?q=photosynthesis%20in%20plants%20ppt&amp;q=n&amp;form=QBRE&amp;sp=-1&amp;lq=0&amp;pq=photosynthesis%20in%20plants%20ppt&amp;sc=12-28&amp;sk=&amp;cvid=651E9C1DD4614EA49D8CC122B1C7AA7C</a></li> </ol> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |    |
| <b>Course Outcomes</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | On completion of the course, students should be able to:<br>CO1: Explain fundamental concepts of plant water relations, including osmosis, diffusion, and water potential.<br>CO2: Describe mechanisms of mineral nutrition, phloem transport, transpiration, and stomatal regulation.<br>CO3: Identify structures and functions of chloroplasts, photoreceptors, and plant hormones.<br>CO4: Demonstrate understanding of photosynthetic and respiratory pathways<br>CO5: Assess the role of plant hormones in growth & development.<br>CO6: Apply knowledge to analyze plant movements, circadian rhythms, and environmental responses. |    |

**Mapping of COs with PSOs:**

| CO \ PSO | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|----------|------|------|------|------|------|
| CO1      | 3    | 1    | 1    | 3    | 3    |
| CO2      | 3    | 3    | 1    | 3    | 3    |
| CO3      | 3    | 2    | 1    | 3    | 3    |
| CO4      | 3    | 3    | 1    | 3    | 3    |
| CO5      | 3    | 3    | 3    | 3    | 3    |

| SEMESTER                                      | THREE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | COURSECODE                                  | 26BTUC2106 |
|-----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|------------|
| Course Title                                  | <b>PALEOBOTANY AND EVOLUTION</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                             |            |
| No. of Credits                                | 04                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | No. of contact hours per Week               | 04         |
| New Course/<br>Revised Course                 | New Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | If revised, Percentage of Revision effected | -          |
| Category                                      | Core Major - 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                             |            |
| Scope of the Course<br>(may be more than one) | <ul style="list-style-type: none"> <li>To help the students gain knowledge of the geological time scale and fossilisation process.</li> <li>Study the origin of life with special reference to plant evolution.</li> <li>Study the vegetative and reproductive organs of fossils, plant speciation, paleoclimate reconstruction, and coal/petroleum exploration</li> </ul>                                                                                                                                |                                             |            |
| Cognitive Levels addressed by the Course      | K-1: Recall key terms and definitions of the geological time scale<br>K-2: Understand vegetative and reproductive organs of fossils.<br>K-3: Apply knowledge in plant evolution.<br>K-4: Analyse the aspects of evolution and the origin of life.<br>K-5: Evaluate the significance of plant speciation.<br>K-6: Design experiments, paleoclimate reconstruction, and coal/petroleum exploration.                                                                                                         |                                             |            |
| Course Objectives                             | The Course aims to: <ul style="list-style-type: none"> <li>Enhance students' knowledge on geological time scale.</li> <li>Understand the structure and importance of various fossils.</li> <li>Gain insight into various aspects of evolution and the origin of life.</li> <li>Learn about water chemistry, acids, bases, and buffer systems.</li> <li>Explore the significance of plant speciation.</li> <li>Helps in recognizing paleoclimate reconstruction, and coal/petroleum exploration</li> </ul> |                                             |            |
| Unit                                          | Content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                             | No.Ofhours |
| I                                             | <b>Paleobotanical Research</b><br>Introduction to Palaeobotany, Geological time scale - sequence of plants in geological time. Fossils and fossilisation processes: types- compression, casts, moulds, petrification, impressions and coal balls. Radiocarbon dating. Indian Paleobotanical Research Institutes, Indian Palaeobotanists, Contributions of Birbal Sahni                                                                                                                                    |                                             | 6          |
| II                                            | <b>Paleobotany</b><br>Study of vegetative and reproductive organs of the following plant fossils: <i>Rhynia</i> , <i>Lepidodendron</i> , <i>Lepidocarpon</i> , <i>Calamites</i> and <i>Williamsonia sewardiana</i> .                                                                                                                                                                                                                                                                                      |                                             | 10         |
| III                                           | <b>Plant Fossils</b><br>Evolutionary Significance: Role of fossils in understanding plant evolution, seed habit. Study of plant fossils from Algae, fungi, bryophytes, Pteridophytes, Gymnosperms and Angiosperms. Use of fossils in dating, paleoclimate reconstruction, and coal/petroleum exploration                                                                                                                                                                                                  |                                             | 12         |
| IV                                            | <b>Theories of Evolution</b><br>Evolution - origin of life, chemosynthetic theory - evidence (any five). Theories of evolution: Darwin, Lamarck, De Vries, and the modern synthetic theory. Variation - analysis and sources; adaptive radiation; concept of species - allopatric and sympatric.                                                                                                                                                                                                          |                                             | 10         |
| V                                             | <b>Speciation</b><br>Plant speciation: Allopatric, Sympatric; Reproductive isolation; Biological Species concept. Sources of Variations; Population Genetics; Hardy-Weinberg Law and Genetic Drift; Climate change and plant evolution; Weed evolution; Extinctions - an overview; K-T extinction.                                                                                                                                                                                                        |                                             | 10         |
|                                               | <b>Text Books:</b> <ol style="list-style-type: none"> <li>Gupta, M.N. 1972. The Gymnosperms (2<sup>nd</sup> Edition) Shiva Lal Agarwala &amp; Co., Agra.</li> <li>Vashista, P.C. 1976. Gymnosperms, S.Chand &amp; Co. New Delhi.</li> <li>Bhatnagar, S.P and Moitra, A. 1996. Gymnosperms. New Age International Publishers, New Delhi, India.</li> </ol>                                                                                                                                                 |                                             |            |

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|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                        | <p>4. <a href="#">Anil Kumar</a>. 2006. Gymnosperms. S. Chand &amp; Company Pvt. Ltd. New Delhi.</p> <p>5. Bhatnagar S.P and Alok Moitra. 2013. Gymnosperms. Publisher: New Age International Pvt Ltd Publishers. New Delhi.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|                        | <p><b>Reference Books:</b></p> <ol style="list-style-type: none"> <li>1. Sporne, K.R.1991. The Morphology of Gymnosperms. B.I. Publications, New Delhi.</li> <li>2. Bhatnagar, S.P and Moitra, A. 1996. Gymnosperms, New Age Int. Pvt. Ltd., New Delhi.</li> <li>3. Stewart, W.N and Rathwell, G.W. 1993. Palaeobotany and the Evolution of Plants. Cambridge University Press.</li> <li>4. <a href="#">Raup, D.M</a> and Steven, M. Stanley. 2004. Principles of palaeontology. San Francisco: W.H. Freeman, 1971.</li> <li>5. Bhatnagar S.P and Alok Moitra. 2013. Gymnosperms. Publisher: New Age International Pvt Ltd Publishers. New Delhi.</li> <li>6. Smith, G.M. 1955. Cryptogamic Botany Vol.II. Tata McGraw Hill. New Delhi.</li> <li>7. James.W. Byng. 2015. The Gymnosperms practical hand book. A practical guide to extant families and genera of the world. Published by plant Gateway, Tol Bot Street, Herford, SG137BX, United Kingdom.</li> <li>8. Sharma, O.P. 2012. Textbook of Pteridophyta, TATA MacMillan India Ltd., New Delhi.</li> <li>9. Chamberlain, C.J. 1934. Gymnosperms: Structure and Evolution. Chicago Reprinted 1950). New York.</li> <li>10. Kirkaldy, J.E. 1963. The study of Fossils. Hutchinson Educational, London</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|                        | <p><b>E-Resources:</b></p> <ol style="list-style-type: none"> <li>1. <a href="https://books.google.co.in/books?hl=en&amp;lr=&amp;id=Pn7CAAAQBAJ&amp;oi=fnd&amp;pg=PA1&amp;dq=Introduction+to+Gymnosperms&amp;ots=sfYSzCL02&amp;sig=ysX1KRvetV0bAza4Sq6RWau4XU8&amp;redir_esc=y#v=onepage&amp;q=Introduction%20to%20Gymnosperms&amp;f=false">https://books.google.co.in/books?hl=en&amp;lr=&amp;id=Pn7CAAAQBAJ&amp;oi=fnd&amp;pg=PA1&amp;dq=Introduction+to+Gymnosperms&amp;ots=sfYSzCL02&amp;sig=ysX1KRvetV0bAza4Sq6RWau4XU8&amp;redir_esc=y#v=onepage&amp;q=Introduction%20to%20Gymnosperms&amp;f=false</a></li> <li>2. <a href="https://books.google.co.in/books/about/Botany_for_Degree_Gymnosperm_Multicolor.html?id=HTdFYFNxnWQC&amp;redir_esc=y">https://books.google.co.in/books/about/Botany_for_Degree_Gymnosperm_Multicolor.html?id=HTdFYFNxnWQC&amp;redir_esc=y</a></li> <li>3. <a href="https://books.google.co.in/books/about/Gymnosperms.html?id=4dvyNckni8wC">https://books.google.co.in/books/about/Gymnosperms.html?id=4dvyNckni8wC</a></li> <li>4. <a href="https://arboretum.harvard.edu/wp-content/uploads/2013-70-4-beyond-pine-cones-an-introduction-to-gymnosperms.pdf">https://arboretum.harvard.edu/wp-content/uploads/2013-70-4-beyond-pine-cones-an-introduction-to-gymnosperms.pdf</a></li> <li>5. <a href="https://www.palaeontologyonline.com/">https://www.palaeontologyonline.com/</a></li> <li>6. <a href="https://www.google.co.in/books/edition/Gymnosperms/3YrT5E3Erm8C?hl=en&amp;gbpv=1&amp;dq=gymnosperms&amp;printsec=frontcover">https://www.google.co.in/books/edition/Gymnosperms/3YrT5E3Erm8C?hl=en&amp;gbpv=1&amp;dq=gymnosperms&amp;printsec=frontcover</a></li> <li>7. <a href="https://www.amazon.in/Paleobotany-Biology-Evolution-Fossil-Plants/dp/0123739721">https://www.amazon.in/Paleobotany-Biology-Evolution-Fossil-Plants/dp/0123739721</a></li> <li>8. <a href="https://books.google.co.in/books/about/Paleobotany.html?id=HzYUAAIAAJ">https://books.google.co.in/books/about/Paleobotany.html?id=HzYUAAIAAJ</a></li> <li>9. <a href="https://trove.nla.gov.au/work/11471742?q&amp;versionId=46695996">https://trove.nla.gov.au/work/11471742?q&amp;versionId=46695996</a></li> <li>10. <a href="http://www.freebookcentre.net/Biology/Evolutionary-Biology-Books.html">http://www.freebookcentre.net/Biology/Evolutionary-Biology-Books.html</a></li> </ol> |
| <b>Course Outcomes</b> | <p>On completion of the course, students should be able to:</p> <p><b>CO1:</b> Explain the structures of various plant fossils.</p> <p><b>CO2:</b> Describe the process of plant speciation.</p> <p><b>CO3:</b> Understand process of evolution.</p> <p><b>CO4:</b> Demonstrate the structure and importance of plant fossils.</p> <p><b>CO5:</b> Assess roles paleoclimate reconstruction, and coal/petroleum exploration</p> <p><b>CO6:</b> understand the vegetative and reproductive organs of various plant fossils</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

Mapping of COs with PSOs:

| CO \ PSO | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|----------|------|------|------|------|------|
| CO1      | 3    | 1    | 1    | 3    | 3    |
| CO2      | 3    | 3    | 1    | 3    | 3    |
| CO3      | 3    | 2    | 1    | 3    | 3    |
| CO4      | 3    | 3    | 1    | 3    | 3    |
| CO5      | 3    | 3    | 3    | 3    | 3    |

| SEMESTER                                      | THREE                                                                                                                                                                                                                                                                                                                                                                              | COURSE CODE                                 | 26BTUC2107 |
|-----------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|------------|
| Course Title                                  | PLANT PHYSIOLOGY, PLANT BIOCHEMISTRY AND PALEOBOTANY & EVOLUTION PRACTICAL                                                                                                                                                                                                                                                                                                         |                                             |            |
| No. of Credits                                | 01                                                                                                                                                                                                                                                                                                                                                                                 | No. of contact hours per Week               | 03         |
| New Course/<br>Revised Course                 | New Course                                                                                                                                                                                                                                                                                                                                                                         | If revised, Percentage of Revision effected | -          |
| Category                                      | Core Major - 4                                                                                                                                                                                                                                                                                                                                                                     |                                             |            |
| Scope of the Course<br>(may be more than one) | <ul style="list-style-type: none"> <li>• To help the students gain knowledge of the geological time scale and fossilization process.</li> <li>• Study the origin of life with special reference to plant evolution.</li> <li>• Study the vegetative and reproductive organs of fossils, plant speciation, , paleoclimate reconstruction, and coal/petroleum exploration</li> </ul> |                                             |            |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| Cognitive Levels addressed by the Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | K-1: Recall key terms and definitions of the geological time scale<br>K-2: Understand vegetative and reproductive organs of fossils.<br>K-3: Apply knowledge in plant evolution.<br>K-4: Analyse the aspects of evolution and the origin of life.<br>K-5: Evaluate the significance of plant speciation.<br>K-6: Design experiments, paleoclimate reconstruction, and coal/petroleum exploration.                                                                                                                     |             |
| Course Objectives                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | The Course aims to: <ul style="list-style-type: none"> <li>• Enhance students' knowledge on geological time scale.</li> <li>• Understand the structure and importance of various fossils.</li> <li>• Gain insight into various aspects of evolution and the origin of life.</li> <li>• Learn about water chemistry, acids, bases, and buffer systems.</li> <li>• Explore the significance of plant speciation.</li> <li>• Helps in recognizing paleoclimate reconstruction, and coal/petroleum exploration</li> </ul> |             |
| Exp. No                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | EXPERIMENTS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | No.OffHours |
| 1.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Determination of Osmotic potential by plasmolytic method in the plant cell sap ( <i>Tradescantia</i> /Onion peel)                                                                                                                                                                                                                                                                                                                                                                                                     | 3           |
| 2.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Determination of Stomatal Index and Stomatal Frequency from the two surfaces of leaves                                                                                                                                                                                                                                                                                                                                                                                                                                | 3           |
| 3.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Extraction, Separation and study of photosynthetic pigments by paper chromatography                                                                                                                                                                                                                                                                                                                                                                                                                                   | 3           |
| 4.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Determination of the rate of photosynthesis in an aquatic plant ( <i>Hydrilla</i> )                                                                                                                                                                                                                                                                                                                                                                                                                                   | 3           |
| 5.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Estimation of Carbohydrates – Molisch's test, Benedict's test / Fehling's test                                                                                                                                                                                                                                                                                                                                                                                                                                        | 3           |
| 6.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Estimation of seed viability                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 3           |
| 7.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Estimation of proteins from plant sources - Lowry's method                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 3           |
| 8.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Quantitative estimation of plant fatty acids                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 3           |
| 9.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Observation and study of plant fossils                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 3           |
| 10.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Study of extinct plant species (Through videos and photos)                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 3           |
| <b>Reference Books:</b> <ol style="list-style-type: none"> <li>1. Bajracharya, D., (1999). Experiments in Plant Physiology- A Laboratory Manual. Narosa Publishing House, New Delhi.</li> <li>2. Hopkins, W. G., Huner, N. P. A. (2009). Introduction to Plant Physiology, 4th edition. New Delhi, Delhi: Wiley India Pvt. Ltd.</li> <li>3. Taiz, L., Zeiger, E., (2010). Plant Physiology. Sinauer Associates Inc., U.S.A. 5th Edition.</li> <li>4. InamA, Sahay S, Akhtar A (2016). Experiments in Plant Physiology, Biochemistry and Ecology, Jaya Publishing House, N Delhi.</li> <li>5. Plummer DT (2003). An introduction to practical Biochemistry. 3rd Edn. Tata McGraw Hill Publishing Company Ltd.</li> <li>6. Wilson &amp; Walker: Experimental Biochemistry (2006, Cambridge University Press)</li> <li>7. Nelson, D.L. &amp; Cox, M.M. (2017). <i>Lehninger Principles of Biochemistry</i>. W.H. Freeman.</li> <li>8. Sawhney, S.K. &amp; Randhir Singh (2000). <i>Introductory Practical Biochemistry</i>. Narosa Publishing House.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |
| <b>E-Resources:</b> <ol style="list-style-type: none"> <li>1. <a href="https://www.bing.com/search?q=water%20translocation%20in%20plants%20ppt&amp;q=water%20translocation%20in%20plants%20ppt&amp;form=QBRE&amp;sp=-1&amp;ghc=1&amp;lq=0&amp;pq=water%20translocation%20in%20plants%20ppt&amp;sc=12-32&amp;sk=&amp;cvid=083D449B3DE24BA4985944AF21FF0B8C">https://www.bing.com/search?q=water%20translocation%20in%20plants%20ppt&amp;q=water%20translocation%20in%20plants%20ppt&amp;form=QBRE&amp;sp=-1&amp;ghc=1&amp;lq=0&amp;pq=water%20translocation%20in%20plants%20ppt&amp;sc=12-32&amp;sk=&amp;cvid=083D449B3DE24BA4985944AF21FF0B8C</a></li> <li>2. <a href="https://www.bing.com/search?q=photosynthesis%20in%20plants%20ppt&amp;q=photosynthesis%20in%20plants%20ppt&amp;form=QBRE&amp;sp=-1&amp;lq=0&amp;pq=photosynthesis%20in%20plants%20ppt&amp;sc=12-28&amp;sk=&amp;cvid=651E9C1DD4614EA49D8CC122B1C7AA7C">https://www.bing.com/search?q=photosynthesis%20in%20plants%20ppt&amp;q=photosynthesis%20in%20plants%20ppt&amp;form=QBRE&amp;sp=-1&amp;lq=0&amp;pq=photosynthesis%20in%20plants%20ppt&amp;sc=12-28&amp;sk=&amp;cvid=651E9C1DD4614EA49D8CC122B1C7AA7C</a></li> <li>3. <a href="https://www.bing.com/search?q=water%20translocation%20in%20plants%20ppt&amp;q=water%20translocation%20in%20plants%20ppt&amp;form=QBRE&amp;sp=-1&amp;ghc=1&amp;lq=0&amp;pq=water%20translocation%20in%20plants%20ppt&amp;sc=12-32&amp;sk=&amp;cvid=083D449B3DE24BA4985944AF21FF0B8C">https://www.bing.com/search?q=water%20translocation%20in%20plants%20ppt&amp;q=water%20translocation%20in%20plants%20ppt&amp;form=QBRE&amp;sp=-1&amp;ghc=1&amp;lq=0&amp;pq=water%20translocation%20in%20plants%20ppt&amp;sc=12-32&amp;sk=&amp;cvid=083D449B3DE24BA4985944AF21FF0B8C</a></li> <li>4. <a href="https://www.bing.com/search?q=photosynthesis%20in%20plants%20ppt&amp;q=photosynthesis%20in%20plants%20ppt&amp;form=QBRE&amp;sp=-1&amp;lq=0&amp;pq=photosynthesis%20in%20plants%20ppt&amp;sc=12-28&amp;sk=&amp;cvid=651E9C1DD4614EA49D8CC122B1C7AA7C">https://www.bing.com/search?q=photosynthesis%20in%20plants%20ppt&amp;q=photosynthesis%20in%20plants%20ppt&amp;form=QBRE&amp;sp=-1&amp;lq=0&amp;pq=photosynthesis%20in%20plants%20ppt&amp;sc=12-28&amp;sk=&amp;cvid=651E9C1DD4614EA49D8CC122B1C7AA7C</a></li> </ol> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | On completion of the course, students should be able to:<br><b>CO1:</b> Explain the structures of various plant fossils.<br><b>CO2:</b> Describe the process of plant speciation.<br><b>CO3:</b> Understand the process of evolution.<br><b>CO4:</b> Demonstrate the structure and importance of plant fossils.<br><b>CO5:</b> Assess roles in paleoclimate reconstruction, and coal/petroleum exploration<br><b>CO6:</b> understand the vegetative and reproductive organs of various plant fossils                  |             |

**Mapping of COs with PSOs:**

| PSO \ CO | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|----------|------|------|------|------|------|
| CO1      | 3    | 1    | 1    | 3    | 3    |
| CO2      | 3    | 3    | 1    | 3    | 3    |
| CO3      | 3    | 2    | 1    | 3    | 3    |
| CO4      | 3    | 3    | 1    | 3    | 3    |
| CO5      | 3    | 3    | 3    | 3    | 3    |

**SEMESTER IV**

| SEMESTER                                   | FOURTH                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | COURSE CODE                                 | 26BTUC2208   |
|--------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|--------------|
| Course Title                               | PLANT ECOLOGY                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                             |              |
| No. of Credits                             | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | No. of contact hours per Week               | 4            |
| New Course/<br>Revised Course              | New Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | If revised, Percentage of Revision effected | -            |
| Category                                   | Core Major -5                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                             |              |
| Scope of the Course (may be more than one) | <ul style="list-style-type: none"> <li>Basic knowledge of the structure, character and function of eco ecosystem</li> <li>Organisms and their interactions with the environment at various levels</li> </ul>                                                                                                                                                                                                                                                                         |                                             |              |
| Cognitive Levels addressed by the Course   | K-1: Gain knowledge about ecological principles, ecosystem structure and function<br>K-2: Understand divisions of ecology<br>K-3: Know about plant succession and ecological adaptation<br>K-4: Overview of techniques in plant community studies<br>K-5: Get a better understanding of Environmental Impact Assessment                                                                                                                                                              |                                             |              |
| Course Objectives                          | The Course aims to: <ul style="list-style-type: none"> <li>Understand the fundamentals of ecology</li> <li>Gain knowledge about ecosystem components</li> <li>Learn plant succession and ecological adaptations.</li> <li>Explain population ecology and types of ecosystems</li> <li>Relate the significance of environmental audit and sustainability</li> </ul>                                                                                                                   |                                             |              |
| Unit                                       | Content                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                             | No. of hours |
| I                                          | <b>Fundamentals of Plant Ecology</b><br>Ecology-Principles and approaches, Structure and function of Ecosystem, Role of climatic, edaphic and biotic factors, Biogeochemical cycles (Nitrogen and Carbon).                                                                                                                                                                                                                                                                           |                                             | 12           |
| II                                         | <b>Divisions of Ecology</b><br>Ecosystem components (Abiotic and Biotic) –Autotrophs, Heterotrophs. Ecosystem function: Ecological pyramids. Productivity of ecosystem - Primary Productivity –Gross primary productivity-Net primary productivity- Secondary productivity. Food chain. Food web.                                                                                                                                                                                    |                                             | 12           |
| III                                        | <b>Ecological Adaptations of Plants</b><br>Autecology and Synecology – Vegetation – Units of Vegetation. Plant succession –Hydrosere and Xerosere. Ecological classification of plants. Plant succession, Hydrophytes, Mesophytes, Xerophytes, Halophytes and Epiphytes - Morphological and Anatomical features in relation to their habitats (Adaptation)                                                                                                                           |                                             | 12           |
| IV                                         | <b>Population Ecology</b><br>Ecosystem - Structure; Processes; Trophic organisation. Types of ecosystems - Sea, Estuarine ecosystem, Desert, Forest, Grassland. Techniques in plant community studies - Quadrat and transect methods - species area curve - density, frequency, abundance, dominance of populations - importance value index - construction of phytographs.                                                                                                          |                                             | 12           |
| V                                          | <b>Environmental deterioration:</b><br>Pollution – Air pollution - causes, Particulate matter, Ozone, Acid rain and greenhouse effect. Water Pollution - Freshwater pollution – Sewage contamination, Industrial effluents, Toxic chemicals (Pesticides and Herbicides). Marine Pollution – Thermal Pollution – Radioactive Pollution – Preventive Measures Against Pollution. Soil erosion causes and conservation methods. Deforestation - Cause, Effects and Preventive Measures. |                                             | 12           |

|                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Refer<br/>ences</b> | <b>Text Books:</b> <ol style="list-style-type: none"> <li>1. Ambasht, R.S. 2017. A textbook of plant ecology 15ed (pb 2019). CBS Publishers Distributors.</li> <li>2. Arumugam, N. (1994). Concepts of Ecology (Environmental Biology). Saras Publications, Nagercoil, Tamil Nadu.</li> <li>3. Verma, P.S. and Agarwal, V.K. (1999). Concept of Ecology (Environmental Biology). S. Chand &amp; Co., New Delhi.</li> <li>4. Vasishtha, P.C. (1993). Plant Ecology. II Edition. Vishal Publications.</li> <li>5. Sharma, P.D. (2000). Ecology &amp; Environment. Rastogi Publications, Meerut, India.</li> <li>6. Kumar, H.D. (1992). Modern Concepts of Ecology (7th Edn.). Vikas Publishing Co., New Delhi.</li> <li>7. Shukla, R.S. and P.S. Chandal. (2000). Plant Ecology and Soil Science. Chand &amp; Co. Ltd., New Delhi.</li> <li>8. Beeby A. &amp; Brennan A. M. 2004. First Ecology. Ecological Principles and Environmental Issues. Oxford University Press.</li> <li>9. Dix J. H. 1989. Environmental Pollution. Atmosphere, Land, Water and Noise. Wiley Chichester.</li> <li>10. Barrow C. J. 2005. Environmental Management: Principles &amp; Practices,</li> <li>11. Ronald Good 1947. The Geography of Flowering Plants. Longmans, Green and Co, New York</li> </ol> |
|                        | <b>Reference Books:</b> <ol style="list-style-type: none"> <li>1. Odum, E.P. 1983. Basic Ecology, Saunders, Philadelphia</li> <li>2. Smith, R.L. 1996. Ecology and Field Biology, Harper Collins, New York.</li> <li>3. Ambasht R.S. (1992). Textbook of Plant Ecology, Students and Friends &amp; Co. Varanasi.</li> <li>4. Schimper, A.F. (1960). Plant geography. Lubrecht &amp; Cramer Ltd., New York.</li> <li>5. Mani, M.S. (1974). Ecology &amp; Biogeography of India. Dr. W. Junk Publishers, The Hague.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|                        | <b>E-Resources:</b><br><a href="https://swayam.gov.in/nd2_hec19_hs10/preview">https://swayam.gov.in/nd2_hec19_hs10/preview</a><br><a href="https://swayam.gov.in/nd1_noc20_ge16/preview">https://swayam.gov.in/nd1_noc20_ge16/preview</a><br><a href="https://swayam.gov.in/nd1_noc20_hs77/preview">https://swayam.gov.in/nd1_noc20_hs77/preview</a><br><a href="https://www.youtube.com/watch?v=yXgUn794TVo">https://www.youtube.com/watch?v=yXgUn794TVo</a><br><a href="https://www.youtube.com/watch?v=0zctBpOxRi4">https://www.youtube.com/watch?v=0zctBpOxRi4</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

