# SRI VIDYA MANDIR ARTS & SCIENCE COLLEGE

## (Autonomous)

[An Autonomous College Affiliated to Periyar University, Salem, Tamil Nadu]
[Accredited by NAAC with 'A' Grade with CGPA of 3.27]
[Recognized 2(f) & 12(B) Status under UGC Act of 1956]
Katteri – 636 902, Uthangarai (Tk), Krishnagiri (Dt)
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## DEGREE OF BACHELOR OF SCIENCE IN BOTANY

## CHOICE BASED CREDIT SYSTEM (CBCS)

## REGULATIONS AND SYLLABUS FOR

## B.Sc. BOTANY PROGRAMME

## (SEMESTER PATTERN)

**(For Students Admitted in the College from the Academic Year 2024-2025 Onwards)**

# REGULATIONS AND SYLLABUS FOR B.Sc. BOTANY PROGRAMME

**(For Students Admitted in the College from the Academic Year 2024-2025 Onwards)**

## 1. Vision of the Department

The vision is to maintain our position as a Premier Department of higher learning and research in Botany and further commit ourselves towards achieving academic excellence.

## 2. Mission of the Department

The mission is to strive for an excellent environment for the learning and research in diverse fields in plant sciences, such as biotechnology, tissue culture, and microbial sciences by facilitating appropriate solutions to industrial, health, agricultural and environmental challenges.

## 3. Definitions

**(i) Programme:** Programme means a course of study leading to the award of the degree in a discipline.

**(ii) Course:** Course refers to the subject offered under the Degree Programme.

## 4. Aims of the Programme

1. The existing flora for enhancing the beauty of our planet earth mother and to pass it on for our future generation.
2. Demonstrate communication skills to present a clear, coherent and independent exposition of knowledge and ideas
3. To understand the interconnections of knowledge within and across disciplines
4. Apply knowledge, theories, methods, and practices in their chosen field of study to address real-world challenges and opportunities
5. Express the proficiency in experimental techniques and methods of analysis appropriate for their area of specialization
6. Graduates will learn about the internal organization of plants and their role in functioning of plant system
7. Graduates will acquire knowledge on the production of GMOs which play a significant role in field of agriculture and medicine
8. Graduates will learn the relationship between Botany and its relevant disciplines, such as Biotechnology, Microbiology, Biochemistry, Biophysics, Bioinformatics and Nanobiotechnology

9. The students will be preparing for different research/teaching qualification and competitive examinations, such as, Teacher Recruitment Board, Forest Ranger Officers, Horticulture Department, BSI Department, TNPSC and UPSC etc.

**5. Programme Outcomes (PO)**

| | |
|---|---|
| **PO1** | The study of botany will provide a good knowledge about Microbiology, Phycology, Taxonomy, Molecular Biology, Medicinal plants, Plant Tissue Culture and Ecological distributions. |
| **PO2** | Acquire tremendous opening to enhance the plant science knowledge on Plant Diversity and ecological dimension of vascular cryptogams and Angiosperms and to study the plant kingdom. |
| **PO3** | Gain knowledge and understand the range of plant diversity in terms of structure, function and environmental relationship from primitive to highly evolved plant groups. |
| **PO4** | Gather knowledge on various physiological and biochemical pathways and their vital role in biotic factors. |
| **PO5** | Apply logical information on the significance of moral natural standards and resulting duties applicable to biodiversity protection, practical and manageable utilization of plants. |
| **PO6** | Students can reveal the medicinal properties of plants in the socioeconomic values of identified plant sciences and to spread information on different parts of therapeutic plants and proper contemplations on human health issues. |
| **PO7** | Information on conservation of plant resources and different hotspots expand studies to investigate their helpful qualities economically, socially and aesthetically. |
| **PO8** | Use look into research based information and research techniques including the lab experiments, analysis and data prediction, information, and advancement of the data to provide a substantial ends. |

**6. Programme Specific Outcomes (PSO)**

| | |
|---|---|
| **PSO1** | Through scientific classification, the students understand about the plant communities and binomial names, economic significance including the utilizations and varieties among several types of Angiosperms. |
| **PSO2** | Students can apply the knowledge and relate the information gained from the allied subjects viz; Zoology and Chemistry, to explain and conclude through the interdisciplinary approaches. |
| **PSO3** | The students enhance knowledge on the pathways of metabolisms, transport and translocation of water and solutes and biochemical parameters like carbohydrate, protein and lipid together with a better understanding of regulation of growth, development and influence of environment. |
| **PSO4** | The students will have the option to secure tremendous academic information on the science of fossils and living plants alongside their associations with their condition in the environment. |
| **PSO5** | Investigation of horticulture and arranging procedures helps to the students to execute information on the procedure of development of nurseries and the management and maintenance of the gardens. |

**7. Eligibility for Admission**

A candidate who has passed Higher Secondary Examination in Academic or vocational stream with Botany/Biology under higher secondary board of examination, Tamil Nadu or an examination accepted as Equivalent there to by the syndicate subject to such conditions as may be prescribed thereto are permitted to appear and qualify for the B.Sc degree examination of this Autonomous College affiliated to Periyar University after a course of study of three academic years.

**8. Duration of the Programme**

The Programme for the Degree of Bachelor of Science (B.Sc.) in Botany shall consist of three academic years divided into six semesters. Each Semester consists of 90 working days (450 hours).

**9. Features of Choice Based Credit System**

Under Choice Based Credit System (CBCS), a set of Courses consisting of Core Courses, Elective Courses, Skill Based Elective Courses and Non-Major Elective Courses are offered. Beside the Core Courses, which are totally related to the major subject, the students have the advantage of studying supportive papers and Non-Major Courses. This provides enough

opportunity to the students to learn not only the major courses but also inter disciplinary and application oriented courses.

**10. Syllabus**

The syllabus of the B.Sc. Botany Degree Programme is divided into the following Courses:

1. Core Courses
2. Elective Courses
3. Language Course
4. Non-Major Elective Course
5. Extra Credit Courses

**(i)** **Language Courses:** The language courses are offered by the language (Tamil/English) Departments in a particular language.

**(ii)** **Core Courses:** The Core Courses are related to the Programme concerned including practicals offered under the Programme.

**(iii)** **Elective Courses:** The Elective Courses offered under the Programme related to the major or non-major but are to be selected by the students.

**(iv)** **Skill Based Elective Courses (SBEC):** This course aims to impart advanced and recent developments in the concerned discipline.

**(v)** **Non-Major Elective Courses (NMEC):** Irrespective of the discipline, the student can select papers that are offered by other disciplines as non-major elective course.

**(vi)** **Extension Activity:** Participation in NSS/NCC/YRC/RRC/Sports or other co-circular activities are considered as Extension Activity.

**(vii)** **Extra Credit Courses:** In order to facilitate the students gaining extra credits, the Extra Credit Courses are offered. According to the guidelines of the UGC, the students are encouraged to avail this option of enriching the knowledge by enrolling themselves in the Massive Open Online Courses (MOOC) provided by various portals, such as SWAYAM, NPTEL, etc.

**11. Programme of Study**

The Programme of study for the Degree shall be in the Branch – Botany (Choice Based Credit System) with internal assessment comprised of instructions in the following subjects according to the syllabi and books prescribed from time to time.

**12. Credit**

Weightage given to each course of study is termed as Credit.

**13. Credit System**

The weightage of credits are spread over to four different semesters during the period of study and the cumulative credit point average shall be awarded based on the credits earned by the student. A total of 140 Credits are prescribed for the B.Sc. Botany Degree Programme which is the minimum Credit requirement for the three year B.Sc. Botany Degree Programme.

# SRI VIDYA MANDIR ARTS & SCIENCE COLLEGE

**(Autonomous)**

## Bachelor of Science (B.Sc.) in Botany

## Programme Pattern and Syllabus (CBCS)

**(For Students Admitted in the College from the Academic Year 2024-2025 Onwards)**

| Sl. No. | Part | Nature of Course | Course Code | Name of the Course | Hours/ Week | Credits | Marks | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | CIA | ESE | Total |
| **SEMESTER I** | | | | | | | | | |
| 1 | I | Language | 24UTA1F01 | Tamil – I | 6 | 3 | 25 | 75 | 100 |
| 2 | II | Language | 24UEN1F01 | English – I | 6 | 3 | 25 | 75 | 100 |
| 3 | III | Core – I | 24UBO1C01 | Plant Diversity – I (Algae) | 5 | 6 | 25 | 75 | 100 |
| 4 | | Core Practical – I | - | Practical – I (Plant Diversity I - Algae) | 3 | Assessment in the academic year end | | | |
| 5 | | Allied – I | 24UZO1A01 | Allied Zoology – I | 5 | 3 | 25 | 75 | 100 |
| 6 | | Allied Practical – I | - | Allied: Zoology Practical – I | 3 | Assessment in the academic year end | | | |
| 7 | IV | Non-Major Enhancement Courses - 1 (NMEC - 1) | To be offered by other department | | 2 | 2 | 25 | 75 | 100 |
| 8 | | Foundation Course (FC) | 24UBO1FC01 | Basics of Botany | 2 | 2 | 25 | 75 | 100 |
| **Total** | | | | | **36** | **19** | **150** | **450** | **600** |
| **SEMESTER II** | | | | | | | | | |
| 10 | I | Language | 24UTA2F02 | Tamil – II | 6 | 3 | 25 | 75 | 100 |
| 11 | II | Language | 24UEN2F02 | English – II | 6 | 3 | 25 | 75 | 100 |
| 12 | III | Core – II | 24UBO2C02 | Plant Diversity – II (Fungi, Bacteria, Viruses, Plant pathology and Lichens) | 5 | 6 | 25 | 75 | 100 |
| 13 | | Core Practical – II | 24UBO2P01 | Practical – I (Including Core Course – I & I : Algae, Fungi, Bacteria, Viruses, | 3 | 5 | 40 | 60 | 100 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Plant pathology and Lichens) | | | | | |
| 14 | | Allied Zoology – II | 24UZO2A02 | Allied Zoology – II | 5 | 3 | 25 | 75 | 100 |
| 15 | | Allied Practical – II | 24UZO2AP01 | Allied Zoology Practical – II | 3 | 2 | 40 | 60 | 100 |
| 16 | IV | Non-Majore Enhancement Courses - 2 (NMEC - 2) | To be offered by other department | | 2 | 2 | 25 | 75 | 100 |
| 17 | | Skill Enhancement Courses – 1 (SEC 1) | 24UBO2S01 | Botanical garden and landscaping | 2 | 2 | 25 | 75 | 100 |
| **Total** | | | | | **30** | **26** | **230** | **570** | **800** |
| **SEMESTER III** | | | | | | | | | |
| 19 | I | Language | 24UTA3F03 | Tamil – III | 6 | 3 | 25 | 75 | 100 |
| 20 | II | Language | 24UEN3F03 | English – III | 4 | 3 | 25 | 75 | 100 |
| 21 | III | Core – II | 24UBO3C03 | Plant Diversity III - Bryophytes and Pteridophytes | 5 | 6 | 25 | 75 | 100 |
| 22 | | Core Practical – II | - | Plant Diversity III (Bryophytes and Pteridophytes) | 3 | Assessment in the academic year end | | | |
| 23 | | Allied – III | 24UCH3A01 | Allied Chemistry – I | 5 | 3 | 25 | 75 | 100 |
| 24 | IV | Skill Enhancement Courses 2 (SEC 2) | 24UBO3S02 | Herbal Technology | 2 | 2 | 25 | 75 | 100 |
| 25 | | Skill Enhancement Courses 3 (SEC 3) | 24UBO3S03 | Entrepreneurial Skill Entrepreneurial opportunities in Botany | 1 | 1 | 25 | 75 | 100 |
| 26 | | EVS | - | Environmental studies | 1 | Assessment in the academic year end | | | |
| **Total** | | | | | **30** | **18** | **150** | **450** | **600** |
| **SEMESTER IV** | | | | | | | | | |
| 29 | I | Language | 24UTA4F04 | Tamil – IV | 6 | 3 | 25 | 75 | 100 |
| 30 | II | Language | 24UEN4F04 | English – IV | 4 | 3 | 25 | 75 | 100 |
| 12 31 | | Core – II | 24UBO4C04 | Plant Diversity – IV (Gymnosperms, | 5 | 6 | 25 | 75 | 100 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | III | | | Paleobotany and Evolution) | | | | | |
| 32 | | Core Practical – II | 24UBO4P02 | Practical – II (Core III and IV: Bryophytes, Pteridophytes, Gymnosperms, Paleobotany and Evolution) | 4 | 5 | 40 | 60 | 100 |
| 33 | | Allied – IV | 24UCH4A02 | Allied Chemistry – II | 4 | 3 | 25 | 75 | 100 |
| 34 | | Allied Practical – IV | 24UCH4AP02 | Allied Chemistry Practical – II | 2 | 2 | 40 | 60 | 100 |
| 35 | | Elective – Industry Module | 23UBO4E01 | Cultivation of Algae | 4 | 2 | 25 | 75 | 100 |
| 36 | IV | Skill Enhancement Courses 5 (SEC 5) | 24UBO4S06 | Fermentation technology | 2 | 2 | 25 | 75 | 100 |
| 37 | | Skill Enhancement Courses SEC 7 | 24UBO4S07 | Environmental impact analysis | 2 | 1 | 25 | 75 | 100 |
| 39 | | | 24UBO4EVS01 | Environment studies | 1 | 1 | 25 | 75 | 100 |
| **Total** | | | | | **36** | **26** | **255** | **645** | **900** |
| **SEMESTER V** | | | | | | | | | |
| 40 | | Core IX | 24UBO5C05 | Plant Morphology, Taxonomy and Economic Botany | 5 | 4 | 25 | 75 | 100 |
| 42 | | Core XI | 24UBO5C06 | Plant Anatomy and Embryology | 5 | 4 | 25 | 75 | 100 |
| 43 | | Core XII | 24UBO5C07 | Core - Cell Biology, Genetics and Plant Breeding | 5 | 4 | 25 | 75 | 100 |
| 44 | | Core XIII | 24UBO5P06 | Practical covering – Core XI and XII-Practical VI | 6 | Assessment in the academic year end | | | |
| 45 | IV | Elective course 1 | 24UBO5E01 | Bio-Analytical Techniques | 5 | 2 | 25 | 75 | 100 |
| | | | 24UBO5E02 | Aquatic Botany | | | | | |
| | | | 24UBO5E03 | Entrepreneurial | | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Botany | | | | | |
| 47 | | Project | 24UBO5PR01 | Project with viva voce | 4 | 4 | 40 | 60 | 100 |
| | | Internship | 24UBO5IN01 | Internship and viva voce | - | 2 | - | - | 100 |
| 48 | | Value Education | 24UBO5VE01 | Value Education | 1 | 2 | 25 | 75 | 100 |
| **Total** | | | | | **30** | **22** | **270** | **630** | **900** |
| **SEMESTER VI** | | | | | | | | | |
| 10 | I | Core XIV | 24UBO6C08 | Core – Plant Ecology and Phytogeography | 5 | 4 | 25 | 75 | 100 |
| 11 | II | Core XV | 24UBO6C09 | Core - Plant Biotechnology and Molecular Biology | 5 | 4 | 25 | 75 | 100 |
| 12 | III | Core XVI | 24UBO6C10 | Core -Plant Physiology and Plant Biochemistry | 5 | 4 | 25 | 75 | 100 |
| | | Core Practical - 3 | 24UBO6P03 | Practical covering – Core XIV, XV and XVI - Practical-VII | - | 4 | 40 | 60 | 100 |
| 13 | | Core Practical - 4 | 24UBO6C04 | Practical covering – Core XIV, XV and XVI - Practical-VII | 6 | 3 | 40 | 60 | 100 |
| 14 | | Elective course | 24UBO6E04 | Horticulture | 3 | 2 | 25 | 75 | 100 |
| | | | 24UBO6E05 | Natural Resource Management | | | | | |
| | | | 24UBO6E06 | Forestry | | | | | |
| 15 | | Elective course | 24UBO6E07 | Bionanotechnology | 3 | 2 | 40 | 60 | 100 |
| | | | 24UBO6E08 | Computer application in Botany | | | | | |
| | | | 24UBO6E09 | Forensic Botany | | | | | |
| 16 | IV | Skill Enhancement Courses Professional Competency Enhancement | 24UBO6S10 | Training for Competitive examinations | 2 | 2 | 25 | 75 | 100 |
| | | | 24UBO6S11 | Botany for Competitive examinations | | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 24UBO6S12 | General Studies for Competitive examinations | | | | | |
| | | | 24UBO6S04 | Botany for Advanced Studies | | | | | |
| 17 | | Value education | 24UBO6VE02 | - | 1 | 1 | 25 | 75 | 100 |
| **Total** | | | | | **30** | **21** | **255** | **645** | **900** |
| **TOTAL CREDITS** | | | | | | **140** | **---** | | |

**Note:**

CBCS – Choice Based Credit system
CIA – Continuous Internal Assessment
ESE – End of Semester Examinations
SWAYAM –Study Webs of Active-Learning for Young Aspiring Minds
NPTEL –National Programme on Technology Enhanced Learning