#### **Mapping of COs with PSOs:**

| CO \ PSO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|----------|-------|-------|-------|-------|-------|
| CO1      | 3     | 1     | 1     | 3     | 3     |
| CO2      | 3     | 3     | 1     | 3     | 3     |
| CO3      | 3     | 2     | 1     | 3     | 3     |
| CO4      | 3     | 3     | 1     | 3     | 3     |
| CO5      | 3     | 3     | 3     | 3     | 3     |

| SEMESTER                                 | FOURTH                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | COURSE CODE                                      | 26BTUC2209 |
|------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------|------------|
| Course Title                             | CELL AND MOLECULAR BIOLOGY                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                  |            |
| No. of credits                           | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | No. of contact hours per week                    | 3          |
| New Course / Revised Course              | New Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | If revised, the percentage of revisions effected | -          |
| Category                                 | Core Major-6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                  |            |
| Scope of the Course                      | <ul style="list-style-type: none"> <li>● Basic understanding of the molecules of life</li> <li>● Developing skills to analyse mutagenesis</li> <li>● Creates an employability scope in the molecular screening laboratories</li> </ul>                                                                                                                                                                                                                                                                               |                                                  |            |
| Cognitive Levels addressed by the course | K-1 Ability to remember historical developments of cell biology.<br>K-2 Comprehensive knowledge of molecules of life<br>K-3 Capacity to understand molecular mechanisms and cell metabolism<br>K-4 Use molecular techniques for a better understanding of the structures of DNA, RNA and Proteins<br>K-5 Make new techniques for transcription<br>K-6 Assess the functions of DNA, RNA and Proteins                                                                                                                  |                                                  |            |
| Course Objectives                        | <b>The course aims to</b> <ul style="list-style-type: none"> <li>● Impart information on the historical developments of cell and molecular biology.</li> <li>● Make the student knowledgeable about the concept of cell and molecular biology.</li> <li>● Give an in-depth knowledge of cell metabolism.</li> <li>● Enhance students' knowledge of nucleic acid structure.</li> <li>● Expose the students to the mechanisms of the transcription and translation processes in prokaryotes and eukaryotes.</li> </ul> |                                                  |            |

| UNIT                   | Content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | No. of Hours |
|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| I                      | <b>Introduction to Cell Biology</b><br>History of cell biology; Cell theory; Diversity of cell size and shape; Micrometry; Characteristics of prokaryotic and eukaryotic cells; Plant cell wall - structure and function; Cell membrane - Fluid Mosaic Model; Transport across cell membrane - passive, active and facilitated transport; endocytosis and exocytosis.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 13           |
| II                     | <b>Structure and function of the organelles:</b><br>Mitochondria and Chloroplast - role in energy transactions; Endoplasmic Reticulum - types and structure; Golgi Apparatus - organisation, protein glycosylation, protein sorting and export from Golgi Apparatus; Lysosomes, Peroxisomes and Vacuoles; Cytoskeleton - function and structure of microtubules, microfilaments and intermediary filaments; Nucleus and its organisation; Nucleolus.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 13           |
| III                    | <b>Cell division and cycle</b><br>Cell division - phases of eukaryotic cell cycle; mitosis and meiosis; Regulation of cell cycle - checkpoints and role of protein kinases; Introduction to Cancer Cell Biology; Apoptosis (Cell Death)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 13           |
| IV                     | <b>Genetic Material of the cell</b><br>Early observations on the mechanism of heredity, DNA and RNA as genetic material, and the Properties of Genetic material. Structure of DNA -primary, secondary and different forms (A, B & Z). Prokaryotic and Eukaryotic Chromosome Organisation-Genes – definition, types and functional organisation. Fine structure of gene-Central dogma of Molecular biology.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 13           |
| V                      | <b>Gene structure and expression</b><br>Organisation of genes in prokaryotes & Eukaryotes. Molecular mechanism and Enzymology of Transcription in prokaryotes and Eukaryotes, post-transcriptional modifications, Genetic code, Molecular mechanism and Enzymology of Translation in prokaryotes and Eukaryotes, Post-translational modifications. Regulation of gene expression in prokaryotes– Operon concept, lac & trp operon.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 12           |
| <b>References</b>      | <b>Text Books</b> <ol style="list-style-type: none"> <li>1. Geoffrey M. Cooper - The Cell A Molecular Approach, 8<sup>th</sup> Edition, Oxford University Press (2019).</li> <li>2. Bruce Alberts, Molecular Biology of Cell, 6<sup>th</sup> Edition, 2015, Garland Science, Taylor &amp; Francis Group, LLC</li> <li>3. David Freifelder, 2020, Molecular Biology, 4<sup>th</sup> Reprint., Narosa Publishing House, New Delhi, India.</li> <li>4. Lansing M. Prescott, John P. Harley and Donald A. Klein (2020). Microbiology (11<sup>th</sup> Ed.). Mc Graw Hill companies.</li> <li>5. E.J. Gardner, M.J. Simmons, D.P. Snustad, 2006. Principles of Genetics (8<sup>th</sup> Ed.) John Wiley &amp; Sons, New York.</li> </ol> <b>References</b> <ol style="list-style-type: none"> <li>1. Lizabeth A. Allison., Fundamental Molecular Biology, 2<sup>nd</sup> Edition, 2012 John Wiley &amp; Sons, Inc.</li> <li>2. David P. Clark, Molecular Biology, 3<sup>rd</sup> Edition, 2019 Elsevier Inc.</li> <li>3. Robert F. Weaver, Molecular Biology, 5<sup>th</sup> Edition 2012 by The McGraw-Hill Companies, Inc.</li> <li>4. Michael M. Cox, Molecular Biology Principles and Practice, 2012 by W. H. Freeman and Company.</li> <li>5. James D. Watson, Molecular biology of the gene, 7<sup>th</sup> Edition, 2014, Cold Spring Harbor Laboratory.</li> </ol> <b>Web resources</b> <ol style="list-style-type: none"> <li>1. <a href="http://www.cellbio.com/education.html">www.cellbio.com/education.html</a></li> <li>2. <a href="https://www.loc.gov/rr/scitech/selected-interval/molecular.html">https://www.loc.gov/rr/scitech/selected-interval/molecular.html</a></li> <li>3. <a href="http://global.oup.com/uk/orc/biosciences/molbio/">global.oup.com/uk/orc/biosciences/molbio/</a></li> <li>4. <a href="https://www.loc.gov/rr/scitech/selected-internet/molecular.html">https://www.loc.gov/rr/scitech/selected-internet/molecular.html</a></li> </ol> |              |
| <b>Course Outcomes</b> | <b>Upon completion of this course, students will be able to:</b><br>CO1: Outline the fundamental concepts of life.<br>CO2: Discuss the various kinds of components of a cell and membranes<br>CO3: Explain the mechanisms of cell catabolism.<br>CO4: Describe the structure and composition on genetic material.<br>CO5: Compare the differences of transcription & translation process in prokaryotes with eukaryotes.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |              |

Mapping of COs with PSOs:

| CO \ PSO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|----------|-------|-------|-------|-------|-------|
| CO1      | 3     | 1     | 1     | 3     | 3     |
| CO2      | 3     | 2     | 2     | 3     | 3     |
| CO3      | 3     | 2     | 1     | 3     | 3     |
| CO4      | 3     | 2     | 2     | 3     | 3     |
| CO5      | 3     | 2     | 2     | 3     | 3     |

| SEMESTER                                      | FOURTH                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | COURSE CODE                                 | 26BTUC2210   |
|-----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|--------------|
| Course Title                                  | ANATOMY AND EMBRYOLOGY OF ANGIOSPERMS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                             |              |
| No. of Credits                                | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | No. of contact hours per Week               | 4            |
| New Course/<br>Revised Course                 | New Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | If revised, Percentage of Revision effected | -            |
| Category                                      | Core Major-7                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                             |              |
| Scope of the Course<br>(may be more than one) | <ul style="list-style-type: none"> <li>Basic knowledge of anatomical structure and reproductive phase of angiosperms.</li> <li>Understand the sexual reproduction and reproductive parts of angiosperms</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                             |              |
| Cognitive Levels addressed by the Course      | K-1: Gain knowledge about the meristem and tissue systems in plants.<br>K-2: Understand the developmental process of the plant body.<br>K-3: Appreciate the techniques in embryology and palynology.<br>K-4: Figure out different mechanisms of pollination<br>K-5: Get a thorough knowledge of double fertilisation and triple fusion                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                             |              |
| Course Objectives                             | The Course aims to: <ul style="list-style-type: none"> <li>Learn about the classification of plant tissues and meristems</li> <li>Gain knowledge about the unusual pattern of secondary growth in plants</li> <li>Understand the significance of embryology and palynology</li> <li>Compare the economic and evolutionary significance of pollination</li> <li>Grasp the idea of classification and the significance of polyembryony.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                             |              |
| Unit                                          | Content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                             | No. of hours |
| I                                             | <b>Plant Tissues and Tissue Systems</b><br>Introduction to plant tissues and their classification. Classification, structure, and function of meristems. Histogen theory, Tunica Corpus Theory. Occurrence, structure and functions of simple tissues: Parenchyma, Collenchyma, Sclerenchyma. Complex tissues: Xylem and Phloem. Special tissues- Types of secretory tissues: digestive glands, glandular hairs, nectaries.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                             | 12           |
| II                                            | <b>Structure of the Plant Body</b><br>Types of Stomata in monocot and Dicot; Anatomy of primary structures: roots, stems, and leaves in dicots and monocots. Nodal Anatomy- types of nodes. Secondary growth in the dicot stem and root. Brief account of Heartwood and sapwood, Dendrochronology. Spring wood and Autumn Wood. Anomalous secondary growth in <i>Dracaena</i> , <i>Bignonia</i> and <i>Boerhaavia</i> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                             | 12           |
| III                                           | <b>Sporogenesis</b><br>Microsporogenesis: general account on pollen structure and morphology. Structure and functions of the microsporangium and its wall layers. Pollinia. Megasporogenesis- process, types and female gametophyte development.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                             | 12           |
| IV                                            | <b>Fertilisation and Embryogenesis</b><br>Monosporic, Bisporic and Tetrasporic development of embryosac; detailed structure of <i>Polygonum</i> type of Embryosac. Types of ovules. Pollination- Types, Self-Pollination and Cross-Pollination. Significance of Cross-Pollination. Basic concept of self-incompatibility.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                             | 12           |
| V                                             | <b>Fertilization and Embryogenesis</b><br>Pollen-pistil interaction, pollen tube entry into the ovule- Porogamy, Chalazogamy and Mesogamy. Double fertilisation and triple fusion- processes and significance. Structure, development, and types of endosperms. Development of Embryo in Dicots and Monocots. Brief account of Polyembryony, Apomixis and parthenocarpy.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                             | 12           |
| <b>References</b>                             | <b>Text Books:</b> <ol style="list-style-type: none"> <li>Bhojwani, S.S. and Bhatnagar, S.P. (2011). The Embryology of Angiosperms, Vikas Pub. House. Delhi. 5th edition.</li> <li>Verma, P.S. and Agarwal, V.K. (1999). Concept of Ecology (Environmental Biology). S. Chand &amp; Co., New Delhi.</li> <li>Dutta, A. C. (2019). Botany for Degree Students. Oxford University Press.</li> <li>Esau, K. (1953). Plant Anatomy. John Wiley &amp; Sons.</li> <li>Johri, B.M. I (1984). Embryology of Angiosperms, Springer-Verlag, Netherlands</li> <li>Pandey, B. P. (2009). Plant Anatomy and Embryology. S. Chand &amp; Company Ltd.</li> <li>Shivanna, K.R. (2003). Pollen Biology and Biotechnology. Oxford and IBH Pub. Co. Pvt. Ltd. Delhi.</li> <li>Tripathi, R. D. (2018). Introduction to Plant Anatomy. Rastogi Publications</li> <li>Fahn, A. (1990). Plant Anatomy. Pergamon Press.</li> <li>Kaur, R., &amp; Singh, J. (2019). Practical Plant Embryology. S. Chand Publishing.</li> </ol> |                                             |              |
|                                               | <b>Reference Books:</b> <ol style="list-style-type: none"> <li>Mauseth, J. D. (2012). Plant Anatomy and Development. Jones &amp; Bartlett Learning</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                             |              |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                              |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2. Singh, S., & Singh, P. K. (2015). Textbook of Embryology. CBS Publishers & Distributors Pvt. Ltd<br>3. O'Brien, T. P., & McCully, M. E. (1981). Introduction to Plant Anatomy. Academic Press.<br>4. Mauseth, J. D. (2012). Plant Anatomy: An Applied Approach. Jones & Bartlett Learning.<br>5. Irish, V. F. (2009). Plant Development and Evolution. Wiley-Blackwell.<br>6. Taiz, L., & Zeiger, E. (2010). Principles of Plant Physiology. Sinauer Associates, Inc.                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                              |
| <b>E-Resources:</b><br><a href="http://virtualplant.ru.ac.za/Main/ANATOMY/prac5.htm">http://virtualplant.ru.ac.za/Main/ANATOMY/prac5.htm</a><br><a href="https://www.youtube.com/watch?v=Q1VosdthSLM">https://www.youtube.com/watch?v=Q1VosdthSLM</a><br><a href="https://www.youtube.com/watch?v=WfURKyslthI">https://www.youtube.com/watch?v=WfURKyslthI</a><br><a href="https://www.youtube.com/watch?v=2_Kj_GtWBdU">https://www.youtube.com/watch?v=2_Kj_GtWBdU</a><br><a href="https://www.biologydiscussion.com/stems-2/dicot-stem/secondary-growth-in-dicot-stem-with-diagram/70397">https://www.biologydiscussion.com/stems-2/dicot-stem/secondary-growth-in-dicot-stem-with-diagram/70397</a><br><a href="https://www.google.com/search?q=neela+bakore+reproduction+in+flowering+plants">https://www.google.com/search?q=neela+bakore+reproduction+in+flowering+plants</a> |                                                                                                                                                                                                                                                                                                                                                              |
| <b>Course Outcomes</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | On completion of the course, students should be able to:<br>CO 1: Explain the general characteristics of plant tissues.<br>CO2: Understand the anatomy of primary structures in plants.<br>CO3: Assess the structure and morphology of pollen grain.<br>CO4: Interpret types of pollination.<br>CO5: Explain the development of embryo in dicot and monocot. |

#### Mapping of COs with PSOs:

| CO \ PSO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|----------|-------|-------|-------|-------|-------|
| CO1      | 3     | 1     | 1     | 3     | 3     |
| CO2      | 3     | 3     | 1     | 3     | 3     |
| CO3      | 3     | 2     | 1     | 3     | 3     |
| CO4      | 3     | 3     | 1     | 3     | 3     |
| CO5      | 3     | 3     | 3     | 3     | 3     |

| SEMESTER                                 | FOURTH                                                                                                                                                                                                                                                                                                                                                                                                   | COURSE CODE                                     | 26BTUC2211   |
|------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|--------------|
| Course Title                             | <b>PRACTICAL IV: PLANT ECOLOGY, CELL &amp; MOLECULAR BIOLOGY, ANATOMY AND EMBRYOLOGY OF ANGIOSPERMS</b>                                                                                                                                                                                                                                                                                                  |                                                 |              |
| No. of credits                           | 1                                                                                                                                                                                                                                                                                                                                                                                                        | No. of contact hours per week                   | 3            |
| New Course / Revised Course              | New Course                                                                                                                                                                                                                                                                                                                                                                                               | If revised, the percentage of Revision effected | -            |
| Category                                 | Core Major-7                                                                                                                                                                                                                                                                                                                                                                                             |                                                 |              |
| Scope of the Course                      | ❖ Basic understanding of plant ecology<br>❖ Developing skills to explain the structure and composition of genetic materials<br>❖ Creates an employability scope in the molecular screening laboratories                                                                                                                                                                                                  |                                                 |              |
| Cognitive Levels addressed by the course | K-1 Ability to remember molecular techniques<br>K-2 Comprehensive knowledge of mutants<br>K-3 Use molecular techniques for a better understanding of DNA<br>K-4 Capacity to understand the separation of DNA and protein<br>K-5 Make new techniques to analyse mutagenesis<br>K-6 Assessment of DNA amplification by PCR                                                                                 |                                                 |              |
| Course Objectives                        | <b>The course aims to:</b> <ul style="list-style-type: none"> <li>Impart a practical knowledge on how to measure, isolate a single colony, and check the genetic marker</li> <li>Demonstrate antibiotic resistance mechanism</li> <li>Conduct genetic mapping studies</li> <li>Determine transposon-mediated mutagenesis</li> <li>Perform mutagenesis and isolate chromosomal and plasmid DNA</li> </ul> |                                                 |              |
| EXP. No.                                 | EXPERIMENTS                                                                                                                                                                                                                                                                                                                                                                                              |                                                 | No. of Hours |
| 1.                                       | Study of ecological and anatomical modifications of xerophyte, hydrophyte, halophyte, parasite and epiphyte                                                                                                                                                                                                                                                                                              |                                                 | 3            |
| 2                                        | Estimation of COD and BOD and calculate the primary productivity of the pond                                                                                                                                                                                                                                                                                                                             |                                                 | 3            |
| 3                                        | Determination of organic matter of different soil samples by the Walkley & Black rapid titration method.                                                                                                                                                                                                                                                                                                 |                                                 | 3            |
| 4                                        | Use the Quadrat method to evaluate the minimum size of the quadrat required for a vegetation study                                                                                                                                                                                                                                                                                                       |                                                 | 3            |

|                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |   |
|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
| 5                      | Demonstration of meiosis in <i>Rhoeo/ Chlorophytum/ Maize</i> and identification of different stages of Meiosis.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 3 |
| 6                      | Demonstration of the separation of DNA by Agarose gel electrophoresis                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 6 |
| 7                      | Demonstration of PCR                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 3 |
| 8                      | Anatomy of the stem - primary structure                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 6 |
| 9                      | Root Primary Structure and Leaf Anatomy                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 3 |
| 10                     | Observation of pollen germination                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 6 |
| 11.                    | Anomalous Secondary thickening - <i>Boerhaavia, Nyctanthes</i> ,                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 6 |
| 12.                    | TS of Mature anther- <i>Datura, Ixora</i> & Types of ovules -                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 3 |
| 13.                    | Embryos of Monocots and Dicots                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 3 |
| <b>References</b>      | <ol style="list-style-type: none"> <li>Pandey, S. N. (2009). Plant Anatomy and Embryology. India: Vikas Publishing House Pvt Limited</li> <li>Bhojwani, S. S, Bhatnagar, S. P., and Dantu, P. K. (2015). The embryology of angiosperms. Vikas Publishing House</li> <li>Pandey, B P, (2001). Plant Anatomy, S Chand Publications</li> <li>Siddiqui G A, (2012). Plant Anatomy, Pragun Publications</li> <li>Odum, E.P. 2005. Fundamentals of ecology. Cengage Learning India Pvt. Ltd., New Delhi. 5th edition.</li> <li>Singh, J.S., Singh, S.P., Gupta, S. 2006. Ecology Environment and Resource Conservation. Anamaya Publications, New Delhi, India.</li> <li>Sharma, P.D. 2010. Ecology and Environment. Rastogi Publications, Meerut, India. 8th edition.</li> <li>Wilkinson, D.M. 2007. Fundamental Processes in Ecology: An Earth Systems Approach. Oxford University Press. U.S.A.</li> <li>Kormondy, E.J. 1996. Concepts of ecology. PHI Learning Pvt. Ltd., Delhi, India. (4th ed). 5. Krishnamurthy, K.V. 2004. An Advanced Text Book of Biodiversity - Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi</li> <li>Allison L.A. 2007. Fundamental Molecular Biology. Blackwell Publishing. U.S.A.</li> <li>Cooper G.M. and Hausman R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press &amp; Sunderland, Washington, D.C.; Sinauer Associates, MA.</li> <li>De Robertis E.D.P. and De Robertis E.M.F. 2006. Cell and Molecular Biology (8th ed). Lippincott Williams and Wilkins. Philadelphia.</li> <li>Friefelder D. 1987. Molecular Biology (2nd ed.). Narosa Publishing House. New Delhi.</li> <li>Karp G. 2010. Cell and Molecular Biology: Concepts and Experiments (6th ed.). John Wiley &amp; Sons. Inc.</li> <li>Krebs J.E., Goldstein E.S. and Kilpatrick S.T. 2014. Jones &amp; Bartlett Learning, LLC. Burlington, MA.</li> <li>Sheeler P. and Bianchi D.E. 2006. Cell and Molecular Biology (3rd ed.). Wiley India (P.) Ltd. New Delhi.</li> <li>Surzyeki S (2000). Basic Techniques in Molecular Biology, Springer.</li> </ol> |   |
| <b>Course Outcomes</b> | <p><b>Upon completion of this practical course, students should be able to:</b></p> <p>CO 1: Explain how to measure isolate single colony and checking genetic marker</p> <p>CO 2: Demonstrate the antibiotic resistance mechanism</p> <p>CO 3: Carry out mutagenesis and isolate chromosomal and plasmid DNA</p> <p>CO 4: Determine molecular weight of protein using PAGE</p> <p>CO5: Demonstrate PCR</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |   |

#### Mapping of COs with PSOs:

| CO \ PSO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|----------|-------|-------|-------|-------|-------|
| CO1      | 3     | 3     | 3     | 3     | 3     |
| CO2      | 3     | 3     | 3     | 3     | 3     |
| CO3      | 3     | 3     | 3     | 3     | 3     |
| CO4      | 3     | 3     | 3     | 3     | 3     |
| CO5      | 3     | 3     | 3     | 3     | 3     |