**Major Elective Courses**

1. Plant Biotechnology
2. Forestry
3. Food and Nutrition

**Non-Major Elective Courses**

| Semester No. | Part | Nature of Course | Course Code | Name of the Course | Hours/ Week | Credits | Marks | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | CIA | ESE | Total |
| I | IV | Non-Majore Enhancement Courses - 1 (NMEC - 1) | 24UBO1N01 | Organic farming | 2 | 2 | 25 | 75 | 100 |
| | | | 24UBO1N02 | Environmental Biotechnology | | | | | |
| | | | 24UBO1N03 | Nursery and Landscaping | | | | | |
| II | IV | Non-Majore Enhancement Courses - 2 (NMEC - 2) | 24UBO2N04 | Mushroom cultivation | 2 | 2 | 25 | 75 | 100 |
| | | | 24UBO2N05 | Herbal Medicine | | | | | |
| | | | 24UBO2N06 | Global Climate change | | | | | |

**List of Extension Activities**

1. National Cade Corps (NCC)
2. National Service Scheme (NSS)
3. Youth Red Cross (YRC)
4. Physical Education (PYE)
5. Eco Club (ECC)
6. Red Ribbon Club (RRC)

7. Women Empowerment Cell (WEC)

**13. Break-Up of Marks and Credits**

The break-up of marks and credits for the B.Sc. Botany Degree Programme is as follows:

| Sl. No. | Part | Subject | Marks | Credits |
|---|---|---|---|---|
| 1. | I | Language – Tamil | 400 | 12 |
| 2. | II | Language – English | 400 | 12 |
| 3. | III | Core – Theory/Practical | 1400 | 62 |
| | | Allied – Theory/Practical | 600 | 21 |
| | | Major Elective Courses | 200 | 10 |
| 4. | IV | Skill Based Elective Courses | 700 | 14 |
| | | Non-Major Elective Courses | 200 | 4 |
| | | Environmental Studies | 100 | 2 |
| | | Value Education | 100 | 2 |
| 5. | V | Extension Activities | - | 1 |
| **Total** | | | **4100** | **140** |

1. The students are advised to complete one **SWAYAM/MOOC course per year** and submit the course completion certificate to the HOD during the even semester of each year. Two credits will be given for each **SWAYAM/MOOC** course who have successfully completed.
2. The field trip preferably relevant to the course should be undertaken every year.

**15. Examinations**

The examinations consist of Continuous Internal Assessment (CIA) and end of semester examinations (ESE). The ESE shall be of Three Hours duration for each theory course at the end of every semester. The candidate failing in any course(s) will be permitted to appear for each failed course(s) in the subsequent examination. The end of semester practical examinations shall be of Three Hours for each practical course conducted at the end of every even semester.

To maintain uniformity, particularly for interdepartmental transfer of credits, there shall be a uniform pattern of examination to be adopted by all the teachers offering courses. There shall be two tests, seminar and assignment for CIA and ESE during each semester. The distribution of marks for CIA and ESE shall be 25 marks and 75 marks, respectively. Further, the distribution of CIA will be 15 marks for test, 5 marks for assignment and 5 marks for attendance. The average of the highest two test marks will be taken for CIA.

## 16. Components of Continuous Internal Assessment (CIA)

| Components | | Marks | Total Marks |
|---|---|---|---|
| **Theory** | | | |
| CIA I | 75 | (75+75 = 150/10) 15 | 25 |
| CIA II | 75 | | |
| Assignment | | 05 | |
| Attendance | | 05 | |
| **Practical** | | | |
| CIA | | 25 | 40 |
| Practical Observation Notebook | | 10 | |
| Attendance | | 05 | |

## 17. Question Paper Pattern

### (i) Theory Examinations (CIA I & CIA II = 25 Marks and ESE = 75 Marks)

| Section | Marks | Description | Total Marks |
|---|---|---|---|
| A<br>(Answer ALL)<br>Q1–Q15 | 15 × 1 = 15 | Multiple Choice Questions (MCQ)<br>(Three questions from each unit) | 15 |
| B<br>(Answer any THREE out of FIVE)<br>Q16–Q20 | 3 × 5 = 15 | Write in a Paragraph<br>(One question from each unit) | 15 |
| C<br>(Either or Pattern)<br>Q20–Q25 | 5 × 9 = 45 | Descriptive/Detailed Answers<br>(Two questions from each unit) | 45 |
| **Total Marks** | | | **75** |

Passing Minimum (CIA) 40% = 10 Marks

Passing Minimum (ESE) 40% = 30 Marks

**40 Marks**

### (ii) Practical Examinations (CIA = 40 Marks and ESE = 60 Marks)

| Components | Marks | Total |
|---|---|---|
| Experiments | 50 | |

| | | |
|---|---|---|
| Record Work | 10 | 60 |

Passing Minimum (CIA) 40% = 16 Marks

Passing Minimum (ESE) 40% = 24 Marks

**40 Marks**

The candidate shall be declared to have passed the theory examination if the candidates secure not less than 30 marks out of 75 marks in the semester examination in each theory course and 10 marks out of 25 marks in the CIA and in total not less than 40 marks.

For the practical course, 24 marks out of 60 marks in the semester examination and the record notebook taken together and 16 marks out of 40 marks in the CIA and in total 40 marks. There is no passing minimum for the record notebook. However, submission of the record notebook is necessary.

Candidate who does not obtain the required minimum marks for a pass in a Course/Practical/Project shall be declared Re-Appear (RA) and the candidate has to appear and pass the same at a subsequent appearance.

**18. Maximum Duration for the Completion of the B.Sc. Botany Programme**

The maximum duration for completion of the B.Sc. Botany Programme shall not exceed twelve semesters.

**19. COMMENCEMENT OF THIS REGULATION**

This regulation and syllabus shall take effect from the academic year 2020–2021 for students who are admitted to the first year of the Programme during the academic year 2020–2021 and thereafter.

**20. GRADING**

Once the marks of the cumulative CIA and ESE are available, they will be added. The marks thus obtained will then be graded as per details given below:

**Marks and Grades:**

The following table gives the marks grade points, letter grades and classification to indicate the performance of the candidate.

| Range of Marks | Grade Points | Letter Grade | Description |
|---|---|---|---|
| 90–100 | 9.0–10.0 | O | Outstanding |

| | | | |
|---|---|---|---|
| 80–89 | 8.0–8.9 | D+ | Excellent |
| 75–79 | 7.5–7.9 | D | Distinction |
| 70–74 | 7.0–7.4 | A+ | Very Good |
| 60–69 | 6.0–6.9 | A | Good |
| 50–59 | 5.0–5.9 | B | Average |
| 00–49 | 0.0 | RA | Re-appear |
| ABSENT | 0.0 | AAA | ABSENT |

Ci = Credits earned for course i in any semester

Gi = Grade Point obtained for course i in any semester

n = Semester in which such course were credited

**Grade point average (for a Semester):**

**Calculation of grade point average semester-wise and part-wise is as follows:**

GRADE POINT AVERAGE [GPA] = Σi Ci Gi / Σi Ci

$$GPA = \frac{\text{Sum of the multiplication of grade points and credits earned}}{\text{Sum of the credits of the courses in a semester}}$$

**Calculation of Cumulative Grade Point Average (CGPA) (for the entire programme):**

The Cumulative Grade Point Average (CGPA) of a candidate who has passed all the examinations will be computed as follows;

Cumulative Grade Point Average [CGPA] = ΣnΣiCniGni / ΣnΣiCni

$$GPA = \frac{\text{Sum of the multiplication of grade points and credits earned in the entire program}}{\text{Sum of the credits of the courses of the entire program}}$$

**21. Classification of Successful Candidates**

A candidate who passes all the examinations and securing following CGPA and Grades shall be declared as follows:

| CGPA | GRADE | CLASSIFICATION OF FINAL RESULT |
|---|---|---|
| 9.5–10.0 | O+ | First Class – Exemplary |

| | | |
|---|---|---|
| 9.0 and above but below 9.5 | O | |
| 8.5 and above but below 9.0 | D++ | First Class with Distinction |
| 8.0 and above but below 8.5 | D+ | |
| 7.5 and above but below 8.0 | D | |
| 7.0 and above but below 7.5 | A++ | First Class |
| 6.5 and above but below 7.0 | A+ | |
| 6.0 and above but below 6.5 | A | |
| 5.5 and above but below 6.0 | B+ | Second Class |
| 5.0 and above but below 5.5 | B | |
| 4.5 and above but below 5.0 | C+ | Third Class |
| 4.0 and above but below 4.5 | C | |

**22. Rank Holder**

The student who secures highest marks in aggregate of all the subjects in first attempt of within the minimum period prescribed for the Programme from the date of admission to the Programme will be the Rank Holder. The Rank Holder will be awarded with a certificate and prize.

**23. CONFERMENT OF THE DEGREE**

No candidate shall be eligible for conferment of the Degree unless he/she has undergone the prescribed Programme of study for a period of not less than six semesters in an Institution approved by and affiliated to the Periyar University and earns has passed the Examinations as have been prescribed.

**24. TRANSITORY PROVISION**

Candidates who have undergone the Programme of Study prior to the Academic Year 2020–2021 will be permitted to take the Examinations under those Regulations for a period of six years i.e. up to and inclusive of the Examination of April 2026. Thereafter, they will be permitted to take the Examination only under the Regulations in force at that time.

# PROGRAMME SYLLABUS

| Program: B.Sc. Botany | | | | |
|---|---|---|---|---|
| **Core – I** | **Course Code:** 24UBO1C02 | | **Course Title: Plant Diversity – I (Algae)** | |
| **Semester** | **Hours/Week** | **Total Hours** | **Credits** | **Total Marks** |
| I | 5 | 75 | 6 | 100 |

## Course Objectives

1. To provide a comprehensive knowledge on the biology of algae.
2. To provide a basis for better understanding of the evolution higher of plants.
3. To understand reproductive biology, ecology of plants by studying the simpler systems in algae.
4. To understand the role of algae in ecosystems as primary producers of nutrition.
5. To understand importance of algae to animals and humans.

## SYLLABUS

**UNIT - I**

General characteristics of algae, Classification of algae (Fritsch-1935-1945), criteria for classification, Algal distribution and ecology.

**UNIT - II**

Thallus organization (unicellular-*Chlorella*, Diatoms, colonial - *Volvox*, filamentous - *Anabaena*, *Oedogonium*, siphonous - *Caulerpa*, parenchymatous - *Sargassum*, *Gracilaria*).

**UNIT - III**

Reproduction - Vegetative, asexual, sexual reproduction and life histories (Haplontic - *Oedogonium* and *Chara*, Diplontic - *Diatoms* and *Sargassum*, Diplohaplontic - *Ulva* and Diplobiontic - *Gracilaria*).

**UNIT - IV**

Algal cultivation methods, Algal production systems; indoor cultivation methods and large-scale cultivation of algae, harvesting of algae.

**UNIT - V**

Algae as food and feed: Agar-agar, Alginic acid and Carrageenan; Diatomite.

Resource potential of algae: Application of algae as fuel, agriculture and pharmaceutical. Phycoremediation. Role of algae in $CO_2$ sequestration, Algae as indicator of water pollution, algal bioinoculants, Bioluminescence.

**Recommended Texts:**

1. Dehradun. Edwardlee, R. 2018. Phycology, 5th Ed., Cambridge University Press, London.
2. Kumar, H.D. 1999. Introductory Phycology. Affiliated East-West Press, Delhi
3. Singh, Pandey and Jain. 2020. A text book of Botany, 5th Edition, Rastogi Publication, Meerut.
4. Vashishta, P.C. 2014. S.Chand & Company Ltd, New Delhi.
5. Ian Morris. 1977. An introduction to the algae. Hutchinson & Co (Publishers) Ltd. London.

**References Books:**

1. Aziz, F and Rasheed, R. 2019. A Course Book of Algae. Publisher: University of Sulaimani.ISBN: 978-9922-20-391-1.
2. Mihir Kumar, D. 2010. Algal Biotechnology. Daya Publishing House, New Delhi.
3. Chapman V.J. and Chapman D.J, 2013. The Algae. Alpha Numera.
4. Fritsch, F.E. 1945. Structure and reproduction of Algae. Cambridge University press.
5. Round, FE. 1984.The Ecology of Algae. Cambridge University Press.
6. Lee, R.D. 2008.Phycology 4th Edition, Cambridge University Press, New York.
7. Bold, H.C and Wynne, M.J. 1978. Introduction to the Algae: Structure and Function. Prantice Hall of India New Delhi.

**Web Resources:**

1. https://www.crcpress.com/Therapeutic-and-Nutritional-Uses-of algae/Pereira/p/book/9781498755 382
2. https://www.crcpress.com/Algae-Anatomy-Biochemistry-and-Biotechnology-Second Edition/ Barsanti-Gualtieri/p/book/9781439867327
3. https://www.crcpress.com/Marine-Algae-Biodiversity-Taxonomy-Environmental-Assessment-and-Biotechnology/Pereira-Neto/p/book/9781466581678
4. https://www.kopykitab.com/Botany-For-Degree-Students-ALGAE-by-B-R-Vashishta-Dr-A-K-Sinha-Dr-V-P-Singh
5. https://www.wileyindia.com/a-textbook-of-algae.html
6. https://www.kobo.com/in/en/ebook/algae-biotechnology
7. https://www.ikbooks.com/books/book/life-sciences/botany/a-textbook-algae/9788188237449/

## Course Outcomes (COs)

On successful completion of the course, the students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Relate to the structural organization, reproduction and significance of algae. | K1 |
| CO2 | Demonstrate knowledge in understanding the various life cycle patterns and the fundamental concepts in algal growth | K2 |
| CO3 | Explain the benefits of various algal technologies on the ecosystem. | K3 |
| CO4 | Compare and contrast the thallus organization and modes of reproduction in algae. | K4 |
| CO5 | Determine the emerging areas of Algal Biotechnology for identifying commercial potentials of algal products and their uses. | K5 |

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

## Mapping of COs with POs

| Cos | PO1 | PO2 | PO3 | PO4 | PO5 | PSO6 | PSO7 | PSO8 | PSO9 | PSO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 1 | 3 | 2 | 1 | 2 | 2 | 2 | 1 |
| **CO 2** | 3 | 3 | 2 | 2 | 3 | 3 | 2 | `1 | 3 | 3 |
| **CO 3** | 2 | 2 | 1 | 1 | 2 | 2 | 1 | 3 | 2 | 2 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 2 |
| **CO 5** | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 2 | 3 |

**S-Strong (3)  M-Medium (2)  L-Low(1)**

## NON-MAJOR ELECTIVE-I

| Program: B.Sc. Botany | | | | |
|---|---|---|---|---|
| Non-Major Enhancement Course I | **Course Code: 24UBO1N01** | | **Course Title: ORGANIC FARMING** | |
| **Semester** | **Hours/Week** | **Total Hours** | **Credits** | **Total Marks** |
| I | 2 | 30 | 2 | 100 |

## COURSE OBJECTIVES

1. To enable students to gain knowledge on the scope of organic farming and its significance.
2. To impart practical insights sustainable agriculture, green manuring, recycling and composting.
3. To understand the physical and chemical properties of soil.
4. To study sustainable agriculture.
5. To know about the importance of biofertilizers.

**UNIT – I**

Soil – physical, chemical properties. Soil pollution – oil, chemicals –fertilizers, pesticide and herbicide, non-degradable solids, biomagnification, consequences of land pollution – damage to soil and crops.

**UNIT – II**

Organic farming, basic concept of organic farming, integrated plant nutrient supply management, integrated insect pest and disease management, integrated soil and water management. Sustainable agriculture practices-crop rotation and mixed cropping.

**UNIT III**

Management of organic wastes and green manures: Farm manures, Composts, Mulches and pest control, importance of organic manure, importance of green manure, crops of green manure, oil cake. Animal based organic manure–cow dung, vermicompost - methods, production and utilization.

**UNIT IV**

Biofertilizers – classification, nitrogen fixers–*Rhizobium*, Cyanobacteria, *Azolla* and Vesicular Arbuscular Mycorrhiza.

**UNIT V**

Recycling of bio-degradable municipal, agricultural and Industrial wastes – biocompost making methods.

**Text Books**

1. NIIR Board. 2012. The complete Technology Book on Biofertilizer and organic farming. 2nd Edition. NIIR Project Consultancy Services.
2. Sathe, T.V. 2004. Vermiculture and Organic Farming. Daya publishers.
3. Subba Rao N.S. 2017. Biofertilizers in Agriculture and Forestry. Fourth Edition.Medtech.
4. Vayas,S.C, Vayas, S. and Modi, H.A. 1998. Bio-fertilizers and organic Farming Akta Prakashan, Nadiad.
5. Dongarjal, R.P and Zade, S.B. 2019. Insect Ecology and Integrated Pest Management Akinik Publications, New Delhi.