### SEMESTER V

| SEMESTER                      | FIFTH                   | COURSECODE                                  | 26BTUC3112 |
|-------------------------------|-------------------------|---------------------------------------------|------------|
| Course Title                  | TAXONOMY OF ANGIOSPERMS |                                             |            |
| No. of Credits                | 3                       | No. of contact hours per Week               | 3          |
| New Course/<br>Revised Course | New Course              | If revised, Percentage of Revision effected | -          |
| Category                      | Core Major - 8          |                                             |            |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |            |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| Scope of the Course<br>(may be more than one)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <ul style="list-style-type: none"><li>Students will understand classification systems from artificial to modern phylogeny</li><li>Students will explore the principles and rules of botanical nomenclature.</li></ul>                                                                                                                                                                                                                                                                                                                                                                       |            |
| Cognitive Levels<br>addressed by the Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | K-1: Recall key terms, definitions, and plant morphology.<br>K-2: Explain floral structures, inflorescence types, placentation, and taxonomic principles.<br>K-3: Use floral diagrams, formulas, and taxonomic keys for plant identification.<br>K-4: Compare families, study distinguishing features, and analyse species concepts.<br>K-5: Assess classification systems, nomenclature rules, and economic importance of families.<br>K-6: Prepare herbarium specimens, design digital documentation, and propose new taxonomic approaches.                                               |            |
| Course Objectives                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | The Course aims to: <ul style="list-style-type: none"><li>Enhance knowledge of plant morphology and systematics.</li><li>Learn classification systems: artificial, natural, phylogenetic, and APG.</li><li>Understand taxonomic hierarchy.</li><li>Recognise features and economic importance of major plant families.</li><li>Acquire skills in taxonomic keys, herbarium preparation, and digital documentation.</li><li>Appreciate the role of botanical gardens, surveys, and herbaria.</li><li>Develop awareness of modern trends like chemotaxonomy and molecular taxonomy.</li></ul> |            |
| Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | No.Ofhours |
| I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Introduction to Plant Morphology, Morphology of Root, Stem and Leaf - their modifications. Inflorescence types - racemose, cymose and specialised (cyathium, hypanthodium, coenanthium, verticillaster, thyrus, fascicle). Floral parts arrangement, placentation, aestivation; Floral diagram and floral formula. Types of fruits - simple, aggregate and multiple.                                                                                                                                                                                                                        | 10         |
| II                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Classification of Angiosperms– Artificial (Linnaeus'), Natural (Bentham & Hooker's) and Phylogenetic (Engler and Prantl), APG System (IV - 2016). ICBN: Rules and recommendations, a brief account of ICN. Taxonomic keys - intended (yoked) and bracketed keys.                                                                                                                                                                                                                                                                                                                            | 10         |
| III                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Typification, Author citation, effective and valid publication, rejection of names, principle of priority and its limitations; taxonomy in relation to anatomy, embryology and chemistry. Digital resources of plant taxonomy, Herbarium techniques                                                                                                                                                                                                                                                                                                                                         | 10         |
| IV                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Vegetative and floral features of the following families and their economic importance: Dicots: Ranunculaceae, Myrtaceae, Fabaceae, Cucurbitaceae, Rubiaceae, Apocynaceae, Malvaceae, Solanaceae, Acanthaceae.                                                                                                                                                                                                                                                                                                                                                                              | 8          |
| V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Vegetative and floral features of the following families and their economic importance: Dicots: Lamiaceae, Euphorbiaceae, Asteraceae, Monocots: Zingiberaceae, Orchidaceae, Poaceae, Cyperaceae                                                                                                                                                                                                                                                                                                                                                                                             | 8          |
| <b>Text Books:</b> <ol style="list-style-type: none"><li>Singh V, Jain DK (2012) – Taxonomy of Angiosperms, Rastogi Publication, Meerut</li><li>Pandey BP (2007) – Angiosperms: Taxonomy, Embryology and Anatomy, S Chand &amp; Co, New Delhi</li><li>Chopra GL (1984) – Angiosperms: Systematic and Life Cycle, Pradeep Publications, Jalandhar</li><li>Gangulee, H.C., J.S. Das &amp; C. Dutta (1982) – College Botany (5th Ed.), New Central Book Agency, Kolkata</li><li>Verma BK (2011) – Introduction to Taxonomy of Angiosperms, PHI Learning, New Delhi</li><li>Sporne, K.R. (1974) – Morphology of Angiosperms, Hutchinson University Press, London</li></ol>                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |            |
| <b>Reference Books:</b> <ol style="list-style-type: none"><li>Singh G (1999, 2012, 2018, 2019) – Plant Systematics: Theory and Practice; Plant Systematics – An Integrated Approach; Oxford &amp; IBH / CRC Press</li><li>Judd WS, Campbell CS, Kellogg AE, Stevens PF (1999) – Plant Systematics: A Phylogenetic Approach, Sinauer Associates</li><li>Simpson MG (2006, 2010, 2019) – Plant Systematics, Elsevier Academic Press</li><li>Radford AE (1974) – Vascular Plant Systematics, Harper &amp; Row Publishers</li><li>Clive A. Stace (1991) – Plant Taxonomy and Biosystematics, Cambridge University Press</li><li>Davis PH &amp; Heywood VH (1963) – Principles of Angiosperm Taxonomy, Oliver &amp; Boyd Ltd.</li><li>Lawrence GH.M. (1951) – Introduction to Plant Taxonomy; Taxonomy of Vascular Plants, Macmillan</li><li>Stuessy TF (2009) – Plant Taxonomy: The Systematic Evaluation of Comparative Data, Columbia University Press</li><li>Harris JG, Harris MW (2001) – Plant Identification Terminology: An Illustrated Glossary, Spring Lake Pub</li></ol> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |            |
| <b>E-Resources:</b> <ol style="list-style-type: none"><li><a href="https://courseware.cutm.ac.in/wp-content/uploads/2020/05/APG-SYSTEM-Note.pdf">https://courseware.cutm.ac.in/wp-content/uploads/2020/05/APG-SYSTEM-Note.pdf</a></li><li><a href="https://www.mobot.org/MOBOT/research/APweb/treeapweb2s.gif">https://www.mobot.org/MOBOT/research/APweb/treeapweb2s.gif</a></li><li><a href="https://www.digitalatlasofancientlife.org">https://www.digitalatlasofancientlife.org</a></li><li><a href="http://apps.kew.org/herbcat/navigator.do">http://apps.kew.org/herbcat/navigator.do</a></li></ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |            |

|                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                        | 5. <a href="https://efloraofindia.com/">https://efloraofindia.com/</a><br>6. <a href="https://powo.science.kew.org/">https://powo.science.kew.org/</a> 9. Page, R.D.M., Holmes, E.C. (1998). Molecular Evolution: A phylogenetic approach. Blackwell Publishing Ltd.                                                                                                                                                                                                                                         |
| <b>Course Outcomes</b> | On completion of the course, students should be able to:<br>CO1: Explain morphology and modifications of plant organs.<br>CO2: Describe inflorescence types, floral structures, and formulas.<br>CO3: Understand classification systems and nomenclature rules.<br>CO4: Demonstrate use of floral diagrams, taxonomic keys, and herbarium techniques.<br>CO5: Assess features and economic importance of major plant families.<br>CO6: Apply taxonomy in documentation, conservation, and modern approaches. |

**Mapping of COs with PSOs:**

| CO \ PSO | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|----------|------|------|------|------|------|
| CO1      | 3    | 1    | 1    | 3    | 3    |
| CO2      | 3    | 3    | 1    | 3    | 3    |
| CO3      | 3    | 2    | 1    | 3    | 3    |
| CO4      | 3    | 3    | 1    | 3    | 3    |
| CO5      | 3    | 3    | 3    | 3    | 3    |

| SEMESTER                                      | FIFTH                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | COURSECODE                              | 26BTUC3113 |
|-----------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|------------|
| Course Title                                  | PRACTICAL V- TAXONOMY OF ANGIOSPERMS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                         |            |
| No. of Credits                                | 01                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | No. of contact hours per Week           | 3          |
| New Course/<br>Revised Course                 | New Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | If revised,PercentageofRevisioneffected | -          |
| Category                                      | Core Major - 9                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                         |            |
| Scope of the Course<br>(may be more than one) | <ul style="list-style-type: none"><li>Students will learn taxonomic description and identification of plants up to the genus level.</li><li>Students will develop field-based competencies through ecological surveys and herbarium/museum visits.</li><li>Students will integrate classical floras with modern taxonomy for biodiversity and conservation studies.</li></ul>                                                                                                                                                                                                                                                                                                                               |                                         |            |
| Cognitive Levels addressed by the Course      | K-1: Recall basic taxonomic terms, diagnostic characters, and key concepts in plant classification.<br>K-2: Comprehend distinguishing features of major families and principles of artificial key construction.<br>K-3: Apply identification techniques to describe specimens and classify them up to genus level using floras.<br>K-4: Analyse morphological variations, compare family traits, and interpret ecological adaptations during fieldwork.<br>K-5: Evaluate the taxonomic significance of characters and the role of systematics in biodiversity and conservation.<br>K-6: Design artificial keys, herbarium sheets, and systematic documentation integrating classical and modern approaches. |                                         |            |
| Course Objectives                             | The Course aims to: <ul style="list-style-type: none"><li>build understanding of taxonomic principles and diagnostic features of major plant families.</li><li>train students in specimen description, identification, and artificial key construction.</li><li>provide field exposure to diverse vegetation and visits to herbaria/museums.</li><li>develop skills in herbarium techniques and systematic documentation.</li><li>integrate classical taxonomy with modern approaches for biodiversity and conservation studies.</li></ul>                                                                                                                                                                  |                                         |            |
| Exp. No                                       | EXPERIMENTS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                         | No.OfHours |
| 1                                             | Study of morphology of various parts of Angiosperms                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                         | 3          |
| 2                                             | Taxonomic description of plants of the following families: Ranunculaceae, Myrtaceae, Cucurbitaceae, Rubiaceae, Apocynaceae, Solanaceae, Acanthaceae, Lamiaceae, Euphorbiaceae, Asteraceae, Zingiberaceae, Poaceae, Cyperaceae                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                         | 15         |
| 3                                             | Describe the study specimen in technical terms and identify up to genus level using the Flora.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                         | 3          |
| 4                                             | Preparation of an artificial key to segregate any five given plants included in the syllabus.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                         | 3          |
| 5                                             | Field trip (3-5 days) to study the florain different areas/Visits to standard Herbaria, institutions or Botanical museums.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                         | 15         |
| 6                                             | Plant collection: submission of at least 25 herbarium sheets                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                         | 3          |
| 7                                             | Botanical key preparation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                         | 3          |
|                                               | Reference Books:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                         |            |

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|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                        | <ol style="list-style-type: none"> <li>1. Flora of the Presidency of Madras by J.S. Gamble (1915), Authority of the Secretary of State for India in Council.</li> <li>2. Sharma, O.P. (1996). Plant Taxonomy. TATA McGraw-Hill, New Delhi.</li> <li>3. Singh G (1999) Plant Systematics: Theory and Practices, Oxford and IBH Publishing Co, New Delhi.</li> <li>4. Singh V, Jain DK (2012) Taxonomy of Angiosperms, 2nd edition, Rastogi Publication, Meerut.</li> <li>5. Verma BK (2011) Introduction to Taxonomy of Angiosperms, PHI Learning, New Delhi.</li> <li>6. Harris, J. G., Harris, M. W. 2001. Plant Identification Terminology: An Illustrated Glossary. Spring Lake, Utah: Spring Lake Pub. Spring Lake, Utah.</li> <li>7. Simpson, M. G. (2019). Plant systematics. 3rd Edition, Academic Press</li> <li>8. Vashista, PC (1990). Taxonomy of Angiosperms – S.Chand &amp; Co., New Delhi</li> </ol> |
|                        | <b>E-Resources:</b> <ol style="list-style-type: none"> <li>1. <a href="http://apps.kew.org/herbcat/navigator.do">http://apps.kew.org/herbcat/navigator.do</a></li> <li>2. <a href="https://efloraofindia.com/">https://efloraofindia.com/</a></li> <li>3. <a href="https://powo.science.kew.org/">https://powo.science.kew.org/</a></li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Course Outcomes</b> | <p>On completion of the course, students should be able to:</p> <p><b>CO1:</b> Recall and explain fundamental concepts of plant taxonomy, diagnostic characters, and classification principles.</p> <p><b>CO2:</b> Apply techniques of specimen description and identification up to genus level using standard floras.</p> <p><b>CO3:</b> Analyze morphological variations and construct artificial keys to segregate plant specimens.</p> <p><b>CO4:</b> Evaluate the taxonomic significance of characters and the role of systematics in biodiversity and conservation.</p> <p><b>CO5:</b> Design and prepare herbarium sheets, field notes, and systematic documentation integrating classical and modern approaches.</p>                                                                                                                                                                                      |

**Mapping of COs with PSOs:**

| CO \ PSO | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|----------|------|------|------|------|------|
| CO1      | 3    | 1    | 1    | 3    | 3    |
| CO2      | 3    | 3    | 1    | 3    | 3    |
| CO3      | 3    | 2    | 1    | 3    | 3    |
| CO4      | 3    | 3    | 1    | 3    | 3    |
| CO5      | 3    | 3    | 3    | 3    | 3    |

| SEMESTER                                      | FIFTH                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | COURSE CODE                                 | 26BTUC3114   |
|-----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|--------------|
| Course Title                                  | <b>MICROBIOLOGY AND PLANT PATHOLOGY</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                             |              |
| No. of Credits                                | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | No. of contact hours per Week               | 3            |
| New Course/<br>Revised Course                 | New Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | If revised, Percentage of Revision effected | -            |
| Category                                      | Core Major -10                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                             |              |
| Scope of the Course<br>(may be more than one) | <ul style="list-style-type: none"> <li>Students will be able to develop their skills in the fundamentals of Microbiology</li> <li>Students will be able to develop Employability in various microbiological fields</li> </ul>                                                                                                                                                                                                                                                                      |                                             |              |
| Cognitive Levels addressed by the Course      | K-1: Remember the Concept and scope of microbiology<br>K-2: Understand emerging viruses and challenges<br>K-3: Apply to know microbial growth, microscopy, staining, and sterilisation techniques<br>K-4: Analyze microbial culture techniques<br>K-5: Evaluate prokaryotic and eukaryotic cell structure<br>K-6: Create knowledge on the fundamentals of microbiology.                                                                                                                            |                                             |              |
| Course Objectives                             | The Course aims to: <ul style="list-style-type: none"> <li>Enhance the students' knowledge of the historical aspects and development of microbiology</li> <li>Know about the scope of microbiology</li> <li>Give an overview of microscopy and microbial growth</li> <li>Make the students knowledgeable about the various microbial techniques involved.</li> <li>Acquire an overall knowledge of the morphology and functions of the structures within the prokaryotes and eukaryotes</li> </ul> |                                             |              |
| Unit                                          | Content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                             | No. Of hours |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                          |
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| I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>History and Scope of Microbiology</b><br>Introduction- History of Microbiology- Milestones in Microbiology. Theories of Spontaneous Generation, germ theory. Contribution of Anton Van Leeuwenhoek, Louis Pasteur, Robert Koch and Edward Jenner - Scope and Applications of Microbiology in various fields: Industries -Food, Agriculture, Environment, Medical and Research.                                                                               | 6                                                        |
| II                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>Microscopy and Staining</b><br>Microscopy- Principles and applications of Simple, Compound, Phase contrast, Fluorescent, SEM and TEM- Specimen preparations for Electron Microscope. Principles and types of staining- Simple, Differential (Gram's, Spore and Capsule).                                                                                                                                                                                     | 8                                                        |
| III                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>Sterilization Techniques and microbial culture</b><br>Sterilization, Principles and types: Physical- Moist heat- Dry heat- Filtration (Membrane), Radiations, Chemical agents- Mode of action. Preservation and maintenance methods of microbial cultures (slant culture, stab culture, soil culture, mineral oil overlaying, refrigeration, glycerol preservation, cryopreservation, lyophilization). National and international Culture Collection Centres | 12                                                       |
| IV                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>Microbial Culture Media and inoculation</b><br>Microbial growth and nutritional requirements. Batch-Continuous-Synchronous culture. Growth curve. Culture and media preparation-Types of media – Liquid, semi-solid, Solid, Natural, semi-synthetic, Synthetic, enriched, Selective, Differential media. Isolation-Serial dilution techniques- Pure culture techniques-Pour plate, Spread plate and Streak plate                                             | 12                                                       |
| V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>General symptoms of plant diseases</b><br>Geographical distribution of diseases, Aetiology, General characteristics of Bacteria and Viruses. Host-Pathogen relationships, Disease cycle and environmental relation, prevention and control of the following plant diseases. Bacterial diseases – Citrus canker. Viral diseases – Tobacco Mosaic Fungal diseases Tikka-disease of groundnut.                                                                  | 10                                                       |
| <b>Text Books:</b> <ol style="list-style-type: none"> <li>1. Pandey, B.P. 1997. College Botany. Vol. I Fungi &amp; Pathology.</li> <li>2. Mehrotra, R.S and Aneja, K.R. 2003. An introduction to mycology. New age International (P) Ltd, Publishers, New Delhi.</li> <li>3. Poonam Singh and Ashok Pandey. 2009. Biotechnology for agro-Industrial residues utilization. Springer.</li> <li>4. Satyanarayana T and Johri B.N. 2005. Microbial diversity, Current Perspectives and Potential Applications, IK International.</li> <li>5. Nair, L.N. 2007. Topics in Mycology and Pathology, New Central Book agency, Kolkata.</li> <li>6. Sharma, P.D. 2011. Plant Pathology, Rastogi Publication, Meerut, India</li> <li>7. Mahendra Rai. 2009. Advances in Fungal Biotechnology. I.K. International Publishing House, New Delhi.</li> </ol> <b>Reference Books:</b> <ol style="list-style-type: none"> <li>1. Alexopoulos, C.J., Mims, C.W., Blackwell, M. 1996. Introductory Mycology. 4th edition. John Wiley &amp; Sons (Asia) Singapore.</li> <li>2. Webster, J and Weber, R. 2007. Introduction to Fungi. 3rd edition. Cambridge University Press, Cambridge.</li> <li>3. Sharma, O.P. 2011. Fungi and allied microbes The McGraw –Hill companies, New Delhi.</li> <li>4. Burnett, J.H. 1971. The fundamentals of Mycology. ELBS Publication, London.</li> <li>5. Bessey, E.A. 1979. Morphology and Taxonomy of fungi, Vikas publishing House Pvt. Ltd, New Delhi.</li> <li>6. Dharani Dhar Awasthi. 2000. A Handbook of Lichens Vedams eBooks (P) Ltd. New Delhi.</li> <li>7. Pelzer, M.J., Chan, E.C.S and Krieg, N.R. 1983. Microbiology, Tata McGraw Hill Publishing House, New Delhi.</li> <li>8. Pandey, P.B. 2014. College Botany- 1: Including Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta. Chand Publishing, New Delhi.</li> <li>9. Mishra, A. and Agarwal, R.P. 1978. Lichens – A Preliminary Text. Oxford and IBH.</li> <li>10. Pandey, B.P. 2005. College Botany I: Including Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta. S Chand &amp; Company</li> </ol> <b>E-Resources:</b> <ol style="list-style-type: none"> <li>1. <a href="https://www.amazon.in/Fungi-Sarah-C-Watkinson-ebook/dp/B0199YFDFE">https://www.amazon.in/Fungi-Sarah-C-Watkinson-ebook/dp/B0199YFDFE</a></li> <li>2. <a href="http://www.freebookcentre.net/biology-books-download/A-text-book-of-mycology-and-plantpathology.html">http://www.freebookcentre.net/biology-books-download/A-text-book-of-mycology-and-plantpathology.html</a></li> <li>3. <a href="http://www.freebookcentre.net/Biology/Mycology-Books.html">http://www.freebookcentre.net/Biology/Mycology-Books.html</a></li> <li>4. <a href="https://www.kobo.com/us/en/ebook/introduction-to-fungi">https://www.kobo.com/us/en/ebook/introduction-to-fungi</a></li> <li>5. <a href="http://www.freebookcentre.net/biology-books-download/Introductory-Mycology.html">http://www.freebookcentre.net/biology-books-download/Introductory-Mycology.html</a></li> </ol> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                          |
| <b>Course Outcomes</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | On completion of the course, students should be able to: |

|  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | <ol style="list-style-type: none"> <li>1. Enhance the students' knowledge of the historical aspects and development of microbiology</li> <li>2. Know about the scope of microbiology</li> <li>3. Give an overview of microscopy and microbial growth</li> <li>4. Make the students knowledgeable about the various microbial techniques involved.</li> <li>5. Acquire an overall knowledge of the morphology and functions of the structures within the prokaryotes and eukaryotes</li> </ol> |
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| SEMESTER                                      | FIFTH                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | COURSECODE                                  | 26BTUC3115 |
|-----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|------------|
| Course Title                                  | <b>PLANT BIOTECHNOLOGY AND GENETIC ENGINEERING</b>                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                             |            |
| No. of Credits                                | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | No. of contact hours per Week               | 3          |
| New Course/<br>Revised Course                 | New Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | If revised, Percentage of Revision effected | -          |
| Category                                      | Core Major -10                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                             |            |
| Scope of the Course<br>(may be more than one) | <ul style="list-style-type: none"> <li>• Students will be able to understand the fundamentals of plant Biotechnology</li> <li>• Students will be able to apply theoretical knowledge to practical experiments</li> </ul>                                                                                                                                                                                                                                                                   |                                             |            |
| Cognitive Levels addressed by the Course      | K-1: Recall basic terms, definitions, and key concepts in Plant Biotechnology.<br>K-2: Understand the basic infrastructure of the tissue culture lab.<br>K-3: Applying knowledge in the techniques of plant tissue culture.<br>K-4: Analysis of gene transfer methods in plants.<br>K-5: Evaluate the quality of genetically modified crops.<br>K-6: Design experiments, models, or new ideas in plant biotechnology.                                                                      |                                             |            |
| Course Objectives                             | The Course aims to: <ul style="list-style-type: none"> <li>• Enhance students' knowledge of the fundamental concepts and processes of plant biotechnology.</li> <li>• Understand sterilisation methods for chemicals and glassware.</li> <li>• Gain insight into the protocol of tissue culture</li> <li>• Learn about recombinant DNA technology.</li> <li>• Understand disease resistance in transgenic plants.</li> <li>• Acquire practical knowledge on gene editing tools.</li> </ul> |                                             |            |
| Unit                                          | Content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                             | No.Ofhours |
| I                                             | <b>Plant Tissue Culture</b><br>Basic infrastructure of tissue culture lab; Equipment and Instruments; Sterilisation methods for chemicals and glasswares; Composition of media (MS Medium in detail); Nutrient and hormone requirements; Basic protocol of tissue culture - explant selection, sterilisation, inoculation, subculture, maintenance and environmental conditions.                                                                                                           |                                             | 6          |
| II                                            | <b>Plant Tissue Culture-Techniques:</b> Regeneration Protocols: Callus induction, Organogenesis and Somatic Embryogenesis. Single Cell Culture - Cell suspension cultures; Protoplast isolation, culture and fusion. Meristem culture- virus-free plant production, synthetic seeds. Applications of Plant Tissue Culture.                                                                                                                                                                 |                                             | 8          |
| III                                           | <b>Genetic engineering</b><br>Components of plant genetic engineering. molecular tools – nomenclature and characteristics of Restriction enzymes, DNA-modifying enzymes. Vectors used in molecular cloning: Plasmids – properties and classification; PBR322 pUC 18. lambda (gt 10) and M13 phage vector. Cosmids (pJB 8), Yeast vectors                                                                                                                                                   |                                             | 12         |
| IV                                            | <b>Recombinant DNA Technology and Molecular Tools</b><br>rDNA definition, steps involved (outline); Gene transfer methods in plants - Direct gene transfer - electroporation, microinjection, microprojectile /particle bombardment; Indirect gene transfer - Agrobacterium mediated gene transfer, Selection of recombinant clones, PCR, RT-PCR – Principle and Applications. DNA Sequencing – Sanger's method. Molecular Markers. DNA fingerprinting and Plant DNA Barcoding.            |                                             | 12         |
| V                                             | <b>Trends in Plant Biotechnology</b><br>Gene editing tools: CRISPR-Cas9 (Brief account). Genetically Modified (GM) crops - Pest-resistant (Bt cotton); Improved quality traits (Flavr Savr tomato, Golden rice); Edible vaccines. Disease resistance in transgenic plants. Biosafety and bioethics of transgenic plants.                                                                                                                                                                   |                                             | 10         |
|                                               | <b>Text Books:</b> <ol style="list-style-type: none"> <li>1. Bhojwani SS &amp; Dantu PK (2013) Plant Tissue Culture: An Introductory Text, Springer</li> <li>2. Park S (2021) Plant Tissue Culture: Techniques and Experiments, Fourth Edition, Academic Press, Elsevier</li> <li>3. Razdan MK (2003) Introduction to Plant Tissue Culture, Science Publishers, USA</li> </ol>                                                                                                             |                                             |            |

|                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                       | 4. Singh, B.D. (2006) Plant Biotechnology, Kalyani Publications<br>5. Dubey, R.C. (2001, 2004, 2006) A Textbook of Biotechnology, S. Chand & Co., New Delhi<br>6. Gupta, P.K. (1994, 2000, 2004) Elements of Biotechnology, Rastogi Publications, Meerut<br>7. Purohit, S.S. (2005) Biotechnology Fundamentals & Applications, Student Edition, India<br>8. Das H.K. (2010) Textbook of Biotechnology, Wiley India Pvt Ltd, New Delhi<br>9. Chawla H.C. (2003) Plant Biotechnology – Laboratory Manual for Plant Biotechnology, Oxford & IBH Publishing Co. Pvt. Ltd.<br>10. Ignacimuthu, S.J. (2003) Plant Biotechnology, Oxford & IBH Publishing, New Delhi<br>11. John Jothi Prakash, E. (2005) Outlines of Plant Biotechnology, EmkayPb., New Delhi<br>12. Kalyankumar De (2008) Plant Tissue Culture, New Central Book Agency, Calcutta<br>13. Sathyanarayana BN & Vergheese DB (2007) Plant Tissue Culture – Practices and New Experimental Protocols, ILK Publ., New Delhi<br>14. Timir Baran Jha & Biswajit Ghosh (2016) Plant Tissue Culture, Platinum Publishers, Kolkata                                           |
|                       | <b>Reference Books:</b><br>1. Chawla H. S (2009): Introduction to Plant Biotechnology 3rd Edition, Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.<br>2. Desmond S. T Nicholl (2008): An Introduction to Genetic Engineering; Studies in Biology. Cambridge University Press. 3rd Edition.<br>3. Keshavachandran R and Peter K V (2008): Plant Biotechnology: Methods in Tissue Culture and Gene Transfer. Orient Blackswan.<br>4. Razdan M K. (2015): Introduction to Plant Tissue Culture. Oxford and IBH, MKM Publishers 2nd. Edition<br>5. Bhojwani, S.S. & Razdan, M.K. (2004). Plant Tissue Culture, Read Elsevier India Pvt. Ltd.<br>6. Brown TA (2006). Gene cloning and DNA analysis. Blackwell scientific publishers<br>7. Prime rose SB, Twyman RM & old RW (2001). Principle of gene manipulation; an Introduction to genetic engineering. 6th Ed Blackwell oxford.<br>8. Sahni S, Prasad BD & Kumar P (2017) <i>Plant Biotechnology: Transgenics, Stress Management and Biosafety Issues</i> , CRC Press                                                                                                        |
|                       | <b>E-Resources:</b><br>1. <a href="https://plantcelltechnology.com/blogs/free-resources">https://plantcelltechnology.com/blogs/free-resources</a><br>2. <a href="https://ncert.nic.in/textbook/pdf/lebt107.pdf">https://ncert.nic.in/textbook/pdf/lebt107.pdf</a><br>3. <a href="https://www.deshbandhucollege.ac.in/pdf/e-resources/bio-chemistry/BCH%28H%29-VI%20Advanced%20Cell%20Biology-1.pdf">https://www.deshbandhucollege.ac.in/pdf/e-resources/bio-chemistry/BCH%28H%29-VI%20Advanced%20Cell%20Biology-1.pdf</a><br>4. <a href="https://alison.com/course/introduction-to-recombinant-dna-technology">https://alison.com/course/introduction-to-recombinant-dna-technology</a><br>5. <a href="https://www.amrita.edu/course/msc-molecular-medicine-recombinant-dna-technology/">https://www.amrita.edu/course/msc-molecular-medicine-recombinant-dna-technology/</a><br>6. <a href="https://reach.cdc.gov/course/basic-molecular-biology-module-4-polymerase-chain-reaction-pcr-and-real-time-pcr">https://reach.cdc.gov/course/basic-molecular-biology-module-4-polymerase-chain-reaction-pcr-and-real-time-pcr</a> |
| <b>CourseOutcomes</b> | On completion of the course, students should be able to:<br>1. Understand the basic concepts and principles of plant biotechnology.<br>2. Comprehend the requirements of hormones and nutrients for plant tissue culture.<br>3. Develop skills in plant tissue culture techniques, including micropropagation, callus culture, and somatic embryogenesis.<br>4. Apply tissue culture methods for plant breeding and conservation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