**Reference Books**

1. Vayas,S.C, Vayas, S and Modi, H.A. 1998. Bio-fertilizers and organic Farming Akta Prakashan, Nadiad.
2. Sathe, T.V.2004. Vermiculture and Organic Farming. Daya publishers.
3. Subha Rao, N.S.2000. Soil Microbiology, Oxford & IBH Publishers, New Delhi.
4. Reddy, S.R. 2019. Fundamentals of Agronomy Kalyani Publications, Uttar Pradesh
5. Tolanur, S. 2018. Fundamentals of Soil Science IIndEdition , CBS Publishers , New Delhi

**Web Resources**

1. https://www.amazon.com/Beginners-Practical-botanical-horticulture-landscape-ebook/dp/B00MOURUNY
2. https://www.e-booksdirectory.com/listing.php?category=323
3. http://www.freebookcentre.net/Biology/Agriculture-Books.html
4. https://casfs.ucsc.edu/about/publications/Teaching-Organic-Farming/PDF-downloads/TOFG-all.pdf
5. https://www.amazon.in/s?k=the+organic+farming+manual&hvadid=72636563575133&hvbmt=bb&hvdev=c&hvqmt=b&tag=msndeskstdin-21&ref=pd_sl_6sbf0qtxcy_b

## Course Outcomes (COs)

On successful completion of the course, the students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Recognize the different forms of biofertilizers and their uses. | K1 |
| CO2 | Explain and interpret the components, patterns, and processes of bacteria for growth in crop production. | K2 |
| CO3 | Apply techniques for synthesizing green manure and develop strategies to increase crop yield. | K3 |
| CO4 | Analyze and decipher the significance of biofertilizers in soil fertility. | K4 |
| CO5 | Develop new strategies to enhance growth and quality check of medicinal herbs considering the practical issues pertinent to India. | K5 |

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

## Mapping of COs with POs

**1.**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 1 | 3 | 2 | 1 | 2 | 2 | 2 | 2 |
| **CO 2** | 3 | 3 | 2 | 1 | 2 | 3 | 2 | 3 | 2 | 3 |
| **CO 3** | 2 | 2 | 3 | 3 | 1 | 2 | 2 | 3 | 2 | 3 |
| **CO 4** | 3 | 2 | 1 | 1 | 2 | 3 | 2 | 3 | 2 | 3 |
| **CO 5** | 3 | 3 | 2 | 3 | 1 | 2 | 3 | 3 | 3 | 3 |

**S-Strong (3)  M-Medium (2)  L-Low(1)**

## NON-MAJOR ELECTIVE-I

| Program: B.Sc. Botany | | | | |
|---|---|---|---|---|
| Non-Major Enhancement Course I | **Course Code: 24UBO1N02** | | **Course Title: ENVIRONMENTAL BIOTECHNOLOGY** | |
| **Semester** | **Hours/Week** | **Total Hours** | **Credits** | **Total Marks** |
| I | 2 | 30 | 2 | 100 |

## COURSE OBJECTIVES

1. To introduce the student to the various developed and applications of environmental biotechnology.
2. To provide knowledge about the scope of bioremediation and bioleaching using GMOs.
3. To study about pollution of water bodies.
4. To know about bioremediation.
5. To study about biomineralization.

**UNIT – I**

**Introduction:**

The environment-soil, water and air, Pollution and its causes (outline only)

**UNIT – II**

**Source and treatment of polluted waters and effluents:**

Pollution of water bodies by heavy metals and pesticides – removal of heavy metals and pesticides by Biosorption. Removal of oil spills by using microbes. Biological treatment of sewage – characteristics of sewage and objectives in sewage treatment – Aerobic and Anaerobic digestion.

**UNIT III**

**Soil and air pollution and their treatment:**

Soil pollution by Xenobiotics. Degradation of Xenobiotics – pathways of phenol, pentachlorophenol and polychlorinated biphenyl degradation.

**UNIT IV**

**Bioremediation:**

Introduction to bioremediation, *ex situ* and *in situ* bioremediation.

**UNIT V**

**Biometallurgy and related topics:**

Biomineralization – bioleaching – Biofilms and biocorrosion.

**Text Books**

1. Alan Scragg. 1999. Environmental Biotechnology. Pearson Education Limited.
2. Dubey R.C. 2004. A text book of Biotechnology aspects of microbiology, British Sun Publication.
3. Joseph C. Deniel. 1996. Environmental aspects of microbiology, British Sun Publication.
4. Keeshav Thehan. 1997. Biotechnology, New age international )P) Limited, New Delhi.
5. Chandra, A.M and Ghosh, S.K. 2010. Remote sensing and Geographical Information System, Narosa Publishing House Pvt. Ltd. New Delhi.

**Reference Books**

1. Sharma, P.D. 2005. Environmental Microbiology, Narosa Publishing House Pvt. Ltd., New Delhi.
2. Raina Maier M. Iran Pepper L., Charles P. Gerba, 2000, Environmental Microbiology, Academic press, U.K.
3. Alexander N. Glazer and Hiroshi Nikaido. 1994. Microbial Biotechnology.
4. Special issue on Bioremediation and biodegradation. Indian Journal of Experimental Biology, September 2003. Vol. 41(9). National Institute of Science Communication and Information Resources, CSIR New Delhi.
5. Keddy, P.A. 2017. Plant Ecology: Origins, processes, consequences. 2nd ed. Cambridge University Press. ISBN. 978-1107114234.

**Web Resources**

1. https://www.elsevier.com/books/environmental-biotechnology/vallero/978-0-12-407776-8
2. http://www.freebookcentre.net/biology-books-download/Environmental-Biotechnology.html
3. https://www.amazon.in/INTRODUCTION-ENVIRONMENTAL-BIOTECHNOLOGY-K-Chatterji-ebook/dp/B00K7YGIWI
4. https://books.google.co.in/books/about/Textbook_of_Environmental_Biotechnology.html?id=Q2ROFx0WtBQC&redir_esc=y
5. http://library.umac.mo/ebooks/b28045907.pdf

## Course Outcomes (Cos)

On successful completion of the course, the students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Recognize the various causes of pollution and control measures. | K1 |
| CO2 | Explain about the beneficially role of GMOs on environment. | K2 |
| CO3 | Reflect upon various sustainable environmental protection strategies. | K3 |
| CO4 | Analyze the different methods of air, water, and soil quality monitoring process. | K4 |
| CO5 | Evaluate the implications of international legislations and policies for environmental protection. | K5 |

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

## Mapping of COs with POs

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 1 | 3 | 2 | 1 | 2 | 2 | 1 | 3 |
| **CO 2** | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 3 | 2 | 2 |
| **CO 3** | 2 | 2 | 3 | 3 | 1 | 2 | 1 | 3 | 3 | 3 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| **CO 5** | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 2 | 3 |

**S-Strong (3)  M-Medium (2)  L-Low(1)**

## NON-MAJOR ELECTIVE-I

| Program: B.Sc. Botany | | | | |
|---|---|---|---|---|
| Non-Major Enhancement Course I | **Course Code: 24UBO1N03** | | **Course Title: NURSERY AND LANDSCAPING** | |
| **Semester** | **Hours/Week** | **Total Hours** | **Credits** | **Total Marks** |
| I | 2 | 30 | 2 | 100 |

## COURSE OBJECTIVES

1. To acquire knowledge of on the mushroom culture.
2. To be able to design gardens and become entrepreneur in Horticulture.
3. To study the methods of propagation.
4. To know about nursery structure.
5. To learn about gardening.

**UNIT – I**

Introduction, prospects and scope of nursery and landscaping.

**UNIT – II**

Methods of Propagation – cutting, layering, grafting, budding, Floriculture – Rose, Chrysanthemum, Jasmine – cultivation.

**UNIT III**

Gardening – formal garden, informal garden, vegetable garden, landscaped layout designing – formation and maintenance of lawn.

**UNIT IV**

Nursery structures – Green house – Shade house, Mist chamber – Topiary, Bonsai culture.

**UNIT V**

Manures, composting – vermicomposting.

**Text Books**

1. Amarnath V. 2006. Nursery and Landscaping, M/s IBD Publishers, New Delhi.
2. Butts, E and Stensson, K. 2012. Sheridan Nurseries: One hundred years of

People, Plans, and Plants. Dundurn Group Ltd.

3. Russell, T. 2012. Nature Guide: Trees: The world in your hands(Nature Guides). Mukherjee D. Gardening in India, Oxford IBH publishing co, New Delhi.
4. Kumar, N. 1997. Introduction to Horticulture, Rajalakshmi Publications, Nagercoil.
5. Butts, E. and Stensson, K. 2012.Sheridan Nurseries: One hundred years of People,Plans, and Plants. Dundurn Group Ltd.

**Reference Books**

1. Edmond Musser and Andres, Fundamentals of Horticulture, McGraw Hill Book Co. New Delhi.
2. Agrawal, P.K. 1993. Hand Book of Seed Technology, Dept. of Agriculture and Cooperation, National Seed Corporation Ltd., New Delhi.
3. Janick Jules. 1979. Horticultural Science. (3rd Ed.), W.H. Freeman and Co.,San Francisco, USA.
4. Singh, J. 2018. Fundamentals of Horticulture. Kalyani Publishers.
5. Sharma V. K. 1999. Encyclopaedia of Practical Horticulture, Vol I –IV, Deep And Deep Publ. Pvt. Ltd.

**Web Resources**

1. https://www.kopykitab.com/higher-education-ebooks/higher-education-ebooks/Agricultural-Industry-agriculture-eBooks/Nursery-And-Landscaping-by-V-Amarnath
2. https://www.amazon.in/Nursery-Landscaping-Veena-Amarnath/dp/8177542788
3. https://www.amazon.in/Gardening/b?ie=UTF8&node=1637077031
4. https://in.pinterest.com/pin/496733033900458021/?lp=true
5. https://www.gardenvisit.com/ebooks

## Course Outcomes (COs)

On successful completion of the course, the students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Recognize the basic principles and components of gardening. | K1 |
| CO2 | Explain about bio-aesthetic planning and conceptualize flower arrangement. | K2 |
| CO3 | Apply techniques for design various types of gardens according to the culture and art of bonsai. | K3 & K6 |
| CO4 | Compare and contrast different garden styles and landscaping patterns. | K4 |
| CO5 | Establish and maintain special types of gardens for outdoor and indoor landscaping. | K5 & K6 |

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

## Mapping of COs with POs

| Cos | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 1 | 3 | 2 | 1 | 2 | 2 | 1 | 3 |
| **CO 2** | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 2 | 2 | 2 |
| **CO 3** | 2 | 2 | 3 | 1 | 1 | 1 | 1 | 3 | 3 | 1 |
| **CO 4** | 3 | 2 | 2 | 1 | 3 | 2 | 1 | 3 | 2 | 1 |
| **CO 5** | 3 | 3 | 2 | 3 | 2 | 1 | 2 | 3 | 2 | 3 |

**S-Strong (3)** **M-Medium (2)** **L-Low(1)**

## FOUNDATION COURSE FOR BOTANY

| Program: B.Sc. Botany | | | | |
|---|---|---|---|---|
| Foundation Course | Course Code: 24UBO1FC01 | | Course Title: BASICS OF BOTANY | |
| **Semester** | **Hours/Week** | **Total Hours** | **Credits** | **Total Marks** |
| 1 | 2 | 30 | 2 | 100 |

### COURSE OBJECTIVES

1. To learn about the classification, distinguishing traits, geographic distribution, and reproductive cycle of algae, fungi, lichens, and bryophytes.
2. To understand the biodiversity by describing and explaining the morphology and reproductive processes of algae, fungi, bryophytes and microorganisms.
3. To investigate the classification, distinctive traits, distribution and reproduction and life history of the various classes and major types of Pteridophytes and Gymnosperms.
4. Enable to learn various cell structures and functions of prokaryotes and eukaryotes and understand the salient features and functions of cellular organelles.
5. Understanding of laws of inheritance, genetic basis of loci and alleles.

**UNIT – I**

**BIODIVERSITY**

Systematics - Two Kingdom and Five Kingdom systems. Salient features of various Plant Groups - Algae, Fungi, Bryophytes, Pteridophytes and Gymnosperms. Viruses and Bacteria.

**UNIT – II**

**CELL BIOLOGY**

Cell as the basic unit of life - Prokaryotic and Eukaryotic Cell (Plant Cell) - Light Microscope. Ultra Structure of Prokaryotic and Eukaryotic Cells - Cell Wall - Cell Membrane, Plastids and Ribosomes.

**UNIT III**

**PLANT MORPHOLOGY**

Structure and Modification of Root, Stem and Leaf. Structure and Types of Inflorescences, Flowers, Fruits and Seeds.

**UNIT IV**

**GENETICS**

Concept of Heredity and Variation - Mendel's Laws of Inheritance.

**UNIT V**

**PLANT PHYSIOLOGY**

Cell as a Physiological Unit: Water relations -Absorption and movement: Diffusion, Osmosis, Plasmolysis, Imbibition -Permeability, Water Potential - Transpiration - Movement - Mineral Nutrition and Plant Growth Regulators.

**Text Books**

1. Singh, V., Pande, P.C and Jain, D.K. 2021. A Text Book of Botany. Rastogi Publications,Meerut.
2. Bhatnagar, S.P and Alok Moitra. 2020. Gymnosperms, New Age International (P) Ltd., Publishers, Bengaluru.
3. Sharma, O.P. 2017. Bryophyta, MacMillan India Ltd. Delhi.
4. Lee, R.E. 2008. Phycology, IV Edition, Cambridge University Press, New Delhi.
5. Pandey B.P. 1986, Text Book of Botany (College Botany) Vol I and II, S.Chand and Co. New Delhi.
6. Rao, K., Krishnamurthy, K.V and Rao, G.S. 1979. Ancillary Botany,S. Viswanathan Pvt. Ltd., Madras.

**Reference Books**

1. Parihar, N.S. 2012. An introduction to Embryophyta –Pteridophytes - Surjeet Publications, Delhi.
2. Alexopoulos, C.J. 2013. Introduction to Mycology. Willey Eastern Pvt. Ltd.
3. Vashishta, P.C. 2014. Botany for Degree Students Gymnosperms. Chand & Company Ltd, Delhi.
4. Coulter, M. Jhon, 2014. Morphology of Gymnosperms. Surjeet Publications, Delhi.
5. Vashishta, P.C. 2014. Botany for Degree Students Algae. 2014. Chand & Company Ltd, Delhi.
6. Parihar, N.S. 2013. An introduction to Embryophyta –Bryophytes -, Surjeet Publications, Delhi.

**Web resources**

1. https://www.kobo.com/us/en/ebook/the-algae-world
2. http://www.freebookcentre.net/biology-books-download/Fungi-(PDF-15P).html
3. http://scitec.uwichill.edu.bb/bcs/bl14apl/bryo1.htm
4. https://www.toppr.com/guides/biology/plant-kingdom/pteridophytes/

5. https://arboretum.harvard.edu/wp-content/uploads/2013-70-4-beyond-pine-cones-an-introduction-to-gymnosperms.pdf
6. https://www.us.elsevierhealth.com/medicine/cell-biology
7. https://www.us.elsevierhealth.com/medicine/genetics
8. https://www.kobo.com/us/en/ebook/plant-biotechnology-1

## Course Outcomes (COs)

On successful completion of the course, the students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Increase the awareness and appreciation of human friendly algae and their economic importance. | K1 |
| CO2 | Develop an understanding of microbes and fungi and appreciate their adaptive strategies. | K2 |
| CO3 | Develop critical understanding on morphology, anatomy and reproduction of Bryophytes, Pteridophytes and Gymnosperms. | K3 |
| CO4 | Compare the structure and function of cells and explain the development of cells. | K3 |
| CO5 | Understand the core concepts and fundamentals of plant biotechnology and genetic engineering. | K5 |

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

## Mapping of COs with POs

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO 2** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO 3** | 2 | 3 | 3 | 3 | 3 | 1 | 3 | 3 | 1 | 3 |
| **CO 4** | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 3 |
| **CO 5** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 |

**S-Strong (3)  M-Medium (2)  L-Low(1)**

| Program: B.Sc. Botany | | | | |
|---|---|---|---|---|
| **Core – II** | **Course Code:** 24UBO2C02 | | **Course Title: Plant Diversity – II (Fungi, Bacterial, Viruses, Plant Pathology and Lichens)** | |
| **Semester** | **Hours/Week** | **Total Hours** | **Credits** | **Total Marks** |
| II | 5 | 75 | 6 | 100 |

## Course Objectives

1. To describe the common characteristics of fungi as being heterotrophic, unicellular/multicellular.
2. To understand the biology of fungi and to discuss the importance of fungi in various ecological roles.
3. To understand lichen structure, function, identification, and ecology; Comprehend the events of symbiosis and lichenization and to demonstrate the use of lichens as bioindicator species.
4. To identify the main groups of plant pathogens, their symptoms.
5. To understand the various types of plant diseases.

**UNIT – I**

**FUNGI**

Classification of fungi - (Alexopoulos and Mims, 1979), criteria for classification, Characteristic features, thallus organization, mode of nutrition, structure, reproduction and life-history of classes, Zygomycotina - *Mucor*, Ascomycotina - *Aspergillus*, Basidiomycotina - *Agaricus* and Deuteromycotina - *Alternaria*. Symbiotic Associations – Lichens; Mycorrhiza, ectomycorrhiza and endomycorrhiza and their significance.