#### Mapping of COs with PSOs:

| CO \ PSO | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|----------|------|------|------|------|------|
| CO1      | 3    | 1    | 1    | 3    | 3    |
| CO2      | 3    | 3    | 1    | 3    | 3    |
| CO3      | 3    | 2    | 1    | 3    | 3    |
| CO4      | 3    | 3    | 1    | 3    | 3    |
| CO5      | 3    | 3    | 3    | 3    | 3    |

| SEMESTER                      | FIFTH                                                                                                   | COURSECODE                                  | 26BTUC3116 |
|-------------------------------|---------------------------------------------------------------------------------------------------------|---------------------------------------------|------------|
| Course Title                  | <b>PRACTICAL VI: MICROBIOLOGY &amp; PLANT PATHOLOGY AND PLANT BIOTECHNOLOGY AND GENETIC ENGINEERING</b> |                                             |            |
| No. of Credits                | 3                                                                                                       | No. of contact hours per Week               | 3          |
| New Course/<br>Revised Course | New Course                                                                                              | If revised, Percentage of Revision effected | -          |
| Category                      | Core Major - 10                                                                                         |                                             |            |

| Scope of the Course<br>(may be more than one)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <ul style="list-style-type: none"> <li>Students will be able to develop skills in microbiology and plant biotechnology</li> <li>Students will be able to apply theoretical knowledge through practical experiments</li> </ul>                                                                                                                                                                                                                                                                                         |            |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| Cognitive Levels<br>addressed by the Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | K-1: Recall basic terms, definitions, and key concepts in microbiology and plant biotechnology<br>K-2: Understanding the processes and mechanisms clearly.<br>K-3: Applying knowledge in practical examples.<br>K-4: Analysis through comparison, differentiation, and interpretation.<br>K-5: Evaluate the importance, significance, and outcomes of plant biotechniques.<br>K-6: Design experiments, models, or new ideas in microbiology and plant biotechnology.                                                  |            |
| Course Objectives                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | The Course aims to: <ul style="list-style-type: none"> <li>Enhance students' knowledge of the fundamental concepts and processes of microbiology and plant biotechnology</li> <li>Understand staining of bacteria.</li> <li>Gain insight into serial dilution.</li> <li>Learn about the preparation of MS Medium using stock solutions and ready-made medium.</li> <li>Explore pure bacterial culture by the streak plate method.</li> <li>Acquire practical knowledge of DNA isolation from plant tissues</li> </ul> |            |
| Exp. No                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | EXPERIMENTS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | No.OfHours |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Preparation of tissue culture media- semisolid & solid                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 3          |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Isolation of microbes from soil by serial dilution using a spread plate                                                                                                                                                                                                                                                                                                                                                                                                                                               | 6          |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Isolation of pure bacterial culture by the streak plate method                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 3          |
| 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Staining of bacteria: Gram's staining                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 3          |
| 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Demonstration of bacterial motility by the hanging drop method                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 3          |
| 6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Test for the presence of coliform bacteria in contaminated water                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 6          |
| 7                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Analysis of infected leaf samples                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 3          |
| 8                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | The preparation of MS Medium using stock solutions and ready-made medium                                                                                                                                                                                                                                                                                                                                                                                                                                              | 3          |
| 9                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Sterilization and inoculation of explants on culture media.                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 3          |
| 10                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | micropropagation and artificial seeds protocol                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 3          |
| 11                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Study different cloning vectors and parts using virtual media                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 3          |
| 12                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | DNA isolation from plant tissues (Demonstration only)                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 3          |
| <b>Reference Books:</b> <ol style="list-style-type: none"> <li>Das, Sand Saha, R. 2020. Microbiology Practical Manual. CBS Publishers and Distributors (P) Ltd., New Delhi, India.</li> <li>Kanika Sharma (2009). Manual of Microbiology, Ane Books Pvt. Ltd.</li> <li>Gunasekharan G. (2007). Laboratory Manual of Microbiology – New Age Pub:</li> <li>Satyanarayana T and Johri B.N. 2005. Microbial diversity, Current Perspectives and Potential Applications, IK International.</li> <li>Raina Maier M. Iran Pepper L., Charles P. Gerba, 2000, Environmental Microbiology, Academic press, U.K.</li> <li>Dubey R.C. 2004. A textbook of Biotechnology aspects of microbiology, British Sun Publication.</li> <li>Joanne M. Willey, Linda M. Sherwood, C.J. Woolverton (2017). Prescott's Microbiology. 10th Edition. McGraw Hills. International Edition. Singapore.</li> <li>Microbiology: An Introduction by Gerard J. Tortora, Berdell R. Funke, Christine L. Case 2015</li> <li>Pelczar, M.J. (2001) Microbiology, 5th edition. New Delhi, Delhi: Tata Mc-Graw- Hill Co.</li> <li>Keshavachandran R and Peter K V (2008): Plant Biotechnology: Methods in Tissue Culture and Gene Transfer. Orient Blackswan.</li> <li>Harisha S. 2007. Biotechnology Procedures and Experiments Handbook. Infinity Science Press Llc. Hingham. MA.</li> <li>Purohit, SS. (2005). Biotechnology Fundamentals &amp; Applications. 3 rd Ed. Mrs. Saraswathi Purohit for student Edition, India.</li> <li>Gayathri M C (2015), Plant Tissue Culture: Protocols in Plant Biotechnology, Narosa Publishers Pvt Ltd</li> <li>Janardhanan S and Vincent S (2007) Practical Biotechnology, Universities Press</li> <li>Razdan M. K. (2016) An introduction to Plant Tissue Culture, Oxford and I B H publishers</li> </ol> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |            |
| <b>E-Resources:</b> <ol style="list-style-type: none"> <li><a href="http://www.cuteri.eu/microbiologia/manuale_microbiologia_pratica.pdf">http://www.cuteri.eu/microbiologia/manuale_microbiologia_pratica.pdf</a></li> <li><a href="https://conductscience.com/microbiology-techniques">https://conductscience.com/microbiology-techniques</a></li> <li><a href="https://www.clinicalmicrobiologyandinfection.com/article/S1198-743X(23)00059-9/fulltext">https://www.clinicalmicrobiologyandinfection.com/article/S1198-743X(23)00059-9/fulltext</a></li> <li><a href="https://dnrcollege.org/2024/eContent/BT/3.1M.pdf">https://dnrcollege.org/2024/eContent/BT/3.1M.pdf</a></li> <li><a href="https://bpchalihacollege.org.in/online/attendance/classnotes/files/1627706704.pdf">https://bpchalihacollege.org.in/online/attendance/classnotes/files/1627706704.pdf</a></li> <li><a href="https://www.tnu.in/wp-content/uploads/2021/09/Micro-Propagation-Technologies-EC-AGP-508-">https://www.tnu.in/wp-content/uploads/2021/09/Micro-Propagation-Technologies-EC-AGP-508-</a></li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |            |

|                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                        | <a href="#">Practical-Manual.pdf</a><br>8. <a href="https://www.mdpi.com/2073-4395/7/4/71">https://www.mdpi.com/2073-4395/7/4/71</a><br>9. <a href="https://dpvipracollege.ac.in/wp-content/uploads/2023/01/Lab-Manual-PLANT-TISSUE-CULTURE.pdf">https://dpvipracollege.ac.in/wp-content/uploads/2023/01/Lab-Manual-PLANT-TISSUE-CULTURE.pdf</a><br>10. <a href="https://www.careers360.com/biology/cloning-vector-topic-pge">https://www.careers360.com/biology/cloning-vector-topic-pge</a><br>11. <a href="https://experiments.springernature.com/articles/10.1007/978-1-4939-3185-9_17">https://experiments.springernature.com/articles/10.1007/978-1-4939-3185-9_17</a> |
| <b>Course Outcomes</b> | On completion of the course, students should be able to:<br><b>CO1:</b> Explain fundamental concepts and processes of microbiology and plant biotechnology<br><b>CO2:</b> Describe different cloning vectors and parts<br><b>CO3:</b> Identify genetically modified plants.<br><b>CO4:</b> Demonstrate sterilization and inoculation of explants<br><b>CO5:</b> Assess the presence of coliform bacteria in contaminated water<br><b>CO6:</b> Apply knowledge to handle instruments like PCR.                                                                                                                                                                                |

**Mapping of COs with PSOs:**

| CO \ PSO | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|----------|------|------|------|------|------|
| CO1      | 3    | 1    | 1    | 3    | 3    |
| CO2      | 3    | 3    | 1    | 3    | 3    |
| CO3      | 3    | 2    | 1    | 3    | 3    |
| CO4      | 3    | 3    | 1    | 3    | 3    |
| CO5      | 3    | 3    | 3    | 3    | 3    |

| SEMESTER                                      | FIFTH                                                                                                                                                                                                                                                                                                                                                                                                                 | COURSECODE                                  | 26BTUC3109   |
|-----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|--------------|
| Course Title                                  | <b>HERBAL TECHNOLOGY</b>                                                                                                                                                                                                                                                                                                                                                                                              |                                             |              |
| No. of Credits                                | 04                                                                                                                                                                                                                                                                                                                                                                                                                    | No. of contact hours per Week               | 04           |
| New Course/<br>Revised Course                 | New Course                                                                                                                                                                                                                                                                                                                                                                                                            | If revised, Percentage of Revision effected | -            |
| Category                                      | CoreMinor - 5                                                                                                                                                                                                                                                                                                                                                                                                         |                                             |              |
| Scope of the Course<br>(may be more than one) | <ul style="list-style-type: none"> <li>Students will understand the processing and storage of herbs</li> <li>Students will apply theoretical knowledge to develop as entrepreneurs</li> </ul>                                                                                                                                                                                                                         |                                             |              |
| Cognitive Levels addressed by the Course      | K-1: Recall key terms and definitions in herbal technology<br>K-2: Understand types of extracts.<br>K-3: Apply knowledge in compound separation.<br>K-4: Analyse the extraction of essential oils.<br>K-5: Evaluate the significance of herbs in traditional health management.<br>K-6: Develop biobased products from herbal plants.                                                                                 |                                             |              |
| Course Objectives                             | The Course aims to: <ul style="list-style-type: none"> <li>Enhance students' knowledge of the concept of herbs.</li> <li>Understand the extraction, separation and characterisation techniques.</li> <li>Gain insight into the historical perspective of herbs in traditional health management.</li> <li>Learn about surfactants and conditioners from herbs.</li> </ul> Explore the role of herbs as a healthy food |                                             |              |
| Unit                                          | Content                                                                                                                                                                                                                                                                                                                                                                                                               |                                             | No. Of hours |
| I                                             | <b>Herbals-Processing and Extraction:</b> Concepts of herbals; Collection, processing and storage of herbals; Types of extracts- Decoction, Infusion, Digestion, Tinctures, Liquid extracts, Soft extracts, Dry extracts; Methods of extraction- Maceration and Digestion, Percolation, Soxhlet Extraction, Extraction of essential oils (Water and Steam Distillation).                                              |                                             | 10           |
| II                                            | <b>Advanced Extraction, Separation &amp; Characterisation techniques:</b> Liquid-liquid extraction techniques, lyophilisation; Chromatographic techniques: column chromatography - principle, methodology and applications, TLC, principle and application; Spectroscopic techniques to characterize the phytochemicals: UV/Visible, IR, NMR, Mass Spectroscopy - principle, methods and applications.                |                                             | 10           |

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|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| III                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>Herbal medicines in domestic products:</b> Historical perspective of herbs in traditional health management; Ethnobotanical and medicinal importance of <i>Catharanthus roseus</i> and <i>Digitalis purpurea</i> . Preparation of herbal mosquito liquid repellent, cream (ointment), herbal juice for gastric problems - indigestion, antacids, and constipation. Preparation of herbal plant crude extract - decoction for cough, cold and sanitiser. | 10 |
| IV                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>Herbals in cosmetics:</b> Herbal sources of fixed oils, waxes, gums, bleaching agents, antioxidants for skin and hair care; Herbals in Shampoos, surfactants and conditioners; Plant-based hair colourants; Plant-based products in hair fall control; Herbals in oral health and hygiene; Herbals as sources of fragrances (lavender, rose, rosemary).                                                                                                 | 10 |
| V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>Nutraceuticals and Health Benefits</b><br>General aspects, growth, scope, and types of products available in the market. Role of herbals as healthy food: Ginger, Fenugreek, Garlic, and Spirulina. Herbal nutraceuticals and their role in managing Diabetes, cardiovascular diseases, Cancer, and various gastrointestinal diseases                                                                                                                   | 8  |
| <p><b>Text Books:</b></p> <ol style="list-style-type: none"> <li>1. Agarwal, S.S. and Paridhavi, M., —Herbal Drug Technology  Universities Press (India) Private Limited, 2007.</li> <li>2. Panda H (2004) Handbook of Herbal Drugs and its plant sources</li> <li>3. Khare, C.P. (2004) Indian Herbal remedies: Rational Western therapy, Ayurvedic and other usage, Botany, Springer.</li> <li>4. Daniel, M., —Herbal Technology: Concepts and Advances, Satish Serial Publishing House, 2008.</li> </ol> <p><b>Reference Books:</b></p> <ol style="list-style-type: none"> <li>1. Braithwaite, A. and Smith, F.J. 1996. Chromatographic Methods (5th ed) Blackie Academic &amp; Professional, London.</li> <li>2. Vipin Kumar Singh, VP, Das S, Kumar M.(2018). Bioprospection of Traditionally Used Medicinal Plants: An Overview.</li> <li>3. Budzikiewicz, H., Djerassi, C. and Williams, D.H. 1968. Mass Spectrometry of Organic Compounds. Holden-Day, San Francisco, CA.</li> <li>4. Wilson, K. and Walker, J. (Eds). 1994. Principles and Techniques of Practical Biochemistry (4th ed) Cambridge University Press, Cambridge</li> </ol> <p><b>E-Resources:</b></p> <ol style="list-style-type: none"> <li>1. <a href="https://www.ramauniversity.ac.in/online-study-material/pharmacy/bpharma/visemester/herbaldrugtechnology/lecture-1.pdf">https://www.ramauniversity.ac.in/online-study-material/pharmacy/bpharma/visemester/herbaldrugtechnology/lecture-1.pdf</a></li> <li>2. <a href="https://asccollegekolhar.in/wp-content/themes/kolhar/essentials/pdf/elearning/Chemistry/F.Y.B.SC_Chemistry/FYBSc_Chromatographic_Technique.pdf">https://asccollegekolhar.in/wp-content/themes/kolhar/essentials/pdf/elearning/Chemistry/F.Y.B.SC_Chemistry/FYBSc_Chromatographic_Technique.pdf</a></li> <li>3. <a href="https://www.slideshare.net/slideshow/spectroscopy-in-pharmacognosy/200240641">https://www.slideshare.net/slideshow/spectroscopy-in-pharmacognosy/200240641</a></li> <li>4. <a href="https://pharmedicopublishers.com/assets/articles/1735356306.pdf">https://pharmedicopublishers.com/assets/articles/1735356306.pdf</a></li> </ol> |                                                                                                                                                                                                                                                                                                                                                                                                                                                            |    |
| <p><b>Course Outcomes</b></p> <p>On completion of the course, students should be able to:</p> <p><b>CO1:</b> Explain methods of extraction in herbal plants</p> <p><b>CO2:</b> Describe spectroscopic techniques</p> <p><b>CO3:</b> Understand preparation of herbal plant crude extract.</p> <p><b>CO4:</b> Demonstrate herbs in cosmetics.</p> <p><b>CO5:</b> Assess the role of herbal nutraceuticals.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                            |    |

#### Mapping of COs with PSOs:

| CO \ PSO | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|----------|------|------|------|------|------|
| CO1      | 3    | 1    | 1    | 3    | 3    |
| CO2      | 3    | 3    | 1    | 3    | 3    |
| CO3      | 3    | 2    | 1    | 3    | 3    |
| CO4      | 3    | 3    | 1    | 3    | 3    |
| CO5      | 3    | 3    | 3    | 3    | 3    |

## SEMESTER VI

| SEMESTER                                      | SIXTH                                                                                                                                                                                                                                                                                                                                                                                                                                        | COURSECODE                                  | 26BTUC3218 |
|-----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|------------|
| Course Title                                  | <b>GENETICS AND BIOSTATISTICS</b>                                                                                                                                                                                                                                                                                                                                                                                                            |                                             |            |
| No. of Credits                                | 3                                                                                                                                                                                                                                                                                                                                                                                                                                            | No. of contact hours per Week               | 3          |
| New Course/<br>Revised Course                 | New Course                                                                                                                                                                                                                                                                                                                                                                                                                                   | If revised, Percentage of Revision effected | -          |
| Category                                      | Core Major- 12                                                                                                                                                                                                                                                                                                                                                                                                                               |                                             |            |
| Scope of the Course<br>(may be more than one) | <ul style="list-style-type: none"> <li>Students will be able to develop their skills in genetics and plant breeding.</li> <li>Students will be able to develop Employability in various botanical fields.</li> </ul>                                                                                                                                                                                                                         |                                             |            |
| Cognitive Levels addressed by the Course      | K-1:Remember Basic Concepts in Genetics<br>K-2:Understanding the plant breeding and selection techniques.<br>K-3:Apply to know about population genetics<br>K-4:Analyzetechniques in plant breeding<br>K-5: Evaluate sex determination in plants<br>K-6:Create knowledge on genetics and plant breeding                                                                                                                                      |                                             |            |
| Course Objectives                             | The Course aims to: <ul style="list-style-type: none"> <li>Understand the basic principles of inheritance</li> <li>Predict the pattern of inheritance</li> <li>Understand the genetic variation within and between the population</li> <li>Make the students knowledgeable about the genetic basis of breeding</li> <li>Acquire knowledge on hybridization technique.</li> </ul>                                                             |                                             |            |
| Unit                                          | Content                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                             | No.Ofhours |
| I                                             | <b>Introduction, Basic Principles and Concepts of Genetics</b><br>Introduction to Mendelian Principles, Laws of Inheritance, Monohybrid and Dihybrid Cross. Modifications of Mendelian ratios: Incomplete Dominance and Codominance, interaction of genes, Lethal genes, Duplicate Gene, Dominant and Recessive epistasis, Complementary Genes, Concepts of chromosome, allele and gene, chromosome theory of inheritance, Multiple alleles. |                                             | 10         |
| II                                            | <b>Linkage, Crossing Over and Mutation</b><br>Linkage - Complete and Incomplete linkage, Crossing Over: concept, mechanism, Structural changes in chromosomes - Deletion, Duplication, Translocation and Inversion. Numerical changes in chromosomes. Mutation: causes and effects, types of mutagens and practical applications.                                                                                                            |                                             | 09         |
| III                                           | <b>Sex Determination and Sex linked inheritance</b><br>Sex Determination: XX XY, XX-XO, ZZ-ZW, Haplo-Diplo system, genic balance system. X-linked inheritance; Y-linked inheritance. Sex-limited Inheritance, Mechanisms of sex determination in plants ( <i>Melandrium album</i> ). Cytoplasmic Inheritance: Kappa particles in <i>Paramecium</i> , leaf variegation in <i>Mirabilis jalapa</i> . Brief account of Sex linked inheritance.  |                                             | 10         |
| IV                                            | <b>Biostatistics I</b><br>Statistical methods- basic principles, sampling methods (random and stratified sampling); Collection of primary and secondary data, its tabulation and presentation. Measures of central tendency - Mean, median, mode, standard deviation, standard error.                                                                                                                                                        |                                             | 09         |
| V                                             | <b>Biostatistics II</b><br>Correlation and regression analysis, chi-square test, Student's t-test; merits and demerits of measures of central tendency. Probability distributions: Binomial, Poisson and Normal Distributions. Brief account of statistical software – SPSS, PRISM, XLSTAT.                                                                                                                                                  |                                             | 10         |
| References                                    | <b>Text Books:</b><br>1. Acquaah G. 2010. Principles of Plant Genetics and Breeding. Wiley India Pvt Ltd., New Delhi.<br>2. Chaudhari H.K. 1984. Elementary Principles of Plant Breeding (2nd ed.). Oxford – IBH. New Delhi.<br>3. Gupta, P.K. 2018 -19. Genetics. Revised edition. Rastogi Publications, Meerut<br>4. John Ringo 2004. Fundamental Genetics Cambridge University Press.                                                     |                                             |            |
|                                               | <b>Reference Books:</b><br>1. Annadurai, B. 2007. Text Book of Biostatistics. New Age International, New Delhi..<br>2. Allard, R. W. 1999. Principles of plant breeding. John Wiley and Sons<br>3. Pierce B.A. 2011. Genetics: A Conceptual Approach (4th ed.). Macmillan Higher Education Learning. U.K.<br>4. Snustad D.P. and Simmons M.J. 2010. Principles of Genetics (5th ed.). John Wiley & Sons Inc. India.                          |                                             |            |

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|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                       | <b>E-Resources:</b><br>1. <a href="https://egyankosh.ac.in/bitstream/123456789/83794/1/Unit-1.pdf">https://egyankosh.ac.in/bitstream/123456789/83794/1/Unit-1.pdf</a><br>2. <a href="https://www.kobo.com/us/en/ebooks/biostatistics">https://www.kobo.com/us/en/ebooks/biostatistics</a><br>3. <a href="https://www.amazon.in/Biostatistics-Veer-Bala-Rastogi-ebook/dp/B07LDCPXDG">https://www.amazon.in/Biostatistics-Veer-Bala-Rastogi-ebook/dp/B07LDCPXDG</a> |
| <b>CourseOutcomes</b> | On completion of the course, students should be able to:<br>CO 1: Discuss important historical aspects<br>CO2: Describe principles and applications of microscopy and staining techniques<br>CO3: Identify key structures and their functions in both eukaryotes and Prokaryotes<br>CO4: Perform sterilization techniques for microbial control<br>CO5: Assess the microbial growth and demonstrate the different cultural techniques in microbiology             |

### Mapping of COs with PSOs:

| CO \ PSO | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|----------|------|------|------|------|------|
| CO1      | 3    | 1    | 1    | 3    | 3    |
| CO2      | 3    | 3    | 1    | 3    | 3    |
| CO3      | 3    | 2    | 1    | 3    | 3    |
| CO4      | 3    | 3    | 1    | 3    | 3    |
| CO5      | 3    | 3    | 3    | 3    | 3    |

| SEMESTER                                      | SIXTH                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | COURSE CODE                                 | 26BTUC3119   |
|-----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|--------------|
| Course Title                                  | <b>HORTICULTURE AND FORESTRY</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                             |              |
| No. of Credits                                | 03                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | No. of contact hours per Week               | 03           |
| New Course/<br>Revised Course                 | New Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | If revised, Percentage of Revision effected | -            |
| Category                                      | Core Major-13                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                             |              |
| Scope of the Course<br>(may be more than one) | <ul style="list-style-type: none"> <li>Basic knowledge of vegetative reproduction in plants</li> <li>Gain knowledge on various types of gardens and cultivation methods of various plants.</li> </ul>                                                                                                                                                                                                                                                                                                              |                                             |              |
| Cognitive Levels addressed by the Course      | K-1: Gain knowledge about the scope of horticulture<br>K-2: Understand the methods of vegetative propagation<br>K-3: Know about types of gardens<br>K-4: Overview of plant protection measures in horticulture.<br>K-5: Get a better understanding of the land use system                                                                                                                                                                                                                                          |                                             |              |
| Course Objectives                             | The Course aims to: <ul style="list-style-type: none"> <li>Learn about Horticulture, vegetative propagation, manures and irrigation</li> <li>Understand types of gardens and lawn making</li> <li>Know about cultivation techniques of vegetables, fruits, the use of growth regulators and plant protection methods</li> <li>Evaluate the sustainability and conservation practices related to indigenous plant species &amp; forestry management</li> <li>Assess the impact of trees on soil dynamics</li> </ul> |                                             |              |
| Unit                                          | Content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                             | No. Of hours |
| I                                             | <b>Introduction to Horticulture</b><br>Scope and divisions of Horticulture - methods of vegetative propagation - cutting, layering and grafting - organic manures – fertilizers, vermicompost, irrigation practices                                                                                                                                                                                                                                                                                                |                                             | 12           |
| II                                            | <b>Gardening</b><br>Types of gardens: Indoor Garden, Kitchen Garden and Public Garden. Important Ornamentals - habit and types - Garden components - Lawn making, Glasshouse, Greenhouse, Rockery, Water garden, Hydroponics and Aeroponics, Terrace gardening, Topiary and Terrarium, Bonsai                                                                                                                                                                                                                      |                                             | 12           |
| III                                           | <b>Ornamentals Production Technology</b><br>Cultivation practices of ornamental plants (orchids, chrysanthemums, Anthurium, and ornamental trees), and growth regulators in Horticulture. Plant protection measures for Horticulture.                                                                                                                                                                                                                                                                              |                                             | 12           |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |    |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| IV                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>Silviculture and Forest Management</b><br>Evolution of silviculture and its historical context, Characteristics of major tropical forest formations, Ecosystem Structure. Forest types - Champion & Seth, 1968. Forest products – primary and NWFP, Forest services, Forests and Environment - Consequences of deforestation, anthropogenic activities and industrialisation on forest ecosystems. Importance of forest ecosystem with special reference to conservation of natural resources | 12 |
| V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>Agroforestry</b><br>Land Use System - Overview of land use systems related to agroforestry, Principles and criteria for selecting tree species in agroforestry, Soil Productivity and dynamics - Role of Trees in Soil Productivity and Conservation, Strategies for sustainable soil productivity in agroforestry. Role of agroforestry- Fulfilment of food, fodder, fuelwood and shelter-based needs- income generation and subsistence production.                                         | 12 |
| <b>Text Books:</b> <ol style="list-style-type: none"> <li>1. Kumar, N. (1999). An introduction to horticulture. Rajalakshmi Publication, Nagarcoil.</li> <li>2. Manibhusan Rao K (2005) Textbook of Horticulture, Macmillan India Ltd.</li> <li>3. Prasad, 2005, Principles of Horticulture, International Book Dept., Dehradun</li> <li>4. Trivedi, Pratibha P (2010), Home Gardening, ICAR, New Delhi.</li> <li>5. Ram Prakash, Chaudhari DC and Negi SS. 1998. Plantation and Nursery Techniques of Forest Trees. International Book Distributors, Dehra Dun.</li> <li>6. Kumar V. 1999. Nursery and Plantation Practices in Forestry. Scientific Publishers</li> </ol> <b>Reference Books:</b> <ol style="list-style-type: none"> <li>1. Kumar N. (2006). Horticulture: Principles and practices. New India Publishing agency, New Delhi 88.</li> <li>2. Sundararajan, J.S., Muthuswamy, J., Shanmugavelu, K.G. and Balakrishnan, R. A Guide to Horticulture. Thiruvankadam Printers, Coimbatore.</li> <li>3. Bhattacharjee, S.K. (2006). Advances in Ornamental Horticulture. Pointer Publications, Jaipur.</li> <li>4. Nair P. K. R. 1993. An Introduction to Agroforestry. Academic Pub</li> <li>5. Nair P. K. R., Rai M. R. &amp; Buck L. E. 2004. New Vistas in Agroforestry.</li> <li>6. Gregory, G. R. Forest Products, Production, Trade, Consumption, quantity and value of raw material requirements, Ford foundation, New Delhi.</li> </ol> <b>E-Resources:</b> <ul style="list-style-type: none"> <li>• <a href="https://swayam.gov.in/nd2_cec20_ag11/preview">https://swayam.gov.in/nd2_cec20_ag11/preview</a></li> <li>• <a href="https://swayam.gov.in/nd2_cec20_bt13/preview">https://swayam.gov.in/nd2_cec20_bt13/preview</a></li> <li>• <a href="https://swayam.gov.in/nd1_noc20_ce11/preview">https://swayam.gov.in/nd1_noc20_ce11/preview</a></li> <li>• <a href="https://onlinecourses.nptel.ac.in/noc22_bt24/preview">https://onlinecourses.nptel.ac.in/noc22_bt24/preview</a></li> <li>• <a href="https://elearning.fao.org/course/view.php?id=578">https://elearning.fao.org/course/view.php?id=578</a></li> </ul> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |    |
| <b>Course Outcomes</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | On completion of the course, students should be able to:<br>CO 1: Discuss methods of vegetative propagation<br>CO2: Describe a gardening technique<br>CO3: Identify Growth Regulators in Horticulture<br>CO4: Perform silviculture<br>CO5: Assess the role of trees in soil productivity and conservation                                                                                                                                                                                        |    |