**UNIT – II**

**ECONOMIC IMPORTANCE OF FUNGI:**

Cultivation of mushroom – *Pleurotus* (food). Fungi in agriculture application (biofertilizers): Mycotoxins (biopesticides), Production of industrially important products from fungi- alcohol (ethanol), organic acids (citric acid), enzymes (protease). Vitamins (Vitamin B-complex and Vitamin B-12), applications of fungi in pharmaceutical products (Penicillin). Importance of VAM fungi. Harmful effects of Fungi. Agriculture (Biofertilizers); Mycotoxins.

**UNIT – III**

**BACTERIA, VIRUS:** General characters of Bacteria and Viruses, Classification (Bergey's, 1994), structure and reproduction of bacteria, Mycoplasma, Virus - structure and reproduction, T4 Bacteriophage.

**UNIT – IV**

**PLANT PATHOLOGY:** General symptoms of plant diseases; Geographical distribution of diseases; Etiology; Host-Pathogen relationships; Disease cycle and environmental relation; prevention and control of the following plant diseases. **Bacterial diseases** – Citrus canker and Bacterial wilt of Banana.**Viral diseases** – Tobacco Mosaic and Bunchy Top of Bananan. **Fungal diseases** – Blast disease in rice and Tikka disease

**UNIT – V**

**LICHEN:** Classification (Hale, 1969). Habitat, nature of association, Structure, Nature of Mycobionts and Phycobionts, Study of growth forms of lichens (crustose, foliose and fruticose), types, distribution, thallus organization, reproduction and ecological significance of lichens with special reference to *Usnea*.

**Economic importance of Lichens**: food, fodder and nutrition, flavour, tanning and dyeing, cosmetics and perfumes, Brewing and distillation, minerals, Natural products, medicine (Ayurvedic, Siddha), pharmaceutical products, biodegradation agent, air pollution and biomonitoring, soil formation, nitrogen fixation, Harmful aspects, poison from lichens,

**Text Books**

1. Pandey, B.P. 1997. College Botany. Vol. I Fungi & Pathology.
2. Mehrotra, R.S and Aneja, K.R. 2003. An introduction to mycology. New age International (P) Ltd, Publishers, New Delhi.
3. Poonam Singh and Ashok Pandey. 2009. Biotechnology for agro-Industrial residues utilization. Springer.
4. Satyanarayana T and Johri B.N. 2005. Microbial diversity, Current Perspectives and Potential Applications, IK International.
5. Nair, L.N. 2007. Topics in Mycology and Pathology, New Central Book agency, Kolkata.
6. Sharma, P.D. 2011. Plant Pathology, Rastogi Publication, Meerut, India.
7. Mahendra Rai. 2009. Advances in Fungal Biotechnology. I.K. International Publishing House, New Delhi.

**Reference Books**

1. Alexopoulos, C.J., Mims, C.W., Blackwell, M. 1996. Introductory Mycology. 4th edition. John Wiley & Sons (Asia) Singapore.
2. Webster, J and Weber, R. 2007. Introduction to Fungi. 3rd edition. Cambridge University Press, Cambridge.
3. Sharma, O.P. 2011. Fungi and allied microbes The McGraw –Hill companies, New Delhi.
4. Burnett, J.H. 1971.The fundamentals of Mycology. ELBS Publication, London.
5. Bessey, E.A. 1979. Morphology and Taxonomy of fungi, Vikas publishing House Pvt. Ltd, New Delhi.
6. Dharani Dhar Awasthi. 2000. A Handbook of Lichens Vedams eBooks (P) Ltd. New Delhi.
7. Pelzer, M.J., Chan, E.C.S and Krieg, N.R. 1983. Microbiology , Tata MaGraw Hill Publishing House, New Delhi.
8. Pandey, P.B. 2014. College Botany- 1: Including Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta. Chand Publishing, New Delhi.
9. Mishra, A. and Agarwal, R.P. 1978. Lichens – A Preliminary Text. Oxford and IBH.
10. Pandey, B.P. 2005. College Botany I: Including Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta. S Chand & Company.

**Web Resources**

1. https://www.amazon.in/Fungi-Sarah-C-Watkinson-ebook/dp/B0199YFDFE
2. http://www.freebookcentre.net/biology-books-download/A-text-book-of-mycology-and-plant-pathology.html
3. http://www.freebookcentre.net/Biology/Mycology-Books.html
4. https://www.kobo.com/us/en/ebook/introduction-to-fungi
5. http://www.freebookcentre.net/biology-books-download/Introductory-Mycology.html
6. http://www.freebookcentre.net/biology-books-download/Fungi-(PDF-15P).html

**Course Outcomes (COs)**

On successful completion of the course, the students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Recognize the general characteristics of microbes, fungi and lichens and disease symptoms. | K1 |

| | | |
|---|---|---|
| CO2 | Develop an understanding of microbes, fungi and lichens and appreciate their adaptive strategies based on structural organization. | K2 |
| CO3 | Identify the common plant diseases, according to geographical locations and device control measures. | K3 |
| CO4 | Analyze the emerging trends in fungal biotechnology with special reference to agricultural and pharmaceutical applications. | K4 |
| CO5 | Determine the economic importance of microbes, fungi and lichens. | K5 |

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

**Mapping of COs with POs**

| COs | COs | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 1 | 3 | 2 | 1 | 2 | 2 | 2 | 2 |
| **CO 2** | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 1 | 2 | 1 |
| **CO 3** | 2 | 2 | 3 | 3 | 1 | 2 | 1 | 3 | 1 | 3 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| **CO 5** | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |

**S-Strong (3)  M-Medium (2)  L-Low(1)**

| Program: B.Sc. Botany | | | | |
|---|---|---|---|---|
| **Core IV**<br>**Practical – II** | **Course Code:** 24UBO2P02 | | **Course Title: CORE PRACTICAL I (PLANT DIVERSITY –II: Fungi, Bacteria, Viruses, Plant Pathology and Lichens)** | |
| **Semester** | **Hours/Week** | **Total Hours** | **Credits** | **Total Marks** |
| II | 5 | 45 | 5 | 100 |

## COURSE OBJECTIVES

- To enable students to identify microscopic and macroscopic fungi.
- To prepare microslides of fungi and lichens.
- To know the presence of pathogen inside the plant tissues through microscopic sections.
- To identify the bryophytes based on the morphology, and microslides.
- To know the economic importance of the microbes studied.

## EXPERIMENTS

1. Microscopic observation of vegetative and reproductive structures of types prescribed in the
2. syllabus through temporary preparations and permanent slides.
3. Identifying the micro slides relevant to the syllabus.
4. Herbarium specimens of bacterial diseases/photograph.
5. Protocol for mushroom cultivation.
6. Inoculation techniques for fungal culture (Demonstration only).
7. Study of economically important products obtained from fungi:
    a. Fungal biofertilizers, biopesticides, biofungicide (*Trichoderma*),
    b. edible mushroom/Yeast, organic acids (citric acid)
    c. enzymes (protease), antibiotics and vitamins.
8. Mycorrhiza: ecto-mycorrhiza and endo-mycorrhiza (Photographs)
9. Visit to fungal biotechnology laboratories.
10. Ultra sturcture of bacteria.
11. Structure of bacteriophage.
12. Micro-preparation of *Usnea* to study vegetative and reproductive structures.

13. Identifying the micro slides relevant to the syllabus.
14. Study of thallus and reproductive structures (apothecium) through permanent slides.
15. Economic importance of Lichens - Dye and perfume.

**Recommended Texts:**

1. Chmielewski, J.G and Krayesky, D. 2013. General Botany laboratory Manual. AuthorHouse, Bloomington, USA.
2. Das, S and Saha, R. 2020. Microbiology Practical Manual. CBS Publishers andDistributors (P) Ltd., New Delhi, India.
3. Webster, J and Weber, R. 2007. Introduction to Fungi, 3rd Ed. Cambridge UniversityPress, Cambridge.
4. Nair, L.N. 2007. Topics in Mycology and Pathology, New Central Book agency, Kolkata.
5. Nair, L.N. 2007. Topics in Mycology and Pathology, New Central Book agency, Kolkata.

**Reference Books:**

1. Alexopoulos, J and Mims, W. 1985. Introductory Mycology, Wiley Eastern Limited New Delhi.
2. Bendre, M. Ashok and Ashok Kumar, A. 2020. Text Book of Practical Botany 1 ( 10th ed).Rastogi Publications, Meerut.
3. Singh, R and U.C. Singh 2020. Modern mushroom cultivation, 3d Edition Agrobios (India), Jodhpur.
4. Poonam Singh and Ashok Pandey. 2009. Biotechnology for agro-Industrial residues utilization. Springer.
5. Satyanarayana T and Johri B.N. 2005. Microbial diversity, Current Perspectives and Potential Applications, IK International.