**Mapping of COs with PSOs:**

| CO \ PSO | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|----------|------|------|------|------|------|
| CO1      | 3    | 1    | 1    | 3    | 3    |
| CO2      | 3    | 3    | 1    | 3    | 3    |
| CO3      | 3    | 2    | 1    | 3    | 3    |
| CO4      | 3    | 3    | 1    | 3    | 3    |
| CO5      | 3    | 3    | 3    | 3    | 3    |

|                                               |                                                                                                                                                                                                                 |                                             |                   |
|-----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|-------------------|
| <b>SEMESTER</b>                               | <b>SIXTH</b>                                                                                                                                                                                                    | <b>COURSECODE</b>                           | <b>26BTUC3120</b> |
| Course Title                                  | <b>INSTRUMENTATION TECHNIQUES IN PLANT SCIENCE</b>                                                                                                                                                              |                                             |                   |
| No. of Credits                                | 4                                                                                                                                                                                                               | No. of contact hours per Week               | 4                 |
| New Course/<br>Revised Course                 | New Course                                                                                                                                                                                                      | If revised, Percentage of Revision effected | -                 |
| Category                                      | Core Major-14                                                                                                                                                                                                   |                                             |                   |
| Scope of the Course<br>(may be more than one) | <ul style="list-style-type: none"> <li>• Students will be able to develop their skills in bioinstrumentation.</li> <li>• Students will be able to develop Employability in various botanical fields.</li> </ul> |                                             |                   |

| Cognitive Levels addressed by the Course | K-1:Remember Basic Concepts in Instrumentation<br>K-2:Understanding the working principles behind the instruments.<br>K-3:Apply to know microtechniques<br>K-4:Analyzethe structure of cells and chromosomes<br>K-5: Evaluate the role of molecular markers<br>K-6:Create knowledge on various instruments in Biological Sciences                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |            |
|------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| Course Objectives                        | The Course aims to: <ul style="list-style-type: none"> <li>Enhance the students' knowledge of instrumentation techniques</li> <li>Know about the working principle and application of various types of microscopes.</li> <li>Give an overview of centrifugation</li> <li>Make the students knowledgeable about the chromatographic techniques</li> <li>Acquire an overall knowledge on separation of genetic materials.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                         |            |
| Unit                                     | Content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | No.Ofhours |
| I                                        | <b>Micro-techniques</b><br>Instrumentation in plant sciences - Introduction, Importance in botanical research. Microtechniques – Whole mount, Smears, Squash, Sections. Microtomy: Fixation, Dehydration, Infiltration, Embedding, Sectioning. Microtomes – Types- Principles and operating mechanisms of Rotary Microtome. Stains and Staining Techniques - Preparation of Stains: Safranin, Cotton Blue in Lactophenol, Acetocarmine, Methylene Blue, and Crystal Violet. Killing, Fixing, Mounting Media and Dehydrating Agents.                                                                                                                                                                                                                                                                                                                                        | 10         |
| II                                       | <b>Imaging Techniques - X-ray imaging:</b><br>Principles and Applications. MRI and CT scanning: Non-invasive imaging techniques in plant biology. Basics of Magnetic Resonance Imaging (MRI) and Computed Tomography (CT) and their applications. PET imaging: Functional imaging in plant research-Introduction to Positron Emission Tomography (PET), Applications                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 10         |
| III                                      | <b>Centrifugation</b><br>Centrifuge: types of rotors (swinging bucket, fixed angle), Density gradient and Differential centrifugation. Principle and Applications: Ultracentrifuge, Cooling Centrifuge, Analytical centrifugation for estimation of mass of biological molecules.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 09         |
| IV                                       | <b>Chromatography and Spectroscopy</b><br>Basics of chromatography and types, Principles and Applications: Paper and TLC Chromatography, Ion-exchange chromatography, Gel permeation chromatography, HPLC, Gas Chromatography. Brief account of gene mapping methods, QTL mapping, rDNA technology                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 10         |
| V                                        | <b>Buffers, Isolation and Separation of Genetic Materials</b><br>Application and Principle: pH Meter, types of Buffers. Isolation of RNA and DNA from plant material. Principle and Applications: PCR, Agarose gel electrophoresis, SDS-PAGE, Western blotting, Southern Blotting, ELISA. Role of Molecular Markers.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 09         |
| References                               | <b>Text Books:</b> <ol style="list-style-type: none"> <li>Patki L.R, Bhalchandra B.L, Jeevaji I.H. (1987). An introduction to Microtechnique, S.Chand and Company (Pvt) Ltd, New Delhi.</li> <li>K. Wilson and J. Walker Eds. 2005. Biochemistry and Molecular Biology. Cambridge University Press.</li> <li>Bancroft: Theory and Practice of Histological Techniques (2018 Kim S. Suvarna, Christopher Layto, John D. Bancroft)</li> <li>Palanivelu P (2013). Analytical Biochemistry and Separation Techniques, 20th-century publications, Palkalainage, Madurai.</li> <li>Bowman, R. H., et al. (1970). Centrifugation: Practical Manual. American Elsevier Pub. Co.</li> <li>Ausubel, F., Brent, R., Kingston, R. E., Moore, D.D., Seidman, J.G., Smith, J.A., Struhl, K. (1995). Short Protocols in Molecular Biology. 3rd edition. John Wiley &amp; Sons.</li> </ol> |            |
|                                          | <b>Reference Books:</b> <ol style="list-style-type: none"> <li>Ruzin, S.E. (1999). Plant Microtechnique and Microscopy, Oxford University Press, New York. U.S.A</li> <li>Bajpai, P.K. 2006. Biological Instrumentation and methodology. S. Chand &amp; Co. Ltd.</li> <li>Willard H. H., J .A. Dean, L. L. Merritt and F. A. Settle (2011) Instrumental methods of analysis, CBS Publishers and Distributors N. Delhi.</li> <li>Bowman, R. H., et al. (1970). Centrifugation: Practical Manual. American Elsevier Pub. Co.</li> <li>Hayat, M. A. (2000). Principles and Techniques of Electron Microscopy: Biological Applications (4th ed.). Cambridge University Press.</li> <li>Miller, J. M. (2010). Chromatography: Concepts and Contrasts. John Wiley &amp; Sons.</li> </ol>                                                                                         |            |
|                                          | <b>E-Resources:</b> <ol style="list-style-type: none"> <li><a href="https://www.researchgate.net/publication/375609570_Bio-Instrumentation_and_Biological_Techniques">https://www.researchgate.net/publication/375609570_Bio-Instrumentation_and_Biological_Techniques</a></li> <li><a href="https://books.google.co.in/books/about/Molecular_Biology_Bioinstrumentation_Bio.html?id=077FEAAA_QBAJ&amp;redir_esc=y">https://books.google.co.in/books/about/Molecular_Biology_Bioinstrumentation_Bio.html?id=077FEAAA_QBAJ&amp;redir_esc=y</a></li> </ol>                                                                                                                                                                                                                                                                                                                   |            |

|                        |                                                                                                                                                                                                                                                                                                         |
|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course Outcomes</b> | On completion of the course, students should be able to:<br>CO 1: Discuss working of various instruments.<br>CO2: Describe principles and applications of microscopy<br>CO3: Identify types the rotors in centrifuge<br>CO4: Perform spectrometric analysis<br>CO5: Assess genetic material from plants |
|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

#### Mapping of COs with PSOs:

| CO \ PSO | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|----------|------|------|------|------|------|
| CO1      | 3    | 1    | 1    | 3    | 3    |
| CO2      | 3    | 3    | 1    | 3    | 3    |
| CO3      | 3    | 2    | 1    | 3    | 3    |
| CO4      | 3    | 3    | 1    | 3    | 3    |
| CO5      | 3    | 3    | 3    | 3    | 3    |

| SEMESTER                                      | SIXTH                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | COURSECODE                                  | 26BTUC3121   |
|-----------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|--------------|
| Course Title                                  | <b>PHYTOMEDICINES AND THERAPEUTICS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                             |              |
| No. of Credits                                | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | No. of contact hours per Week               | 4            |
| New Course/<br>Revised Course                 | New Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | If revised, Percentage of Revision effected | -            |
| Category                                      | Core Major-15                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                             |              |
| Scope of the Course<br>(may be more than one) | <ul style="list-style-type: none"> <li>Students will be able to develop their skills in Medicinal Botany.</li> <li>Students will be able to develop Employability in various botanical fields.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                             |              |
| Cognitive Levels addressed by the Course      | K-1: Remembering Basic Concepts in Medicinal Botany<br>K-2: Understanding the pharmacological applications.<br>K-3: Apply to know the role of ethnobotany in modern medicine<br>K-4: Analyze cultivation methods of medicinal plants.<br>K-5: Evaluate plant materials for drugs<br>K-6: Create knowledge on medicinally important floras.                                                                                                                                                                                                                                                                                                                 |                                             |              |
| Course Objectives                             | The Course aims to: <ul style="list-style-type: none"> <li>Enhance the students' knowledge of traditional medicinal systems.</li> <li>Know about the role of Ethnic Groups in the Conservation of Plant Genetic Resources</li> <li>Give an overview of Important Drug Derivative Plants</li> <li>Make the students knowledgeable about plant materials for drug preparation.</li> <li>Acquire an overall knowledge of Ethnopharmacology.</li> </ul>                                                                                                                                                                                                        |                                             |              |
| Unit                                          | Content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                             | No. Of hours |
| I                                             | <b>Introduction to Medical Practices</b><br>Introduction to medical practices in India: History, Literature and Physicians of the ancient period. Brief on traditional medicine systems: Ayurvedha, Siddha, Unani, Naturopathy and Homoeopathy. Brief account of Drugs and their functions. Importance and Scope of Medicinal Botany, Indians Contribution to Medicinal Botanical Research. Role of ICMR, NMPB, CIMAP and CDRI                                                                                                                                                                                                                             |                                             | 09           |
| II                                            | <b>Ethnobotany</b><br>Ethnobotany: Classification, Medicinal Ethnobotany and Ethnopharmacology. Role of ethnobotany in Modern Medicine, Medico-ethnobotanical sources in India. Major and Minor Ethnic Groups in South India and their Ethnobotanical and Ethnobiological Heritage. Role of Ethnic Groups in the Conservation of Plant Genetic Resources. Cultivation and processing of medicinal plants: Propagules, cultivation methods, harvesting, processing, grading, packaging, and storage.                                                                                                                                                        |                                             | 10           |
| III                                           | <b>Important Drug Derivative Plants</b><br>Botanical name, family, vernacular, morphology of useful parts, uses, active principles and phytotherapeutics of the following: <i>Ocimum basilicum</i> , <i>Elettaria cardamomum</i> , <i>Tribulus terrestris</i> , <i>Phyllanthus amarus</i> , <i>Asparagus racemosus</i> , <i>Rauvolfia serpentina</i> , <i>Gloriosa superba</i> , <i>Aloe vera</i> , <i>Azadirachta indica</i> , <i>Trichopus zeylanicus</i> , <i>Syzygium aromaticum</i> , <i>Allium sativum</i> , <i>Zingiber officinale</i> , <i>Curcuma longa</i> , <i>Solanum nigrum</i> , <i>Trigonella foenum-graecum</i> , <i>Cuminum cyminum</i> . |                                             | 10           |

|                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |    |
|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| IV             | <b>Plant Materials for Drugs</b><br>Botanical name, family, vernacular, morphology of useful parts, uses, active principles and phytotherapeutics of the following: Carbohydrates: Ispaghula ( <i>Plantago ovata</i> ), Agar ( <i>Gracilaria</i> ), Glycosides: Senna ( <i>Cassia</i> sp), <i>Glycyrrhiza</i> . Tannins: <i>Acacia</i> and Myrobalan. Medicinal oils: <i>Arachis hypogea</i> , <i>Ricinus communis</i> . Volatile oils - <i>Eucalyptus</i> , Clove, lemon. Resins: Asafoetida and <i>Pinus</i> . Alkaloids: <i>Cinchona</i> , <i>Rauwolfia</i> , <i>Atropa</i> , <i>Opium</i> , <i>Justicia adhatoda</i> , <i>Ephedra</i> . Steroids: <i>Solanum</i> and <i>Dioscorea</i> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 09 |
| V              | <b>Plant Toxins and Drug Quality Control</b><br>Toxins of plant origin: Allergens, Teratogens. Dosage and toxicity levels, Allergic reactions, contraindications, and Regulatory guidelines. Crude Drug: Classification and sources of crude drugs, Quality, Safety, and efficacy of herbal medicines. Ensuring standards in herbal medicines/nutraceuticals. Drug Adulteration and Drug Evaluation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 10 |
| Refer<br>ences | <b>Text Books:</b> <ol style="list-style-type: none"> <li>Kadavul K. 2016. Handbook on Utilisation of Medicinal Plants. Published No.9, 4th Cross Street, Vengateswara Nagar-East, Puducherry-605013.</li> <li>Jain S. K. 1995. Manual of Ethnobotany, Scientific Publishers, Jodhpur, 1995.</li> <li>Martin, G.J. (1995). Ethnobotany: A Methods Manual. Chapman Hall</li> <li>Chevallier, A., 1996. The encyclopedia of medicinal plants. D.K. Publishing, Michigan.</li> <li>Mathur, N., 2010. Medicinal plants of india. RBSA Publishers, New Delhi.</li> <li>Sivarajan V,V and Balachandran I,1994. Ayurvedic Drugs and their Plant Sources, Oxford &amp; IBH Publications.</li> <li>Gokhale SB, Kokate, CK and Purohit, AP (2003). Pharmacognosy. Nirali Prakashan, Pune.</li> <li>Kokate, C.K., Purohit A.P and Gokhale, 2008. Pharmacognosy, Nirali Prakashan, Pune</li> </ol> <b>Reference Books:</b> <ol style="list-style-type: none"> <li>Trivedi P.C. 2006. Medicinal Plants: Ethnobotanical Approach. Agrobios. India.</li> <li>Cunningham A. B. 2001. Applied Ethnobotany: People, Wild Plant Use and Conservation. Earthscan, London.</li> <li>Rath, A. K. and Mishra, S. R. (2017). Ethnobotany, Kalyani Publishers, New Delhi.</li> <li>Kokate, C. and Gokeale- Pharmacognacy- Nirali Prakashan, New Delhi.</li> <li>Bhattacharjee, SK (2004). Hand Book of Medicinal plants. Pointer Publishers, Jaipur.</li> <li>Chopra, R.N., Chopra, I.C., Handa, K.L. and Kapur, L.D. (1994). Indigenous Drugs of India. IBH Publishing Co. Pvt. Ltd., New Delhi.</li> </ol> <b>E-Resources:</b> <ol style="list-style-type: none"> <li><a href="https://uou.ac.in/sites/default/files/slm/MSCBOT-608.pdf">https://uou.ac.in/sites/default/files/slm/MSCBOT-608.pdf</a></li> <li><a href="https://archive.org/details/b21304282_0001/page/n33/mode/2up">https://archive.org/details/b21304282_0001/page/n33/mode/2up</a></li> </ol> |    |
| CourseOutcomes | On completion of the course, students should be able to:<br>CO 1: Discuss the Importance and Scope of Medicinal Botany<br>CO2: Describe Medico-ethnobotanical sources in India<br>CO3: Identify the morphology and the useful parts of drug derivative plants<br>CO4: Perform the preparation of drugs from plants<br>CO5: Assess the quality, safety, and efficacy of herbal medicines                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |    |

#### Mapping of COs with PSOs:

| CO \ PSO | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|----------|------|------|------|------|------|
| CO1      | 3    | 1    | 1    | 3    | 3    |
| CO2      | 3    | 3    | 1    | 3    | 3    |
| CO3      | 3    | 2    | 1    | 3    | 3    |
| CO4      | 3    | 3    | 1    | 3    | 3    |
| CO5      | 3    | 3    | 3    | 3    | 3    |

| SEMESTER                      | SIXTH                                                                                                                       | COURSECODE                                  | 26BTUC3122 |
|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|------------|
| Course Title                  | <b>PRACTICAL VII: GENETICS AND BIOSTATISTICS, HORTICULTURE AND FORESTRY AND INSTRUMENTATION TECHNIQUES IN PLANT SCIENCE</b> |                                             |            |
| No. of Credits                | 1                                                                                                                           | No. of contact hours per Week               | 3          |
| New Course/<br>Revised Course | New Course                                                                                                                  | If revised, Percentage of Revision effected | -          |
| Category                      | Core Major- 15                                                                                                              |                                             |            |
| Scope of the Course           | <ul style="list-style-type: none"> <li>Students will be able to develop their skills in a specific area</li> </ul>          |                                             |            |

|                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |            |
|------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| (may be more than one)                   | <ul style="list-style-type: none"><li>Students will be able to get knowledge on plant breeding techniques</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |            |
| Cognitive Levels addressed by the Course | K-1:Rememberthe basics of staining and mounting<br>K-2:UnderstandMendelian ratios<br>K-3:Apply to know Simple Problems in genetics.<br>K-4:Analyze the principles of spectroscopy<br>K-5: Evaluate fixatives in mounting<br>K-6:Create knowledge on the preparation of a sample for the centrifuge.                                                                                                                                                                                                                                                                                                                                                                                             |            |
| Course Objectives                        | The Course aims to: <ul style="list-style-type: none"><li>Enhance the students’ knowledge and impress upon them techniques in plant breeding</li><li>Understand the stages in mitosis.</li><li>Provide practical knowledge and skill in the separation of plant pigments.</li><li>Know the preparation of the buffer and measurement of pH</li><li>Acquire an overall knowledge of the imaging of samples using SEM.</li></ul>                                                                                                                                                                                                                                                                  |            |
| Unit                                     | Content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | No.ofHours |
| 1.                                       | Familiarisation with the use of microscopes and their parts, stains, fixatives and mounting media                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 3          |
| 2.                                       | Observation of charts for Mendelian ratios, Gene interaction and Linkage - Simple Problems in genetics.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 3          |
| 3.                                       | Analysis of data for mean, mode, median, standard deviation and standard error using suitable plant materials                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 3          |
| 4.                                       | Determination of correlation and regression using suitable plant material.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 3          |
| 5.                                       | Separation of plant pigments by paper chromatography/TLC.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 6          |
| 6.                                       | Preparation of buffer and Measurement of pH using pH Meter                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 6          |
| 7.                                       | Methods for sample preparation- Principle and application of ultra-centrifuges                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 6          |
| 8.                                       | Analyzing samples with UV- Vis Spectrophotometer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 6          |
| 9.                                       | Demonstration of imaging samples using SEM                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 3          |
| 10.                                      | Practising horticulture techniques: cutting, layering, grafting                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 3          |
| 11.                                      | Demonstrating the art of topiary, bonsai and rockery                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 3          |
| Referen<br>ces                           | 1. Khandpur, R.S. (2006). Handbook of analytical instruments. Tata McGraw-Hill.<br>2. Nakara, B.C. & Choudhari, K.K. (2003). Instrumentation measurements and analysis. Tata Mc Graw Hill.<br>3. Casey E. J. (1063) Biophysics – Concepts and Mechanisms Van Nostr and Reinhold Company<br>4. Donald A. Johansen (1940) Plant Microtechnique- Mac Graw Hill Book company<br>5. Patabhi, N.V. & Gautham, N. (2002). Biophysics. Narosa Publishing House.<br>6. Danniel, W.W. 1987. Biostatistics. New York, NY: John Wiley Sons.<br>7. Campbell, R.C. 1974. Statistics for Biologists. Cambridge University Press.<br>8. Dawson, C. 2002. Practical research methods. New Delhi: UBS Publishers. |            |
|                                          | E-Resources:<br>1. <a href="https://www.scribd.com/document/700581450/genetics-practical-file">https://www.scribd.com/document/700581450/genetics-practical-file</a><br>2. <a href="https://www.biophysics.org/biophysics-basics#/">https://www.biophysics.org/biophysics-basics#/</a><br>3. <a href="https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SMB2103.pdf">https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SMB2103.pdf</a>                                                                                                                                                                                                                                          |            |
| CourseOutc<br>omes                       | On completion of the course, students should be able to do<br>CO 1: Demonstrate techniques of genetics.<br>CO2: Explain the staining techniques<br>CO3: Identify the different stages of mitosis<br>CO4: Asses the principles and applications of spectrophotometer<br>CO5: Examine mean, mode, median, standard deviation and standard error of plant samples                                                                                                                                                                                                                                                                                                                                  |            |

### Mapping of COs with PSOs:

| PSO \ CO | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|----------|------|------|------|------|------|
| CO1      | 3    | 1    | 1    | 3    | 3    |
| CO2      | 3    | 3    | 1    | 3    | 3    |
| CO3      | 3    | 2    | 1    | 3    | 3    |
| CO4      | 3    | 3    | 1    | 3    | 3    |
| CO5      | 3    | 3    | 3    | 3    | 3    |

|          |       |            |            |
|----------|-------|------------|------------|
| SEMESTER | SIXTH | COURSECODE | 26BTUC3123 |
|----------|-------|------------|------------|

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|-----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|---------------------|
| Course Title                                  | <b>PLANT RESOURCES UTILIZATION AND BIODIVERSITY CONSERVATION</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                             |                     |
| No. of Credits                                | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | No. of contact hours per Week               | 4                   |
| New Course/<br>Revised Course                 | New Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | If revised, Percentage of Revision effected | -                   |
| Category                                      | Core Minor- 6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                             |                     |
| Scope of the Course<br>(may be more than one) | <ul style="list-style-type: none"> <li>Students will be able to develop their skills in Plant Resources utilization.</li> <li>Students will be able to develop Employability in various botanical fields.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                             |                     |
| Cognitive Levels addressed by the Course      | K-1: Remembering Basic Concepts in Biodiversity Conservation<br>K-2: Understanding the plant resources.<br>K-3: Apply to know plant-based bioplastics<br>K-4: Analyze the Importance of economically valuable trees<br>K-5: Evaluate Endangered species of the Western Ghats<br>K-6: Create knowledge on the Red Data Book.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                             |                     |
| Course Objectives                             | The Course aims to: <ul style="list-style-type: none"> <li>Enhance the students' knowledge of Plant resources and utilization</li> <li>Know about the economic importance of spices and condiments</li> <li>Give an overview of drug-yielding plants</li> <li>Make the students knowledgeable about threats to biodiversity.</li> <li>Acquire an overall knowledge of Environmental Impact Assessment.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                             |                     |
| <b>Unit</b>                                   | <b>Content</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                             | <b>No. Of hours</b> |
| I                                             | <b>Introduction to Plant resources and utilization</b><br>Introduction: Concept, Plants as natural resources; Utilization: Bioenergy, food, fodder, fibre, medicine and essences. Plants as ecological indicators, Bio-control agents, Plant-based bio manure, Plant-based bioplastics and Plant-based biofuels. Timber and Non-Timber Products.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                             | 09                  |
| II                                            | <b>Economic Botany</b><br>Economic Importance, family, Scientific name and uses - Cereals: Wheat, Rice, Maize, Millets: Ragi Legumes: Chick pea, Pigeon pea, Cow pea. Sugars and Starches: Sugarcane, Potato. Spices and Condiments: Clove, Black Pepper, Ginger, Turmeric, Cinnamon, Cardamom, Coriander, Nutmeg. Beverages: Tea, Coffee. Latex: Rubber.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                             | 10                  |
| III                                           | <b>Economic Botany</b><br>Economic Importance, family, Scientific name and uses – Fibres: Jute, Cotton. Oils: Coconut, Groundnut, Sesame. Drug-Yielding Plants: <i>Cinchona</i> , <i>Rauvolfia</i> . Fumigatory & Masticatory: Tobacco, Arecanut, <i>Cannabis</i> . Fruits & Nuts: Cashew, Almond, Banana, Apple, Citrus, Mango. Vegetables: Amaranthus, Moringa. Tuber: Tapioca, Yam, Sweet Potato. Dye: Henna, Indigo.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                             | 10                  |
| IV                                            | <b>Conservation of Biodiversity</b><br>Bioreserves and World Heritage Sites in India. Threats to Biodiversity, endemism. hot-spots, Endemic, Rare, Endangered species of the Western Ghats. IUCN Red List categories, Red Data Book, Biodiversity Conservation Strategies; ex-situ and in-situ conservation, botanical gardens, National Parks, Sanctuaries, role of seed banks and Gene Banks. Role of NBPGR, WWF, and IUCN.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                             | 09                  |
| V                                             | <b>Environmental management standards and IPR</b><br>National and international organizations involved in biodiversity conservation. Biodiversity communications, National and International Environmental Conventions. Introduction to TRIPS and WTO, IPR in India and the World. Biopiracy                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                             | 10                  |
| <b>References</b>                             | <b>Text Books:</b> <ol style="list-style-type: none"> <li>Dash M.C. 1993. Fundamentals of Ecology. Tata McGraw Hill Publishing Company Ltd. New Delhi.</li> <li>Mishra D.D. 2008. Fundamental Concepts in Environmental Studies. S. Chand &amp; Co., New Delhi.</li> <li>Wickens, G.E. (2001). Economic Botany: Principles &amp; Practices. The Netherlands: Kluwer Academic Publishers.</li> <li>Kochhar, S.L. (2016). Economic Botany – A Comprehensive Study, 5th Edition. New Delhi, India: Cambridge University Press.</li> <li>Krishnamoorthy K V (2012) An Advanced text book of Biodiversity Conservation, Principles and Practice, Oxford &amp; IBH publishers Co Pvt. Ltd</li> <li>Panday, S.N. &amp; S.P. Misra (2011). Environment and Ecology. Ane Books Pvt. Ltd. New Delhi</li> <li>Barrow C. J. 2005. Environmental Management: Principles &amp; Practices,</li> </ol> <b>Reference Books:</b> <ol style="list-style-type: none"> <li>Odum, E. P., Barrett G., W., 2011, Fundamentals of Ecology, 5ed., Cengage Learning. ISBN-13: 978-8131500200</li> <li>Wilkinson, D. M. (2007). Fundamental Processes in Ecology: An Earth Systems Approach. Oxford University</li> </ol> |                                             |                     |

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|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                        | Press. U.S.A.<br>3. Mackenthun, K.M., (1998). Basic Concepts in Environmental Management, Lewis Publication, London.<br>4. Thangavel, P. & Sridevi, G. (2015). Environmental Sustainability: Role of Green Technologies. Springer publications.<br>5. Cook F.E.M. (1995). Economic Botany: Data Collection Standard Royal Botanic Garden, Kew, Richmond.<br>6. Verma, M. K. (2022). Environment and Sustainable Development. British Library Cataloguing-in-Publication Data.<br>7. Xavier Savarimuthu, S. J., Rao, U., & Reynolds, M. F. (Eds.). (2021). Go Green for Environmental Sustainability: An Interdisciplinary Exploration of Theory and Applications. CRC Press. |
|                        | <b>E-Resources:</b><br>1. <a href="https://egyankosh.ac.in/bitstream/123456789/83793/1/Block-1.pdf">https://egyankosh.ac.in/bitstream/123456789/83793/1/Block-1.pdf</a><br>2. <a href="https://uou.ac.in/sites/default/files/slm/MSCBOT-603.pdf">https://uou.ac.in/sites/default/files/slm/MSCBOT-603.pdf</a><br>3. <a href="https://dst.gov.in/sites/default/files/E-BOOK%20IPR.pdf">https://dst.gov.in/sites/default/files/E-BOOK%20IPR.pdf</a>                                                                                                                                                                                                                            |
| <b>Course Outcomes</b> | On completion of the course, students should be able to:<br>CO 1: Discuss timber and non-timber products.<br>CO2: Describe economically important plants<br>CO3: Identify key structures of drug-yielding plants<br>CO4: Perform botanical gardens<br>CO5: Assess importance of green audits                                                                                                                                                                                                                                                                                                                                                                                 |

| SEMESTER                                      | SIXTH                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | COURSE CODE                                 | 26BTUC3124   |
|-----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|--------------|
| Course Title                                  | <b>INDUSTRIAL BOTANY</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                             |              |
| No. of Credits                                | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | No. of contact hours per Week               | 4            |
| New Course/<br>Revised Course                 | New Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | If revised, Percentage of Revision effected | -            |
| Category                                      | Core Major- 16                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                             |              |
| Scope of the Course<br>(may be more than one) | <ul style="list-style-type: none"> <li>Students will be able to develop their skills in Industrial Botany.</li> <li>Students will be able to develop Employability in various botanical fields.</li> </ul>                                                                                                                                                                                                                                                                                                      |                                             |              |
| Cognitive Levels addressed by the Course      | K-1: Remembering Basic Concepts in Industrial Botany<br>K-2: Understanding the industrial applications.<br>K-3: Apply to know drug discovery and development<br>K-4: Analyze Biological significance of secondary metabolites<br>K-5: Evaluate biofuel production processes<br>K-6: Create knowledge on industrially important floras.                                                                                                                                                                          |                                             |              |
| Course Objectives                             | The Course aims to: <ul style="list-style-type: none"> <li>Enhance the students' knowledge of Techniques to isolate phytochemicals</li> <li>Know about phytoremediation</li> <li>Give an overview of transgenic plants for enhanced metabolite production</li> <li>Make the students knowledgeable about the transesterification process for biodiesel.</li> <li>Acquire an overall knowledge of aromatherapy.</li> </ul>                                                                                       |                                             |              |
| Unit                                          | Content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                             | No. Of hours |
| I                                             | <b>Introduction to Phytochemistry and Industrial Botany</b><br>Introduction to Phytochemistry, Primary and secondary metabolites (Overview). Extraction methods: Hot & Cold extraction, Maceration, Soxhlet extraction. Solvents used in extraction. Techniques used to isolate phytochemicals: Chromatography methods, Precipitation and crystallization, Isolation and purification strategies, and structural elucidation. Use of spectroscopy and analytical techniques in phytochemistry.                  |                                             | 09           |
| II                                            | <b>Phytochemicals in Biological Activities, Industry and Agriculture</b><br>Antioxidants, Antimicrobial, Antiviral, Anti-inflammatory, Analgesics, Anticancer, Antidiabetic, Neuroprotective and Cardiovascular health of phytochemicals. Pharmaceutical Industry: Drug discovery and development, examples of plant-derived drugs. Food Industry: Natural preservatives, nutraceuticals and additives. Agriculture: Biopesticides and bioherbicides, Plant growth regulators, Soil health and phytoremediation |                                             | 10           |
| III                                           | <b>Secondary Metabolites</b><br>Secondary metabolites: types, Biological significance and functions, Industrial applications. Production of secondary metabolites: Factors (Physical & Chemical). Genetic Modification of Secondary Metabolites, Transgenic plants for enhanced metabolite production. Applications of Secondary Metabolites: Pharmaceuticals, nutraceuticals, bioherbicides, biopesticides, fermentation, and plant growth promoters. Brief account of elicitors and precursors                |                                             | 10           |

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| IV              | <b>Biofuels</b><br>Introduction to Biofuels: First, second, and third-generation biofuels, types: Bioethanol, Biodiesel, Biogas. Biofuel Production: Plant-based (corn, sugarcane, algae), waste materials-based (agricultural residues, food waste). Biofuel Production Processes: Fermentation processes for bioethanol, Transesterification process for biodiesel. Socio-economic Impacts of Biofuel Production. Biofuels and Biodiversity - Effects on land use and water resources.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 09 |
| V               | <b>Essential Oils of Aromatic Plants</b><br>Introduction to aromatic plants, uses of essential oils, and Traditional extraction methods. Botanical Sources of Essential Oils - Classification of aromatic plants, Parts of plants used for oil extraction. Extraction Methods - Steam Distillation, Solvent Extraction, Cold Press Extraction, Supercritical Fluid Extraction and CO <sub>2</sub> extraction. Short account on Aromatherapy. Applications of Essential Oils - Therapeutic uses (aromatherapy, medicine), Industrial uses (cosmetics, food and beverages).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 10 |
| Refer<br>ences  | <b>Text Books:</b> <ol style="list-style-type: none"> <li>1. Kokate, C.K., Purohit, A.P., and Gokhale, S.B. 2015. Pharmacognosy. Nirali Prakashan, Pune.</li> <li>2. Harborne, J.B. Phytochemical Methods: A Guide to Modern Techniques of Plant Analysis. 1998. Springer, Dordrecht</li> <li>3. Jain A.K. 2016. Plant Secondary Metabolites. Scientific Publishers, Jodhpur.</li> <li>4. Ashok Pandey, M.A. Kalamdhad, K. Binod, S. Khanal. Biofuels: Production and Future Perspectives. 2015. Elsevier India, New Delhi.</li> <li>5. Ramasamy Vijayakumar (Ed.). 2020. Secondary Metabolites - Sources and Applications. IntechOpen, London.</li> <li>6. Raghava T.S., Mishra R.K., and Sharma. R.K. 2017. Essential Oil Plants and Their Cultivation. Scientific Publishers, Jodhpur, India.</li> <li>7. Ana Maria Loureiro da Seca, Antoaneta Trendafilova (Eds.). 2022. Isolation and Identification of Bioactive Secondary Metabolites. MDPI, Basel.</li> </ol> <b>Reference Books:</b> <ol style="list-style-type: none"> <li>1. Trease, G.E., and Evans, W. C. 2009. Pharmacognosy. Elsevier, New Delhi.</li> <li>2. Dewick, P.M. Medicinal Natural Products: A Biosynthetic Approach. 2009. John Wiley &amp; Sons, Chichester</li> <li>3. Rafael Luque, Carol Sze Ki Lin, Karen Wilson, James Clark (Eds). 2016. Handbook of Biofuels Production. Woodhead Publishing, Cambridge.</li> <li>4. Valerie Ann Worwood. 2016. The Complete Book of Essential Oils and Aromatherapy. New World Library, Novato, CA, USA.</li> <li>5. Dewick, P.M. Medicinal Natural Products: A Biosynthetic Approach. 2009. John Wiley &amp; Sons, Chichester</li> </ol> <b>E-Resources:</b> <ol style="list-style-type: none"> <li>1. www.ncbi.nlm.nih.gov National Center for Biotechnology Information (NCBI)</li> <li>2. www.pharmacognosy.us American Society of Pharmacognosy</li> <li>3. www.phytochemicalsociety.org Phytochemical Society of Euro</li> <li>4. International Federation of Essential Oils and Aroma Trades (IFEAT): www.ifeat.org</li> </ol> |    |
| Course Outcomes | On completion of the course, students should be able to:<br>CO 1: Discuss the Solvents used in the extraction of phytochemicals<br>CO2: Describe natural preservatives<br>CO3: Identify key structures of Transgenic plants<br>CO4: Perform fermentation processes for bioethanol<br>CO5: Assess botanical sources of essential oils                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |    |

## SEMESTER VII

| SEMESTER                                      | SEVEN                                                                                                                                                                                                                                                                                                | COURSE CODE                                 | 26BTUC4125 |
|-----------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|------------|
| Course Title                                  | ALGAL CULTURE TECHNOLOGY                                                                                                                                                                                                                                                                             |                                             |            |
| No. of Credits                                | 4                                                                                                                                                                                                                                                                                                    | No. of contact hours per Week               | 4          |
| New Course/<br>Revised Course                 | New Course                                                                                                                                                                                                                                                                                           | If revised, Percentage of Revision effected | -          |
| Category                                      | Core Major -17                                                                                                                                                                                                                                                                                       |                                             |            |
| Scope of the Course<br>(may be more than one) | <ul style="list-style-type: none"> <li>• Students will be able to develop their skills in algal culture techniques.</li> <li>• Students will be able to develop knowledge in algal research.</li> </ul>                                                                                              |                                             |            |
| Cognitive Levels<br>addressed by the Course   | K-1: Remember Basic Concepts in Algal Biotechnology<br>K-2: Understanding the algal production techniques.<br>K-3: Apply to know the application of algal biofertilizer<br>K-4: Analyze phycoremediation<br>K-5: Evaluate the methods of control of algae<br>K-6: Create knowledge on algal culture. |                                             |            |

| Course Objectives |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | The Course aims to: <ul style="list-style-type: none"> <li>Enhance the students' knowledge of the distribution of economically important algae in India.</li> <li>Know about the cultivation and harvesting of algae.</li> <li>Give an overview of chemical composition in algae.</li> <li>Make the students knowledgeable about liquid seaweed fertiliser.</li> <li>Acquire an overall knowledge of algal culture collection centers in India.</li> </ul> |
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| Unit              | Content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | No.Ofhours                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| I                 | <b>Algal biotechnology</b><br>Introduction to algal biotechnology: Resource potential of algae; commercial utility of algae. Algae as a source of food and feed; Algae as a source of pigments, fine chemicals, fuel and bio-fertilizers. Distribution of economically important algae in India. Uses of the following algae: <i>Spirulina</i> , <i>Chlorella</i> , <i>Gracilaria</i> , <i>Gelidium</i> , <i>Kappaphycus</i> , <i>Sargassum</i> , and <i>Ulva</i> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 10                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| II                | <b>Algal cultivation</b><br>Algal production systems; Strain selection; Algal growth curves; Culture media; Indoor cultivation methods; and scaling up. Measurement of algal growth. Large-scale cultivation of algae. Evaporation and uniform dispersal of nutrients; Harvesting algae. Drying.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| III               | <b>Chemical composition of Algae</b><br>Chemical composition: protein, amino acids, lipids, waxes, glycerol, vitamins, pigments, chlorophyll, carotenoids and phycobiliproteins. Algal immobilization and its applications; Blue-green algal bio-fertilizer: Method of preparation, application, and its advantages over inorganic fertilizers.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 09                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| IV                | <b>Algal biomass application</b><br>Liquid seaweed fertilizer: Method of preparation and application. Biodiesel from algae: algae producing biodiesel; Advantages over other sources of biodiesel; Cultivation and extraction methods. Phycoremediation. Role of algae in nanobiotechnology.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 10                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| V                 | <b>Algal control</b><br>Algal control: Methods of control of algae; Algicides-preparation and Application; ultrasonic sound producing devices to control algae. Algal culture collection centers in India and abroad and their importance; Centers pursuing algal research in India and their field of interest.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Refer<br>ences    | <b>Text Books:</b> <ol style="list-style-type: none"> <li>Barsanti, Laura and Paolo Gualtieri (2005) <i>Algae-Anatomy, Biochemistry and Biotechnology</i>. Taylor &amp; Francis, London, New York.</li> <li>Becker, E.W (1994). <i>Microalgae-Biotechnology and Microbiology</i>. CambridgeUniversity Press.</li> <li>Chandramohan, D. (2007). Prospects of Biodiesel from marine microorganisms.Proceedings of the National Workshop on Biodiesel, Organised by School of Energy, Environment &amp; Natural Resources, Madurai Kamaraj University,Madurai and Ahimsa Agri division, Chennai, 17th and 18th October, 2007.</li> <li>Trivedi, P.C (2001) <i>Algal Biotechnology</i>. Pointer Publishers, Jaipur, India.</li> <li>Venkataraman, L.V. AND E.W. Becker (1985). <i>Biotechnology and Utilisation of Algae – The Indian Experience</i>. Dept. Science and Technology, NewDelhi and Central Food Research Institute, Mysore, India.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|                   | <b>References:</b> <ol style="list-style-type: none"> <li>Andersen, R. A. (Ed.) (2005) <i>Algal culturing techniques</i>. Elsevier.</li> <li>Grobbelaar, J. U (2000) Physiological and technological considerations for optimising mass algal cultures. <i>Journal of Applied Phycology</i>, 12(3), 201-206.</li> <li>Huntley, M. E., Nonomura, A. M., &amp; de la Noüe, J (2018) Algal culture systems. In <i>Biotreatment of agricultural wastewater</i> (pp. 111-130). CRC Press.</li> <li>Tamiya, H (1957) Mass culture of algae. <i>Annual Review of Plant Physiology</i>, 8(1), 309-334.</li> <li>Smith, L. L., Fox, J. M., &amp; Granvil, D. R (1993) Intensive algae culture techniques. <i>CRC Handbook of mariculture</i>, 1, 3-13</li> <li>Fabris, M., Abbriano, R. M., Pernice, M., Sutherland, D. L., Commault, A. S., Hall, C. C., ... &amp; Ralph, P. J (2020) Emerging technologies in algal biotechnology: toward the establishment of a sustainable, algae-based bioeconomy. <i>Frontiers in plant science</i>, 11, 279.</li> <li>Konur, O. (Ed.) (2020) <i>Handbook of algal science, technology and medicine</i>. Academic Press.</li> <li>Preisig, H. R., &amp; Andersen, R. A (2005) Historical review of algal culturing. <i>Algal culturing techniques</i>, 1.</li> <li>Islam MS, Saha BB, Rahman MM and Fayyaz R (2025) <i>Commercial and Industrial Algae Culture and Applications</i>.</li> </ol> |                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|                   | <b>E resources:-</b> <ol style="list-style-type: none"> <li><a href="https://youtu.be/D0IP4j6xmn0?si=GnWlHG5rS8yTCy6i">https://youtu.be/D0IP4j6xmn0?si=GnWlHG5rS8yTCy6i</a></li> <li><a href="https://youtu.be/M8ZUkXui5VA?si=cduf_H4UWaj3H2Pk">https://youtu.be/M8ZUkXui5VA?si=cduf_H4UWaj3H2Pk</a></li> <li><a href="https://youtu.be/vcmkUfxReY4?si=Wh4fAff9FGS-waNj">https://youtu.be/vcmkUfxReY4?si=Wh4fAff9FGS-waNj</a></li> <li><a href="https://youtu.be/TMAkLHuOjJc?si=yPI0lrX6nojOSzkY">https://youtu.be/TMAkLHuOjJc?si=yPI0lrX6nojOSzkY</a></li> <li><a href="https://youtu.be/OnF5BkPDAD0?si=T_6Il2mNM761pITz">https://youtu.be/OnF5BkPDAD0?si=T_6Il2mNM761pITz</a></li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

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|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                        | 6. <a href="https://youtu.be/BX7DGFqscag?si=77xn75xUqpsF3V4v">https://youtu.be/BX7DGFqscag?si=77xn75xUqpsF3V4v</a><br>7. <a href="https://youtu.be/MbXH-qJ3hT8?si=d2xNnZ591u5UXsfl">https://youtu.be/MbXH-qJ3hT8?si=d2xNnZ591u5UXsfl</a>                                                                                                                              |
| <b>Course Outcomes</b> | On completion of the course, students should be able to:<br>CO 1: Discuss the commercial utility of algae<br>CO2: Describe large-scale cultivation of algae<br>CO3: Explain the method of preparation of Blue-green algal bio-fertilizer<br>CO4: Perform the extraction of biodiesel from algae.<br>CO5: Describe ultrasonic sound producing devices to control algae |

| SEMESTER                                      | SEVEN                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | COURSECODE                                  | 26BTUC4126 |
|-----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|------------|
| Course Title                                  | <b>GENOMICS AND PROTEOMICS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                             |            |
| No. of Credits                                | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | No. of contact hours per Week               | 3          |
| New Course/<br>Revised Course                 | New Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | If revised, Percentage of Revision effected | -          |
| Category                                      | Core Major-18                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                             |            |
| Scope of the Course<br>(may be more than one) | <ul style="list-style-type: none"> <li>Students will learn to use computational tools to analyze large data sets</li> <li>Students can understand gene and protein function.</li> </ul>                                                                                                                                                                                                                                                                                                                            |                                             |            |
| Cognitive Levels addressed by the Course      | K-1:Remember Basic Concepts in genomics and proteomics<br>K-2:Understanding the techniques related to genomics and proteomics<br>K-3:Apply the computational skills to execute projects<br>K-4:Analyzedatabases and implement in practice<br>K-5: Evaluate bioinformatics tools for data analysis<br>K-6:Create knowledge on software for genome analysis                                                                                                                                                          |                                             |            |
| Course Objectives                             | The Course aims to: <ul style="list-style-type: none"> <li>Introduce the structure and properties of protein</li> <li>Impart theoretical knowledge on proteomics</li> <li>Give an overview of protein and DNA interaction</li> <li>Make the students knowledgeable about genomics and its techniques</li> <li>Provide information about web based servers and software for genome analysis</li> </ul>                                                                                                              |                                             |            |
| Unit                                          | Content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                             | No.Ofhours |
| I                                             | <b>Genomics I</b><br>Introduction to Genomics; Genome sequencing; Maxam & Gilbert and Sangers method. Whole genome shotgun sequencing, Physical mapping of genomes, Clone-by-clone sequencing, New generation sequencing technologies, Bioinformatics tools to analyse genomes, sequenced genomes (yeast, Arabidopsis and rice)                                                                                                                                                                                    |                                             | 10         |
| II                                            | <b>Genomics II</b><br>Managing and distributing Genome Data: Web-based servers and software for genome analysis: ENSEMBL, VISTA, UCSC Genome Browser, NCBI genome. Selected Model Organisms' Genomes and Databases.                                                                                                                                                                                                                                                                                                |                                             | 6          |
| III                                           | <b>Proteomics I</b><br>Introduction to Proteomics; Protein isolation and identification methods, SDS -PAGE, Isoelectric focussing, 2D gel electrophoresis, Peptide sequencing, Mass Spectrometry methods used in proteomics                                                                                                                                                                                                                                                                                        |                                             | 09         |
| IV                                            | <b>Proteomics II</b><br>Introduction to protein structure; Chemical properties of proteins. Physical interactions that determine the properties of proteins. Short-range interactions, electrostatic forces, van der Waals interactions, hydrogen bonds, and Hydrophobic interactions. Human Genome Project, Determination of covalent structures –Edman degradation.                                                                                                                                              |                                             | 10         |
| V                                             | <b>Proteomics III</b><br>Peptide databases, Immunological methods to study protein functions, Protein-protein and Protein-DNA interactions, Comparative proteomics, subcellular proteomics, quantitative proteomics                                                                                                                                                                                                                                                                                                |                                             | 10         |
| References                                    | <b>Text Books:</b> <ol style="list-style-type: none"> <li>Torr, J. D. 2006. Genetic Engineering-Current Controversies. Green haven Press.</li> <li>Magnien, E. &amp; De Nettancourt, D. 1985. Genetic Engineering of Plants and Micro-Organisms Important for Agriculture. Springer Verlag.</li> <li>Gerald Karp 2013. Cell and Molecular Biology: Concepts and Experiments. 7th Edition, Wiley, NJ, USA.</li> <li>Geoffrey M. Cooper &amp; Robert E. Hausman 2013. The Cell: A Molecular Approach, 6th</li> </ol> |                                             |            |