**Web resources:**

1. https://www.amazon.in/Practical-Manual-Fungi-Fungicides/dp/B0025AEFP4
2. https://books.google.co.in/books/about/Practical_Mycology.html?id=5ycJAQAAMAAJ&redir_esc=y
3. https://www.flipkart.com/colour-handbook-practical-plant-pathology/p/itmefsn6dyhfhs9b
4. https://books.google.co.in/books/about/Practical_Botany.html?id=T5narQEACAAJ&redir_esc=y
5. https://www.kobo.com/us/en/ebook/introduction-to-fungi

***Bonafide record of practical work done should be submitted for the practical examination.**

## Course Outcomes (COs)

On successful completion of the course, the students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Identify microbes, fungi and lichens using key identifying characters | K1 |
| CO2 | Develop practical skills for culturing and cultivation of fungi. | K2 |
| CO3 | Identify and select suitable control measures for the common plant diseases. | K3 |
| CO4 | Analyze the characteristics of microbes, fungi and plant pathogens | K4 |
| CO5 | Access the useful role of fungi in agriculture and pharmaceutical industry. | K5 |

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

## Mapping of COs with POs

| COs | COs | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 1 | 3 | 2 | 1 | 2 | 2 | 2 | 1 |
| **CO 2** | 2 | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 3 | 3 |
| **CO 3** | 2 | 2 | 3 | 3 | 1 | 2 | 1 | 3 | 1 | 2 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 2 |
| **CO 5** | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 2 | 3 |

**S-Strong (3)  M-Medium (2)  L-Low(1)**

## NON-MAJOR ELECTIVE-II

| Program: B.Sc. Botany | | | | |
|---|---|---|---|---|
| **Non-Major Elective-II** | **Course Code: 24UBO2N04** | | **Course Title: MUSHROOM CULTIVATION** | |
| **Semester** | **Hours/Week** | **Total Hours** | **Credits** | **Total Marks** |
| II | 2 | 30 | 2 | 100 |

## COURSE OBJECTIVES

1. To learn and develop skills in mushroom cultivation.
2. To understand and appreciate the role of mushrooms in Nutrition, Medicine and health.
3. To cultivate mushroom cultivation in small scale industry.
4. To learn about diseases and post harvest technology.
5. To study new methods and strategies to contribute to mushroom production.

**UNIT – I**

Introduction: Morphology, Types of Mushroom, identification of edible and poisonous mushroom, Nutritive values, life cycle of common edible mushrooms.

**UNIT – II**

Mushroom cultivation, prospects and scope of Mushroom cultivation in small scale Industry.

**UNIT III**

Life cycle of *Pleurotus spp* and *Agaricus spp.*

**UNIT IV**

Spawn production, growth media, spawn running and harvesting of mushrooms and marketing.

**UNIT V**

Diseases and post harvest technology, Insect pests, nematodes, mites, viruses, fungal competitors and other important diseases.

**Text Books**

1. Handbook of Mushroom Cultivation. 1999. TNAU publication.
2. Marimuthu, T., Krishnamoorthy, A.S., Sivaprakasam, K. and Jayarajan. R. 1991. Oyster

Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.

3. Swaminathan, M. 1990. Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore – 560018.
4. Sing. 2005. Modern Mushroom Cultivation, International Book Distributors, Dehradun.
5. Verma, 2013. Mushroom: edible and medicinal: cultivation conservation, strain improvement with their marketing. Daya Publishing House.

**Reference Books**

1. Handbook of Mushroom Cultivation. 1999. TNAU publication.
2. Marimuthu, T., Krishnamoorthy, A.S., Sivaprakasam, K. and Jayarajan. R. 1991. Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.
3. Swaminathan, M. 1990. Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore – 560018.
4. Nita Bahl. 2002. Handbook on Mushroom 4th edition Vijayprimlani for oxford & IBH publishing co., Pvt., Ltd., New Delhi. Dr.C. Sebastian Rajesekaran Reader in Botany Bishop Heber College, Trichy – 17.
5. Suman. 2005. Mushroom Cultivation Processing and Uses, M/s. IBD Publishers and Distributors, New Delhi.

**Web Resources**

1. https://www.amazon.in/Mushroom-Cultivation-India-B-C/dp/817035479X
2. http://nrcmushroom.org/book-cultivation-merged.pdf
3. http://agricoop.nic.in/sites/default/files/ICAR_8.pdf
4. http://www.agrimoon.com/mushroom-culture-horticulture-icar-pdf-book/
5. https://books.google.co.in/books/about/Mushroom_Cultivation_in_India.html?id=6AJx99OGTKEC&redir_esc=y

## Course Outcomes (Cos)

On successful completion of the course, the students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Recall various types and categories of mushroom. | K1 |
| CO2 | Explain about various types of food technologies associated with mushroom industry. | K2 |
| CO3 | Apply techniques studied for cultivation of various types of mushroom. | K3 |
| CO4 | Analyze and decipher the environmental factors and economic value associated with mushroom cultivation | K4 |
| CO5 | Develop new methods and strategies to contribute to mushroom production. | K5 & K6 |

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

## Mapping of COs with POs

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|
| **CO1** | S | | | S | M | L | M | M |
| **CO 2** | S | | | M | | S | M | S |
| **CO 3** | M | | | S | | M | | S |
| **CO 4** | S | S | S | S | | M | | S |
| **CO 5** | S | S | M | | | | S | S |

**S-Strong (3) M-Medium (2) L-Low(1)**

## NON-MAJOR ELECTIVE-II

| Program: B.Sc. Botany | | | | |
|---|---|---|---|---|
| Non-Major Enhancememnt Course II | **Course Code: 24UBO2N05** | | **Course Title: HERBAL MEDICINE** | |
| **Semester** | **Hours/Week** | **Total Hours** | **Credits** | **Total Marks** |
| II | 2 | 30 | 2 | 100 |

## COURSE OBJECTIVES

1. To understand the nuances of medicinal plants and their phytoconstituents of commercial value.
2. To design and develop medicinal garden.
3. To apply the knowledge to cultivate medical plants.
4. To know the pharmacological importance of medicinal plants.
5. To enlist phytochemicals and secondary metabolites of market and commercial value.

**UNIT – I**

Importance and Relevance of Herbal drugs in Indian System of Medicine, Pharmacognosy – Aim and scope.

**UNIT – II**

Medicinal gardening – Gardens in the Hills and plains; House gardens; plants for gardening – Poisonous plants – Types of plant poison; action of poisons; treatment for poisons, some poisonous plants; their toxicity and action.

**UNIT III**

Adulteration of crude drugs and its detection – methods of adulteration; types of adulteration. Medicinal plants of export values; rejuvenating herbs; Medicinal uses of Non-flowering plants.

**UNIT IV**

Botanical description and active principles of Root drugs; Rhizomes woods and bark drugs (Two examples for each plant organs).

**UNIT V**

Botanical description and active principles of leaves; Flowers; Fruits seed and entire plants as drugs. Taxonomic study of some selected herbals (Two examples for each plant organs).

**Text Books**

1. Somasundaram, S. 1997. Medicinal botany (Maruthuvar Thavaraviyal) – (Tamil Medium Book).
2. Wallis, T.E. 1967. Text Books of Pharmacognosy. J. & A. Churchill Ltd., London,
3. Jains, S.K.. 1996. Medicinal Plants. Deep Publications, New Delhi.
4. Srivastava, A.K. 2006, Medicinal Plants, International Book Distributors, Dehradun.
5. Agarwal,O.P. 1985, Vol. II, Chemistry of organic – natural products. S Chand & Company, New Delhi.
6. Gamble, J.S. and Fisher, 1921, CEC I, II, III Flora of the Presidency, Madras Volumes.
7. Mathew K.M., 1988, Flora of the Tamilnadu and Carnatic.

**Reference Books**

1. Nair, N.C and Henrry, A.N. 1983, Flora of Tamil Nadu, India, Botanical Survey of India.
2. Chopra, R.N., Nagar S.L., and Chopra, I.C. 1956, Glossary of Indian Medicinal Plants.
3. Chopra, R.N., Chopra, I.C., Handa, K.L., and Kapur L.D., 1994, Indigenous drugs of India.
4. Chopra, R.N., Badhuvar R.L and Gosh, G. 1965. Poisonous plants in India.
5. Miller, L and Miller, B. 2017. Ayurveda & Aromatherapy: The Earth Essential Guide to Ancient Wisdom and Modern Healing. *Motilal Banarsidass*, *Fourth edition.*
6. Patri, F and Silano, V. 2002. Plants in cosmetics: Plants and plant preparations used as ingredients for cosmetic products - Volume 1. ISBN 978-92-871-8474-0, pp 218.

**Web Resources**

1. https://www.barnesandnoble.com/b/free-ebooks/nook-books/alternative-medicine-natural-healing/herbal-medicine/_