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|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                        | <p>Edition, Sinauer Associates, Inc., Sunderland, USA.</p> <p>5. Harvey Lodish, Arnold Berk, Chris A. Kaiser &amp; Monty Krieger 2012 Molecular Cell Biology. 7th Edition, W. H. Freeman, NY, USA.</p> <p>6. Stephen R. Bolsover, Elizabeth A. Shephard, Hugh A. White &amp; Jeremy S. Hyams 2011. Cell Biology: A Short Course Wiley-Blackwell, NJ, USA.</p> <p>7. Benjamin Lewin, Johns and Bartlett Publisher, 2006. Genes IX</p> <p>8. S.B. Primrose, Blackwell Publishing, 1987. Modern Biotechnology, 2nd Edition</p> <p>9. B.R. Glick, J.J. Pasternak and C.L. Patten, 2010. Molecular Biotechnology: Principles and Applications of Recombinant DNA, 4th Edition,</p> <p>10. Sambrook and Russell Vol. I to III, 1989 Molecular Cloning: A Laboratory Manual (3rd Edition)</p> <p>11. S.B. Primrose, R.M. Twyman and R.W. Old. Blackwell Science, 2001. Principles of Gene Manipulation 6th Edition, 7. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc.</p> <p>12. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. IX Edition. Benjamin Cummings.</p> <p>13. Russell, P. J. (2009). iGenetics- A Molecular Approach. III Edition. Benjamin Cummings.</p> <p>14. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington. 6. Pevsner, J. (2009). Bioinformatics and Functional Genomics. II Edition. John Wiley &amp; Sons.</p> |
|                        | <p><b>References:</b></p> <p>1. Tyers, Mike, and Matthias Mann. "From genomics to proteomics." <i>Nature</i> 422.6928 (2003): 193-197.</p> <p>2. Bradfield, C. (2004). Genomics and proteomics. <i>Chemical Research in Toxicology</i>, 17(1), 2-2.</p> <p>3. Saraswathy, N., &amp; Ramalingam, P. (2011). <i>Concepts and techniques in genomics and proteomics</i>. Elsevier.</p> <p>4. Yates, J. R., &amp; Osterman, A. L. (2007). Introduction: Advances in genomics and proteomics. <i>Chemical Reviews</i>, 107(8), 3363-3366</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|                        | <p><b>E sources:</b> 1. <a href="https://youtu.be/loqUmQzTt8g?si=GSTAOP3p0fpbiG_e">https://youtu.be/loqUmQzTt8g?si=GSTAOP3p0fpbiG_e</a></p> <p>2. <a href="https://youtu.be/BiyhyLh-zCQ?si=mDx81BVLISrVF_rP">https://youtu.be/BiyhyLh-zCQ?si=mDx81BVLISrVF_rP</a></p> <p>3. <a href="https://youtu.be/UsOBxRZH8j4?si=zbKwzy5WTM-bAW6U">https://youtu.be/UsOBxRZH8j4?si=zbKwzy5WTM-bAW6U</a></p> <p>4. <a href="https://youtu.be/0mqz94bRma8?si=rIROIT3Na8vRxsS2">https://youtu.be/0mqz94bRma8?si=rIROIT3Na8vRxsS2</a></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Course Outcomes</b> | <p>On completion of the course, students should be able to:</p> <p>CO 1: Understand the fundamental concept of the structure and property of protein</p> <p>CO2: Apply the key technique used in genomics and proteomics</p> <p>CO3: Explain immunological methods to study protein functions</p> <p>CO4: Perform physical mapping of genomes</p> <p>CO5: Assess the softwares for genome analysis</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

| SEMESTER                                      | SEVEN                                                                                                                                                                                                                                                                                                                                                                                                                | COURSE CODE                                 | 26BTUC4127   |
|-----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|--------------|
| Course Title                                  | <b>APPLIED MYCOLOGY</b>                                                                                                                                                                                                                                                                                                                                                                                              |                                             |              |
| No. of Credits                                | 03                                                                                                                                                                                                                                                                                                                                                                                                                   | No. of contact hours per Week               | 03           |
| New Course/<br>Revised Course                 | New Course                                                                                                                                                                                                                                                                                                                                                                                                           | If revised, Percentage of Revision effected | -            |
| Category                                      | Core Major-19                                                                                                                                                                                                                                                                                                                                                                                                        |                                             |              |
| Scope of the Course<br>(may be more than one) | <ul style="list-style-type: none"> <li>Students will be able to develop their skills in the identification of fungi.</li> <li>Students will be able to develop as entrepreneurs.</li> </ul>                                                                                                                                                                                                                          |                                             |              |
| Cognitive Levels addressed by the Course      | K-1: Remember basic characteristics of fungi.<br>K-2: Understanding the procedure for mushroom cultivation.<br>K-3: Apply to know symbiotic association<br>K-4: Analyze the role of fungi in biotechnology<br>K-5: Evaluate the application of marine microbial enzyme.<br>K-6: Create knowledge on value-added products on mushrooms.                                                                               |                                             |              |
| Course Objectives                             | The Course aims to: <ul style="list-style-type: none"> <li>Enhance the students' knowledge of fungi classification.</li> <li>Know about the types of fruiting bodies.</li> <li>Give an overview of lichens</li> <li>Make the students knowledgeable about the application of fungi.</li> <li>Acquire an overall knowledge of mycometabolites and their applications.</li> </ul>                                      |                                             |              |
| Unit                                          | Content                                                                                                                                                                                                                                                                                                                                                                                                              |                                             | No. Of hours |
| I                                             | <b>General characteristics of Ascomycota</b><br>General characteristics of fungi: Classification; thallus organisation; Cell wall composition; Nutrition. General characteristics of Ascomycota (asexual and sexual fruiting bodies); Ecology; Life cycle, Heterokaryosis and parasexuality with reference to <i>Saccharomyces</i> , <i>Aspergillus</i> , <i>Penicillium</i> , <i>Neurospora</i> and <i>Peziza</i> . |                                             | 10           |

|                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                |
|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| II                     | <b>General characteristics of Basidiomycota</b><br>General characteristics of Basidiomycota: Ecology; Life cycle and Classification with reference to black stem rust on wheat, <i>Puccinia</i> and <i>Agaricus</i> ; Bioluminescence, Fairy Rings and Mushroom Cultivation. General characteristics of Allied Fungi; Status of Slime molds, General characteristics of Oomycota; Ecology; Life cycle and classification with reference to <i>Phytophthora</i> , <i>Albugo</i> .                                                                                                                                                          | 09                                                                                                                                                                                                                                                                                                                             |
| III                    | <b>General characteristics of Lichen</b><br>Symbiotic associations: Lichen–Occurrence; general characteristics; Growth forms and range of thallus organization; Nature of associations of algal and fungal partners; Reproduction; Mycorrhiza-Ectomycorrhiza, Endomycorrhiza and their significance.                                                                                                                                                                                                                                                                                                                                      | 09                                                                                                                                                                                                                                                                                                                             |
| IV                     | <b>Applied Mycology I</b><br>Applied Mycology: Role of fungi in biotechnology; Application of fungi in food industry; Secondary metabolites (Pharmaceutical preparations); Agriculture (Biofertilizers); Mycotoxins; Biological control (Mycofungicides, Mycoherbicides, Mycoinsecticides, Myconematicides). Value-Added Products of Mushrooms.                                                                                                                                                                                                                                                                                           | 10                                                                                                                                                                                                                                                                                                                             |
| V                      | <b>Applied Mycology II</b><br>Marine Microbial Enzymes and Their Applications. Mycoparasitism. Mushrooms in Enzyme Production; Fungal Proteins with Biotechnology Potential; <i>Trichoderma</i> as a Potential Biofungicidal and Plant Growth Promoter; Myco-Metabolites and Their Applications; Natural Products of Endophytic Fungi and Their Applications; Fungi as Sources of Biobased Fibre Materials; Fungal Consortium for Organic Municipal Solid Waste Composting; Fungal Applications in Biomass to Biorefineries.                                                                                                              | 10                                                                                                                                                                                                                                                                                                                             |
| References             | <b>Text Books:</b><br>1. Kumari, K. (2024). Botany Paper-1 (Mycology and Phytopathology) Book B.Sc.<br>2. Purohit, S.D., & Kukda, G.K. (2021). Mycology: Microbiology & Plant Pathology.<br>3. Pandey, B.P. (2025). Mycology and Phytopathology (Botany for B.Sc. Students).                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                |
|                        | <b>References:</b><br>1. Orlovich, D. (2023). Fundamentals of Mycology and Phytopathology.<br>2. Manoharachary, C., Tilak, K.V.B.R., Mallaiah, K.V., & Kunwar, I.K. (2021). Mycology, Microbiology and Plant Pathology.<br>3. Kharte, S. (2023). Advanced Mycology and Plant Pathology.<br>4. Deepak B, Eivind BL, Dilip KA (1991) Handbook of Applied mycology Volume 5. Taylor and Francis Group                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                |
|                        | <b>E resources:-</b><br>1. ezaccess.libraries.psu.edu<br>2. <a href="https://www.youtube.com/live/3gmS3ZWfvdK?si=Z0Oc-VYMHPbkBkkr">https://www.youtube.com/live/3gmS3ZWfvdK?si=Z0Oc-VYMHPbkBkkr</a><br>3. <a href="https://www.youtube.com/live/DIczPuG7mgI?si=ROcb68xfuhJQG6">https://www.youtube.com/live/DIczPuG7mgI?si=ROcb68xfuhJQG6</a><br>4. <a href="https://www.youtube.com/live/9cC1l-ZtXdc?si=FkPw3cX5DueNxX-o">https://www.youtube.com/live/9cC1l-ZtXdc?si=FkPw3cX5DueNxX-o</a><br>5. <a href="https://www.youtube.com/live/NLuEH3MVeUk?si=rAL4LrHAL2JKCco4">https://www.youtube.com/live/NLuEH3MVeUk?si=rAL4LrHAL2JKCco4</a> |                                                                                                                                                                                                                                                                                                                                |
| <b>Course Outcomes</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | On completion of the course, students should be able to:<br>CO 1: Classify fungi based on their characters.<br>CO2: Describe mushroom cultivation techniques<br>CO3: Identify mycorrhizal associations.<br>CO4: Prepare value added products from mushroom.<br>CO5: Assess the Fungal Applications in Biomass to Biorefineries |

| SEMESTER                                      | SEVEN                                                                                                                                                                                                                                                                                        | COURSE CODE                                 | 26BTUC4128 |
|-----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|------------|
| Course Title                                  | <b>PRACTICAL VIII: ALGAL CULTURE TECHNOLOGY &amp; APPLIED MYCOLOGY</b>                                                                                                                                                                                                                       |                                             |            |
| No. of Credits                                | 01                                                                                                                                                                                                                                                                                           | No. of contact hours per Week               | 03         |
| New Course/<br>Revised Course                 | New Course                                                                                                                                                                                                                                                                                   | If revised, Percentage of Revision effected | -          |
| Category                                      | Core Major- 19                                                                                                                                                                                                                                                                               |                                             |            |
| Scope of the Course<br>(may be more than one) | <ul style="list-style-type: none"> <li>Students will be able to develop their skills in algal culture</li> <li>Students will be able to develop Employability in various botanical fields.</li> </ul>                                                                                        |                                             |            |
| Cognitive Levels<br>addressed by the Course   | K-1: Remember Basic Concepts in algal culture<br>K-2: Understanding the application of mycology<br>K-3: Apply to know plant microscopic characters of fungi<br>K-4: Analyze the mycelial types<br>K-5: Evaluate sectioning of lichens<br>K-6: Create knowledge on algal culture and mycology |                                             |            |

| Course Objectives |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | The Course aims to: <ul style="list-style-type: none"> <li>Enhance the students' knowledge on algal culture technique</li> <li>Know about the thallus structure in fungi</li> <li>Give an overview of sectioning of lichen</li> <li>Make the students knowledgeable about the synthesis of nano-particle from algae</li> <li>Acquire an overall knowledge on mushroom cultivation.</li> </ul> |
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| Sl.No             | Content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | No.Ofhours                                                                                                                                                                                                                                                                                                                                                                                    |
| 1.                | Microscopic observation of fungal thallus structures ; Mycelial types, conidia, sporangia                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 6                                                                                                                                                                                                                                                                                                                                                                                             |
| 2.                | Identification of common Ascomycetes; <i>Saccharomyces</i> , <i>Aspergillus</i> , <i>Penicillium</i> , <i>Alternaria</i> , <i>Neurospora</i> , <i>Peziza</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 6                                                                                                                                                                                                                                                                                                                                                                                             |
| 3.                | Isolation & identification of Oomycetes; <i>Phytophthora</i> , <i>Albugo</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 6                                                                                                                                                                                                                                                                                                                                                                                             |
| 4.                | Lichen thallus sectioning, Mycorrhiza study; Staining of endomycorrhiza (Trypan blue); Observation of ectomycorrhizal roots                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 03                                                                                                                                                                                                                                                                                                                                                                                            |
| 5.                | Identification of economically important algae: <i>Spirulina</i> , <i>Chlorella</i> , <i>Gracilaria</i> , <i>Sargassum</i> , <i>Ulva</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 3                                                                                                                                                                                                                                                                                                                                                                                             |
| 6.                | Demonstration of Algae-based nanoparticle synthesis                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 3                                                                                                                                                                                                                                                                                                                                                                                             |
| 7.                | Preparation of algal culture media                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 3                                                                                                                                                                                                                                                                                                                                                                                             |
| 8.                | Demonstration of Mushroom cultivation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 3                                                                                                                                                                                                                                                                                                                                                                                             |
| 9.                | Industry visit to observe the algal cultivation industry and Mushroom farms                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                               |
| Refer<br>ences    | 1. Andersen, R. A. (Ed.) (2005) Algal culturing techniques. Elsevier.<br>2. Grobbelaar, J. U (2000) Physiological and technological considerations for optimising mass algal cultures. Journal of Applied Phycology, 12(3), 201-206.<br>3. Huntley, M. E., Nonomura, A. M., & de la Noüe, J (2018) Algal culture systems. In Biotreatment of agricultural wastewater (pp. 111-130). CRC Press.<br>4. Tamiya, H (1957) Mass culture of algae. Annual Review of Plant Physiology, 8(1), 309-334.<br>5. Smith, L. L., Fox, J. M., & Granvil, D. R (1993) Intensive algae culture techniques. CRC Handbook of mariculture, 1, 3-13<br>6. Fabris, M., Abbriano, R. M., Pernice, M., Sutherland, D. L., Commault, A. S., Hall, C. C., ... & Ralph, P. J (2020) Emerging technologies in algal biotechnology: toward the establishment of a sustainable, algae-based bioeconomy. Frontiers in plant science, 11, 279.<br>7. Konur, O. (Ed.) (2020) Handbook of algal science, technology and medicine. Academic Press.<br>8. Preisig, H. R., & Andersen, R. A (2005) Historical review of algal culturing. Algal culturing techniques, 1.<br>9. Islam MS, Saha BB, Rahman MM and Fayyaz R (2025) Commercial and Industrial Algae Culture and Applications.<br>10. Kumari, K. (2024). Botany Paper-1 (Mycology and Phytopathology) Book B.Sc.<br>11. Purohit, S.D., & Kukda, G.K. (2021). Mycology: Microbiology & Plant Pathology.<br>12. Pandey, B.P. (2025). Mycology and Phytopathology (Botany for B.Sc. Students).                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                               |
|                   | <b>References Books:</b><br>1. Orlovich, D. (2023). Fundamentals of Mycology and Phytopathology.<br>2. Manoharachary, C., Tilak, K.V.B.R., Mallaiah, K.V., & Kunwar, I.K. (2021). Mycology, Microbiology and Plant Pathology.<br>3. Kharte, S. (2023). Advanced Mycology and Plant Pathology.<br>4. Deepak B, Eivind BL, Dilip KA (1991) Handbook of Applied mycology Volume 5. Taylor and Francis Group<br>5. Andersen, R. A. (Ed.) (2005) Algal culturing techniques. Elsevier.<br>6. Grobbelaar, J. U (2000) Physiological and technological considerations for optimising mass algal cultures. Journal of Applied Phycology, 12(3), 201-206.<br>7. Huntley, M. E., Nonomura, A. M., & de la Noüe, J (2018) Algal culture systems. In Biotreatment of agricultural wastewater (pp. 111-130). CRC Press.<br>8. Tamiya, H (1957) Mass culture of algae. Annual Review of Plant Physiology, 8(1), 309-334.<br>9. Smith, L. L., Fox, J. M., & Granvil, D. R (1993) Intensive algae culture techniques. CRC Handbook of mariculture, 1, 3-13<br>10. Fabris, M., Abbriano, R. M., Pernice, M., Sutherland, D. L., Commault, A. S., Hall, C. C., ... & Ralph, P. J (2020) Emerging technologies in algal biotechnology: toward the establishment of a sustainable, algae-based bioeconomy. Frontiers in plant science, 11, 279.<br>11. Konur, O. (Ed.) (2020) Handbook of algal science, technology and medicine. Academic Press.<br>12. Preisig, H. R., & Andersen, R. A (2005) Historical review of algal culturing. Algal culturing techniques, 1.<br>13. Islam MS, Saha BB, Rahman MM and Fayyaz R (2025) Commercial and Industrial Algae Culture and Applications. |                                                                                                                                                                                                                                                                                                                                                                                               |
|                   | <b>E sources</b><br>1. <a href="https://botanydepot.com">https://botanydepot.com</a><br>1. <a href="https://youtu.be/D0IP4j6xmn0?si=iCxBN3j13ks3HnDbK">https://youtu.be/D0IP4j6xmn0?si=iCxBN3j13ks3HnDbK</a><br><a href="https://youtu.be/CDjuk07E6rI?si=kGS9VPO_Ur3xSYEV">https://youtu.be/CDjuk07E6rI?si=kGS9VPO_Ur3xSYEV</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                               |

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| <b>Course Outcomes</b> | On completion of the course, students should be able to:<br>CO 1: Discuss the characters of fungi<br>CO2: Describe Isolation & identification of fungal pathogens<br>CO3: Identify key structures of ectomycorrhizal roots<br>CO4: Perform algal culture<br>CO5: Assess the synthesis of Algae-based nanoparticle |
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| SEMESTER                                      | SEVEN                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | COURSE CODE                                 | 26BTUC4129   |
|-----------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|--------------|
| Course Title                                  | <b>PLANT TISSUE AND ORGAN CULTURE TECHNIQUES</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                             |              |
| No. of Credits                                | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | No. of contact hours per Week               | 3            |
| New Course/<br>Revised Course                 | New Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | If revised, Percentage of Revision effected | -            |
| Category                                      | Core Minor-7                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                             |              |
| Scope of the Course<br>(may be more than one) | <ul style="list-style-type: none"> <li>Students will be able to develop their skills in the Plant tissue culture technique.</li> <li>Students will be able to gain knowledge on laboratory techniques</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                             |              |
| Cognitive Levels addressed by the Course      | K-1: Remember Basic Concepts in Plant Tissue Culture<br>K-2: Understanding the role of micro and macro nutrients in plant tissue culture.<br>K-3: Apply to know the isolation of single cells<br>K-4: Analyze another culture technique<br>K-5: Evaluate the application of tissue culture<br>K-6: Create knowledge on the production of secondary metabolites                                                                                                                                                                                                                                                                                                                |                                             |              |
| Course Objectives                             | The Course aims to: <ul style="list-style-type: none"> <li>Enhance the students' knowledge of tools and techniques in tissue culture.</li> <li>Know about the preparation of media and culture.</li> <li>Give an overview of the types of cultures</li> <li>Make the students knowledgeable about synthetic seed production.</li> <li>Acquire an overall knowledge of the production of genetically variable plants</li> </ul>                                                                                                                                                                                                                                                |                                             |              |
| Unit                                          | Content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                             | No. Of hours |
| I                                             | <b>Introduction to Plant Tissue culture</b><br>Introduction to Plant Tissue culture; Historical background. Principle; Polarity, Symmetry and Totipotency, Centres of origin and organization, differentiation, dedifferentiation and re-differentiation; vascular differentiations. Laboratory organization; Tools and techniques, methods of sterilization. Laboratory contaminants and their control measures.                                                                                                                                                                                                                                                             |                                             | 10           |
| II                                            | <b>Tissue culture media</b><br>Culture Media Preparation; Role of Micro and Macro nutrients, Vitamins and carbon source in tissue culture. Temperature, sterilisation, PGRs, and solidifying agents. maintenance of cultures. Environmental Conditions. Explant selection.                                                                                                                                                                                                                                                                                                                                                                                                    |                                             | 09           |
| III                                           | <b>Types of culture</b><br>Types of culture: Cell, tissue and organ culture; Callus induction, subculture and maintenance. Isolation of single cells, selection and types of cells. Cell suspension cultures -Batch, continuous. Synchronization of suspension culture.                                                                                                                                                                                                                                                                                                                                                                                                       |                                             | 10           |
| IV                                            | <b>Indirect organogenesis</b><br>Somatic hybridisation and cybridization. Organogenesis; anther culture and production of haploids; somatic embryogenesis; synthetic seed production; cryopreservation; Gene Bank.                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                             | 09           |
| V                                             | <b>Applications</b><br>Application of tissues and Cell culture: Micropropagation; Clonal propagation. Production of genetically variable plants; Resistance to herbicides, insecticides, viruses, and other diseases. Production of secondary metabolites; Alkaloids.                                                                                                                                                                                                                                                                                                                                                                                                         |                                             | 10           |
| <b>References</b>                             | <b>Text Books:</b> <ol style="list-style-type: none"> <li>Dubey, R.C., (2001). A text book of biotechnology.</li> <li>S. Chand &amp; Co., New Delhi. Gupta, P.K. (1994). Elements of Biotechnology. Rastogi Publications, Meerut.</li> <li>Ignacimuthu, S.J. (2003). Plant Biotechnology. Oxford &amp; IBH Publishing, New Delhi.</li> <li>John Jothi Prakash, E. (2005). Outlines of Plant Biotechnology. Emkay Pb., New Delhi</li> <li>Kalyankumar De, (2008). Plant tissue culture. New Central Book Agency, Calcutta.</li> <li>Sathyanarayana BN and Vergheese DB (2007). Plant tissue culture- Practices and new experimental protocols, ILK Publ. New Delhi.</li> </ol> |                                             |              |

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|-----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|---------------------|
|                                               | <b>References:</b> <ol style="list-style-type: none"> <li>1. Bhojwani, S.S. &amp; Razdan, M.K. (2004). Plant Tissue Culture, Read Elsevier India Pvt. Ltd.</li> <li>2. Dix, P.J. (1990). Plant cell line and selection. VCH Publ.</li> <li>3. Islam, A.S. (1996). Plant tissue culture. Oxford &amp; IBH Publ.</li> <li>4. Purohit S.S. (2010). Plant tissue culture, Student edition, Jodhpur.</li> <li>5. Hammond, J.C. McGarvey and V. Yusibov, (2009). Plant Biotechnology, Springer Verlag. New York.</li> </ol> |                                             |                     |
|                                               | <b>Course Outcomes</b><br>On completion of the course, students should be able to:<br>CO 1: Discuss about the principle of plant tissue culture<br>CO2: Describe the media preparation and maintenance of culture<br>CO3: Identify the types of culture<br>CO4: Perform Somatic hybridization and cybridization<br>CO5: Assess the application of tissues and Cell culture                                                                                                                                            |                                             |                     |
| <b>SEMESTER</b>                               | <b>SEVEN</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>COURSE CODE</b>                          | <b>26BTUC4130</b>   |
| Course Title                                  | <b>ADVANCES IN PLANT SCIENCES</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                             |                     |
| No. of Credits                                | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | No. of contact hours per Week               | 3                   |
| New Course/<br>Revised Course                 | New Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | If revised, Percentage of Revision effected | -                   |
| Category                                      | Core minor-8                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                             |                     |
| Scope of the Course<br>(may be more than one) | <ul style="list-style-type: none"> <li>• Students will be able to develop their knowledge in research</li> <li>• Students will be able to design research problems.</li> </ul>                                                                                                                                                                                                                                                                                                                                        |                                             |                     |
| Cognitive Levels addressed by the Course      | K-1: Remember Basic Concepts in Research Methodology<br>K-2: Understanding the types of research<br>K-3: Apply to formulate of hypothesis<br>K-4: Analyze types of data<br>K-5: Evaluate Report writing<br>K-6: Create knowledge on guidelines for design of experiments                                                                                                                                                                                                                                              |                                             |                     |
| Course Objectives                             | The Course aims to: <ul style="list-style-type: none"> <li>• Enhance the students' knowledge of National and International journals in life science</li> <li>• Know about the analysis and interpretation of data</li> <li>• Give an overview of Dissertation writing</li> <li>• Make the students knowledgeable about Scientific writing and presentation</li> <li>• Acquire an overall knowledge of Impact factor and Research metrics</li> </ul>                                                                   |                                             |                     |
| <b>Unit</b>                                   | <b>Content</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                             | <b>No. Of hours</b> |
| I                                             | <b>Advances in Photosynthesis and ontology</b><br>Plant ontology photosynthesis: Bridging Plant Anatomy and Genomics in the Digital Era, tools, .<br>Advances in photosynthesis and respiration. Photosystems, Photophysics of light absorption, excitation energy transfer; C4 photosynthesis and regulations; Genetic engineering of photosynthesis and artificial photosynthesis.                                                                                                                                  |                                             | 10                  |
| II                                            | <b>Proteomics</b><br>Protein isolation and identification methods SDS -PAGE, Isoelectric focusing, 2D gel electrophoresis, Peptide sequencing, Mass Spectrometry methods used in proteomics, Peptide data bases, Immunological methods to study protein functions, Protein-protein and Protein-DNA interactions, Comparative proteomics, subcellular proteomics, quantitative proteomics                                                                                                                              |                                             | 10                  |
| III                                           | <b>Applications of plant tissue culture</b><br>Applications of plant cell, tissue and organ culture, Media types, preparation; callus formation, organogenesis. Somatic embryogenesis, somaclonal variation, embryo culture, artificial seeds. Production of secondary metabolites from plant cell cultures - Processes for enhancing the production of secondary metabolites. Hairy root culture Technology for the production of chemicals: methods and protocols.                                                  |                                             | 09                  |
| IV                                            | <b>Genome sequencing</b><br>Bio membranes and the subcellular organization of eukaryotic cells. Introduction to Genomics, Transcriptomics, Proteomics, Metabolomics and single-cell genomics. Genome sequencing, Whole-genome shotgun sequencing, Physical mapping of genomes, Clone-by-clone sequencing, New-generation sequencing technologies, Bioinformatics tools for analysing genomes, Examples of sequenced genomes (yeast, Arabidopsis, and rice).                                                           |                                             | 10                  |

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|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| V              | <b>Application of Plant Biotechnology</b><br>Application of Plant biotechnology for the production of quality oil, Industrial enzymes, paper, biodegradable plastics, antigens (edible vaccine) and antibodies. Production of crops resistant to abiotic and biotic stresses, crop quality improvement, nutrient enhancement, nitrogen fixation, nutrition up-take, production of male sterile lines, plantibodies, vaccines, plant secondary products, biofuel, bioplastics and plants as bioreactors                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 09 |
| Refer<br>ences | 1. Torr, J. D. 2006. Genetic Engineering-Current Controversies. Green haven Press.<br>2. Magnien, E. & De Nettancourt, D. 1985. Genetic Engineering of Plants and Micro-Organisms Important for Agriculture. Springer Verlag.<br>3. Gerald Karp 2013. Cell and Molecular Biology: Concepts and Experiments. 7th Edition, Wiley, NJ, USA.<br>4. Geoffrey M. Cooper & Robert E. Hausman 2013. The Cell: A Molecular Approach, 6th Edition, Sinauer Associates, Inc., Sunderland, USA.<br>5. Harvey Lodish, Arnold Berk, Chris A. Kaiser & Monty Krieger 2012 Molecular Cell Biology. 7th Edition, W. H. Freeman, NY, USA.<br>6. Stephen R. Bolsover, Elizabeth A. Shephard, Hugh A. White & Jeremy S. Hyams 2011. Cell Biology: A Short Course Wiley-Blackwell, NJ, USA.<br>7. Doods, J. H. and Roberts, L. W. 1985. Experiments in Plant Tissue culture, Cambridge University Press.<br>8. George, E. F. 1993-96. Plant propagation by Tissue culture-2 vols. Exegetics Ltd.<br><b>Reference Books:</b><br>1. Snyder, H. (2019). Literature review as a research methodology: An overview and guidelines. <i>Journal of business research</i> , 104, 333-339.<br>2. Bhattacharyya, D. K. (2006). <i>Research methodology</i> . Excel Books India.<br>3. Goundar, S. (2012). Research methodology and research method. <i>Victoria University of Wellington</i> , 1(1), 1-4.<br>4. Davidavičienė, V. (2018). Research methodology: An introduction. In <i>Modernizing the academic teaching and research environment: Methodologies and cases in business research</i> (pp. 1-23). Cham: Springer International Publishing.<br>5. Rajasekar, D., & Verma, R. (2013). <i>Research methodology</i> . Archers & Elevators Publishing House.<br><b>E resources:-</b><br>1. <a href="https://link.springer.com/journal/11240">https://link.springer.com/journal/11240</a><br>2. <a href="https://www.journals.elsevier.com/journal-of-molecular-biology/">https://www.journals.elsevier.com/journal-of-molecular-biology/</a><br>3. <a href="http://www.springer.com/life+sciences/journal/11008">http://www.springer.com/life+sciences/journal/11008</a><br>4. <a href="http://www.sciencedirect.com/science/journal/00222836?sdc=1">http://www.sciencedirect.com/science/journal/00222836?sdc=1</a><br>5. <a href="http://www.scirp.org/journal/ajmb/">http://www.scirp.org/journal/ajmb/</a><br>6. <a href="https://www.nature.com/nsmb/">https://www.nature.com/nsmb/</a><br><a href="https://www.gmb.org.br/">https://www.gmb.org.br/</a> |    |
| CourseOutcomes | On completion of the course, students should be able to:<br>CO 1: Discuss basic concept of research<br>CO2: Describe report writing<br>CO3: Identify key structures for the preparation of dissertation<br>CO4: Perform search engines in research<br>CO5: Assess impact factor and citation index                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |    |

### **SEMESTER VIII**

| SEMESTER                                      | EIGHTH                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | COURSE CODE                                 | 26BTUC4231 |
|-----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|------------|
| Course Title                                  | <b>ADVANCED MOLECULAR BIOLOGICAL TECHNIQUES</b>                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                             |            |
| No. of Credits                                | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | No. of contact hours per week               | 4          |
| New Course/<br>Revised Course                 | New Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | If revised, Percentage of revision effected | -          |
| Category                                      | Core Major- 20                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                             |            |
| Scope of the Course<br>(may be more than one) | 1. Facilitate the students understanding of the instrumentation techniques<br>2. Learning the fundamental and working principles of instruments<br>3. Understand the concept of research methodology.                                                                                                                                                                                                                                                                                  |                                             |            |
| Cognitive Levels addressed by the Course      | <b>K1-</b> Enrich the knowledge in the field of bioinstrumentation<br><b>K2-</b> Gaining factual ideas in bioinstrumentation and research methods<br><b>K3-</b> Application of recent instrumentation techniques in research<br><b>K4-</b> Focus on the working principles of instruments in the field of Biology<br><b>K5-</b> Developing competence and writing skills in thesis and publications<br><b>K6-</b> Promote and establish the research activities in the field of Botany |                                             |            |

| Course Objectives<br>(Maximum:5) | The Course aims <ul style="list-style-type: none"> <li>To understand the principles and applications of ordinary and electron microscopes</li> <li>To learn the techniques in isolation and separation of cell organelles, micro and macromolecules.</li> <li>To imbibe the principle and applications of Electrophoresis, and calorimeter</li> <li>To understand the research methods, thesis writing and presentation</li> <li>To learn the article publication, ethics and IPR.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |              |
|----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| Unit                             | Content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | No. of Hours |
| I                                | <b>Molecular Sequencing</b><br>Amino acid sequencing and analysis -MALDI-TOF, DNA sequencing –Enzymatic & chemical methods and new generation sequencing – 16S & 18S rRNA sequencing. Blotting techniques – Southern, northern, western and Dot blots. Microarray techniques – oligonucleotide array and cDNA array and its applications.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 12           |
| II                               | <b>PCR techniques</b><br>Principle and applications- types of PCR - enzymology- primer types-methods. PCR amplification for Detection of mutation, monitoring cancer therapy, detect bacterial & viral infections, sex determination of prenatal cells, linkage analysis in sperm cells and studies on molecular evolution.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 13           |
| III                              | <b>Molecular mapping of genome</b><br>Physical mapping and map -based cloning – choice of mapping population & simple sequence repeat loci – southern and fluorescence in situ hybridization for genome analysis - chromosome microdissection and microcloning - molecular markers in genome analysis (RFLP, RAPD, and AFLP analysis) – molecular markers linked disease resistance genes – application of RFLP in forensic, disease prognosis, genetic counselling, pedigree, varietal analysis, animal trafficking and poaching - germplasm maintenance and taxonomy. Molecular mapping of genome.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 12           |
| IV                               | <b>Control of Gene</b><br>Control of Gene Expression at transcription and translation level in Eukaryotes - Eukaryotic genome organization, Proteins involved in the control of transcription, Protein-protein interactions. Regulatory strategies in Eukaryotes - Gene alteration (Gene loss, Gene amplification, Gene rearrangement: the joining of coding sequences in the immune system)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 12           |
| V                                | <b>Transcriptional Control</b><br>Transcriptional Control by hormones, Gene expression regulation by methylation, acetylation and phosphorylation, Regulation of mRNA processing, RNA editing Translational control - Regulation of gene expression in plant cells by light. TATA box, CAAT box and other regulatory DNA sequences; post-translational regulatory mechanisms                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 10           |
| References                       | <b>Text Books</b> <ol style="list-style-type: none"> <li>1. Veerakumari. 2019. Bioinstrumentation. MJP Publishers, Chennai. p.39-98; 113-153; 185-375.</li> <li>2. C.R. Kothari and Gaurav Garg. 2019. Research Methodology- Methods and Techniques. New Age International Publishers, New Delhi. pp.1-25.</li> <li>3. Biju Dharmapalan 2012 Scientific Research Methodology. Narosa Publishing House, New Delhi.</li> <li>4. S. Palanichamy and M. Shunmugavelu 2009. Research methods in biological sciences. Palani paramount publications, Palani</li> <li>5. G.R. Chatwal and S.K. Anand. 2014. Instrumental Methods of Chemical Analysis. Himalaya Publishing House</li> </ol> <b>Reference Books</b> <ol style="list-style-type: none"> <li>1. B. Alberts et. al. 2008. 5th Edition, Molecular Biology of the Cell, Garland</li> <li>2. De Robertis E. D. P and De Robertis E. M. F. 2006. Cell and Molecular Biology. 8th edition. Lipincott Williams and Wilkins, Philadelphia.</li> <li>3. Cooper G. M. and Hausman R. E. 2009. The Cell: A Molecular Approach. 5th Edition. ASM Press &amp; Sunderland, Washington D. C.; Sinauer Associates, MA</li> <li>4. Surzycki S. 2000. Basic techniques in molecular biology. Springer.</li> <li>5. Verma P.S. &amp; Agarwal V. K. Cell Biology, Genetics, Molecular biology, Evolution and Ecology.</li> <li>6. Gerald Karp, Cell and Molecular Biology: Concepts and Experiments. John Wiley and Sons Inc.</li> <li>7. Lodish. H. et. al., 2000. Molecular Cell Biology, Freeman &amp; Company.</li> <li>8. Powar C.B. 1988. Essentials of Cytology, Himalaya Publishing House.</li> <li>9. Rastogi S.G. Cell Biology. Tata Mc Graw Hill Publishing Company New Delhi</li> <li>10. Rastogi. V.B. 2008. Fundamentals of Molecular Biology, Ane Books India</li> </ol> <b>E-Resources</b> <ol style="list-style-type: none"> <li>1. <a href="http://nptel.ac.in/syllabus.php?subject Id= 102107028">http://nptel.ac.in/syllabus.php?subject Id= 102107028</a>.</li> </ol> |              |

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|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                        | 2. <a href="http://b-ok.xyz/book/674611/288bc3">http://b-ok.xyz/book/674611/288bc3</a><br>3. <a href="http://www.researchgate.net/publication/317181728">http://www.researchgate.net/publication/317181728</a> - Lecture Notes on Laboratory Instrumentation and Techniques.<br>4. <a href="https://iiscs.wssu.edu/drupal/node/4673">iiscs.wssu.edu/drupal/node/4673</a><br>5. <a href="http://www.studocu.com/en/search/research">http://www.studocu.com/en/search/research</a> methodology?languages=language_en&type=document<br>*(NPTEL) -National Programme on Technology Enhanced Learning.<br>6. <a href="https://microbenotes.com/centrifuge-principle-parts-types-uses-examples/">https://microbenotes.com/centrifuge-principle-parts-types-uses-examples/</a><br>7. <a href="https://www.nanoscience.com/techniques/scanning-transmission-electron-microscopy/">https://www.nanoscience.com/techniques/scanning-transmission-electron-microscopy/</a> |
| <b>Course Outcomes</b> | <b>On completion of the course, students should be able to:</b><br>CO1: Enabling the students to understand the principles and applications of different types of microscopes, pH meter and buffers.<br>CO2: Providing excellence in isolation and separation techniques.<br>CO3: Enhance the application and separation techniques of various micro and macromolecules<br>CO4: Explain the basic information on research methods<br>CO5: Create awareness on the importance of article publication.                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

### Mapping of COs with PSOs

| CO \ PSO | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|----------|------|------|------|------|------|
| CO1      | 3    | 3    | 3    | 3    | 2    |
| CO2      | 3    | 2    | 3    | 3    | 2    |
| CO3      | 3    | 3    | 3    | 3    | 3    |
| CO4      | 3    | 2    | 3    | 3    | 3    |
| CO5      | 2    | 3    | 3    | 3    | 2    |

| SEMESTER                                      | EIGHTH                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | COURSECODE                                  | 26BTUC4232 |
|-----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|------------|
| Course Title                                  | <b>FORENSIC BOTANY</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                             |            |
| No. of Credits                                | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | No. of contact hours per Week               | 3          |
| New Course/<br>Revised Course                 | New Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | If revised, Percentage of Revision effected | -          |
| Category                                      | Core Major- 21                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                             |            |
| Scope of the Course<br>(may be more than one) | <ul style="list-style-type: none"> <li>Students will be able to develop their skills in Forensics.</li> <li>Students will be able to develop Employability in various botanical fields.</li> </ul>                                                                                                                                                                                                                                                                                                                               |                                             |            |
| Cognitive Levels addressed by the Course      | K-1:Remember Basic concepts in Forensic Botany<br>K-2:Understanding the importance of forensic products<br>K-3:Apply to know plant ecology in forensic botany<br>K-4:Analyze the significance of forensics toxicology<br>K-5: Evaluate the importance of forensic photography<br>K-6:Create knowledge on botanical evidence in crime scenes                                                                                                                                                                                      |                                             |            |
| Course Objectives                             | The Course aims to: <ul style="list-style-type: none"> <li>Enhance the students' knowledge on application of forensic botany.</li> <li>Give an overview plant products for forensics</li> <li>Make the students knowledgeable about the forensic palynology.</li> <li>Acquire an overall knowledge on plant poison and its classification.</li> </ul>                                                                                                                                                                            |                                             |            |
| Unit                                          | Content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                             | No.Ofhours |
| I                                             | <b>The World of Forensics</b><br>Introduction to Forensics: Branches, Principles and Significance. Locard's Exchange principle. Forensic Botany: Introduction, Significance, Applications, Branches: Palynology, Limnology, Plant Anatomy, Plant Ecology, Plant Molecular Biology. Plant architecture- roots, stems, flowers, leaves. Practical plant classification schemes: - vegetables and herbs, fruits bearing trees and plants, landscaping plants: trees, shrubs and vines, grasses, plant cell structure and functions. |                                             | 10         |
| II                                            | <b>Plant Parts/ Products for Forensics</b><br>Forensic importance, Identification and matching of various types of wood, timber                                                                                                                                                                                                                                                                                                                                                                                                  |                                             | 09         |

|                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |    |
|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
|                | varieties, seeds and leaves. Types of fibres: forensic aspects of fibre examinations, Identification and comparison of man-made and natural fibres. Forensic dendrochronology: Introduction to tree-ring analysis, interpreting, and applications. Plant fluids: Identification and collection of sap, gum, latex, and volatile oils. Forensic significance and role of fungal spores and algae.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |    |
| III            | <b>Forensic Palynology, Limnology and Plant Ecology</b><br>Forensic palynology: Fingerprints of localities, sample preparation for pollen spores and analysis. Techniques for collecting, processing, and analysing. Applications of forensic palynology. Forensic limnology: Diatom types & morphology, methods of isolation, identification and comparison. Forensic significance in drowning cases. Plant ecology in forensic botany: Geographical distribution of plant species and its forensic relevance (gravesite analysis, time of deposition, geomorphology).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 10 |
| IV             | <b>Forensic Toxicology</b><br>Toxicological examination and its significance. Plant Poison: Introduction, Classification, and Their Main Active Constituents. Various types of poisonous plants: <i>Abrus precatorius</i> , <i>Aconitum</i> , <i>Anacardium occidentale</i> , <i>Argemone mexicana</i> , <i>Calotropis</i> , <i>Claviceps purpurea</i> , <i>Cinchona</i> , <i>Croton tiglium</i> , <i>Atropa belladonna</i> , <i>Erythroxylum cocoa</i> , <i>Gloriosa superba</i> , <i>Jatropha curcas</i> , <i>Lathyrus sativus</i> , <i>Manihot utilissima</i> , <i>Nerium oleander</i> , <i>Plumbago zeylanica</i> , <i>Ricinus communis</i> , <i>Semicarpus anacardium</i> , <i>Strychnos nux vomica</i> , <i>Thevetia peruviana</i> . Abused drug yielding plants - <i>Opium</i> , <i>Cannabis</i> , <i>Tobacco</i> , <i>Datura</i> and <i>Psilocybe</i> mushrooms.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 09 |
| V              | <b>Collection, Preparations and Documentation of Botanical Evidences</b><br>Use of Botanical Evidence in Criminal Investigation: Botanical evidence and crime scene; source, transfer, evidence recognition, collection, preservation and documentation. Forensic photography: Types and importance. Analysis of samples, DNA analysis, plant DNA typing, RFLP analysis, PCR analysis, and DNA Fingerprinting. Forensic Botany Case studies: Using Plant Anatomy and biosystematics, Dendrochronology techniques, Plant Molecular Biology & DNA, and using Palynology.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 10 |
| Refer<br>ences | <b>Text Books:</b> <ol style="list-style-type: none"> <li>1. Coyle H.M. 2004. Forensic Botany: Principles and Applications to Criminal Casework. CRC Press.</li> <li>2. Hall D.W. and Byrd J. 2012 Forensic Botany: a practical guide. Wiley-Blackwell, 1st edition.</li> <li>3. Heather Miller Coyle, (2nd Edition) (2012), Forensic Botany, CRC Press INC.</li> <li>4. Bock J.H. and Norris D.O. 2016. Forensic Plant Science. Academic Press.</li> <li>5. Ganesslen RE, Essentials of Forensic Science: Blood, Bugs and Plants, 1st Edition, Facts on File Publishers Pvt Ltd, New York, United States, 2008.</li> </ol> <b>Reference Books:</b> <ol style="list-style-type: none"> <li>1. James SH, Nordby JJ, Bell S, Forensic Science: An Introduction to Scientific and Investigative Techniques, 4th Edition, CRC Press Pvt Ltd, Taylor and Francis Group, United Kingdom, 2015.</li> <li>2. Aquila, I. et al. (2014) The role of forensic botany in crime scene investigation: case report and review of literature. Journal of Forensic Sciences, 59(3).</li> <li>3. Julie Roberts, Nicholas Marquez-Grant, (2012), Forensic Ecology: From Crime Scene to Court, John Wiley &amp; Sons Ltd.</li> <li>4. Ferri, G. et al. (2008) Land plants identification in forensic botany: Multigene barcoding approach. Forensic Science International: Genetics Supplement Series, 1(1), pp. 593-595. <a href="https://doi.org/10.1016/j.fsigss.2007.10.023">https://doi.org/10.1016/j.fsigss.2007.10.023</a></li> </ol> <b>E-Resources:</b> <ol style="list-style-type: none"> <li>1. <a href="https://www.dodl.klyuniv.ac.in/download/SLM2023/Botany/BOTDSE%20T%20301.1.pdf">https://www.dodl.klyuniv.ac.in/download/SLM2023/Botany/BOTDSE%20T%20301.1.pdf</a></li> <li>2. <a href="https://legaldesire.com/forensic-botany-and-its-applications/">https://legaldesire.com/forensic-botany-and-its-applications/</a></li> <li>3. <a href="https://www.kew.org/read-and-watch/how-forensic-botany-plant-science-solve-crimes">https://www.kew.org/read-and-watch/how-forensic-botany-plant-science-solve-crimes</a></li> <li>4. <a href="http://www.notesonzooology.com/dna/dna-fingerprinting/">http://www.notesonzooology.com/dna/dna-fingerprinting/</a></li> </ol> |    |
| CourseOutcomes | On completion of the course, students should be able to:<br>CO 1: Discuss the principles of forensic botany<br>CO2: Describe Forensic dendrochronology<br>CO3: Identify forensic relevance of plant species<br>CO4: Perform the classification of plant poison<br>CO5: Assess case studies in forensic botany                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |    |

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|-----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|-------------------|
| <b>SEMESTER</b>                               | <b>EIGHTH</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>COURSECODE</b>                           | <b>26BTUC4233</b> |
| Course Title                                  | <b>ARTIFICIAL INTELLIGENCE IN PLANT SCIENCE</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                             |                   |
| No. of Credits                                | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | No. of contact hours per Week               | 3                 |
| New Course/<br>Revised Course                 | New Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | If revised, Percentage of Revision effected | -                 |
| Category                                      | Core Major -22                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                             |                   |
| Scope of the Course<br>(may be more than one) | <ul style="list-style-type: none"> <li>Students will be able to develop their skills in Artificial Intelligence.</li> <li>Students will be able to develop Employability in various botanical fields.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                             |                   |
| Cognitive Levels addressed by the Course      | K-1:Remember Basic Concepts of Artificial Intelligence in Botany<br>K-2:Understanding the applications and technical advancements.<br>K-3:Apply to know AI Applications in Gene Sequencing and Analysis<br>K-4:AnalyzeImportance of Drone<br>K-5: Evaluate Intellectual Property and AI Transparency<br>K-6:Create knowledge on futuristic approach on plant sciences                                                                                                                                                                                                                                                                                                                        |                                             |                   |
| Course Objectives                             | The Course aims to: <ul style="list-style-type: none"> <li>Enhance the students' knowledge of Artificial Intelligence</li> <li>Know about AI applications in Plant identification and classification</li> <li>Give an overview on programming for Botanical AI</li> <li>Make the students knowledgeable about Artificial Intelligence in the agricultural Industry</li> <li>Acquire an overall knowledge on role of AI in promoting sustainable agriculture and conservation.</li> </ul>                                                                                                                                                                                                     |                                             |                   |
| <b>Unit</b>                                   | <b>Content</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                             | <b>No.Ofhours</b> |
| I                                             | <b>Introduction to AI and Machine Learning</b><br>Artificial Intelligence: History, Basics and Concept of AI, Machine learning, Different Research areas of AI, Applications of AI, Task classification of AI, Agents and Environment. Algorithms, models, training data, overfitting vs underfitting, supervised vs unsupervised learning. Expert systems and Fuzzy logic, Neural Networks, Generative AI, Comparison of Generative AI Models (Models by Open AI, Anthropic, Google, Meta). Artificial Neural Networks, predictive analytics, regression, classification, forecasting models.                                                                                               |                                             | 10                |
| II                                            | <b>AI for Botanical Research</b><br>AI Applications in Plant Identification and Classification (PlantNet, iNaturlist), Machine Learning Models for Plant Identification, Image Processing for Plant Classification, AI in Phenotyping and Disease Detection. AI in Botanical Data Collection and Analysis - Traditional vs. AI-enhanced data collection methods, Sensors and Drones in Data gathering and vegetation mapping. Visualization of Botanical Data with AI Tools, IoT sensors to detect microenvironments.                                                                                                                                                                        |                                             | 09                |
| III                                           | <b>AI for Data Analysis and Programming</b><br>Plant Genomics and Proteomics: AI Applications in Gene Sequencing and Analysis, Sequence assembly, Structure predictions. Biodiversity Analysis: Ecosystem Monitoring and Management (Deforestation, habitat degradation, and species distribution, early detection of wildfires, illegal logging). Programming for Botanical AI: R Program, Python (overview). AI for Botanical Imaging and Analysis: Digital Imaging, Tools and Techniques for Image Analysis (OpenCV), Image segmentation, Feature extraction. Database Management in Botany - Overview of Database Systems in Botanical Research, Data Storage, Retrieval and Management. |                                             | 10                |
| IV                                            | <b>AI for Agriculture</b><br>Artificial Intelligence in the Agricultural Industry: Image-based insight generation (Disease detection, Crop readiness identification, Field management), Importance of Drone, Precision Farming, AI for Pollination Monitoring and drone-assisted pollination. Challenges in the Adoption of Artificial Intelligence in Agriculture. Deep learning and artificial intelligence (AI): Detection of water stress and disease detection in smart/precision Farming. AI-based systems for Traditional Medicine.                                                                                                                                                   |                                             | 09                |
| V                                             | <b>Ethical practices in AI</b><br>Ethical Considerations in Botanical Research, Data Privacy, Intellectual Property and AI Transparency, Crafting Ethical Guidelines for AI use in Botanical Sciences. Role of AI in Promoting Sustainable Agriculture and Conservation, AI in Climate Change Research and Its Implications. Practical Challenges and Future Trends in Botanical AI. Technical limitations of AI in Botany. Strategies to enhance usability of AI in Botanical Research, Exploration of Emerging AI Technologies in Botany.                                                                                                                                                  |                                             | 10                |

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| <b>References</b>     | <p><b>Text Books:</b></p> <ol style="list-style-type: none"> <li>1. Russell, Stuart J., and Peter Norvig. 2010. Artificial intelligence is a modern approach. London,</li> <li>2. Hutter, Marcus 2005. Universal Artificial Intelligence. Berlin: Springer. ISBN 978-3 540- 22139-5.</li> <li>3. Neapolitan, Richard; Jiang, Xia 2018. Artificial Intelligence: With an Introduction to Machine Learning. Chapman &amp; Hall/CRC. ISBN978-1-138-50238-3.</li> <li>4. Artificial Intelligence: A Modern Approach Third Edition Stuart Russell and Peter Norvig, 2010. Pearson Education, Inc. ISBN: 978-0-13-604259-4</li> <li>5. Lucci S., Kopec D. (2013). Artificial intelligence in the 21st century. 22841 Quicksilver Drive Dulles, VA 20166.</li> </ol> <p><b>Reference Books:</b></p> <ol style="list-style-type: none"> <li>1. Wäldchen, J., Mäder, P. 2018. Plant Species Identification Using Computer Vision Techniques: A Systematic Literature Review. Arch Computat Methods Eng 25, 507 543 <a href="https://doi.org/10.1007/s11831-016-9206-z">https://doi.org/10.1007/s11831-016-9206-z</a></li> <li>2. <a href="https://www.greymb.com/blog/ai-in-pollination-management/">https://www.greymb.com/blog/ai-in-pollination-management/</a></li> <li>3. Russell, Stuart J.; Norvig, Peter 2003. Artificial Intelligence: A Modern Approach (2nd ed.), Upper Saddle River, New Jersey: Prentice Hall, ISBN 0-13-790395-2.</li> <li>4. Saranya, T., Deisy, C., Sridevi, S., &amp; Sonai M. A., (2023). A comparative study of deep learning and Internet of Things for precision agriculture. Engineering Applications of Artificial Intelligence. 122 (C).</li> <li>5. Akkem, Y., Saroj K. B., &amp; Aruna V., (2023). Smart farming using artificial intelligence: A review. Engineering Applications of Artificial Intelligence. Vol. 120, 105899.</li> </ol> <p><b>E-Resources:</b></p> <ol style="list-style-type: none"> <li>1. <a href="https://share.google/AR7ZdecnMWxGBZivw">https://share.google/AR7ZdecnMWxGBZivw</a></li> <li>2. <a href="https://thesai.org/Downloads/Volume13No10/Paper_97_Artificial_Intelligence_for_Automated_Plant_Species_Identification.pdf">https://thesai.org/Downloads/Volume13No10/Paper_97_Artificial_Intelligence_for_Automated_Plant_Species_Identification.pdf</a></li> <li>3. <a href="https://www.youtube.com/watch?v=hyndmrXUkEQ">https://www.youtube.com/watch?v=hyndmrXUkEQ</a></li> <li>4. <a href="https://ijireeice.com/wp-content/uploads/2025/03/IJIREEICE.2025.13344.pdf">https://ijireeice.com/wp-content/uploads/2025/03/IJIREEICE.2025.13344.pdf</a></li> </ol> |
| <b>CourseOutcomes</b> | <p>On completion of the course, students should be able to:</p> <p>CO 1: Discuss basics and concept of AI</p> <p>CO2: Describe machine learning models for plant identification techniques</p> <p>CO3: Identify tools and techniques for image analysis</p> <p>CO4: Perform AI-based systems for traditional medicine</p> <p>CO5: Assess the technical limitations of AI in botany</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |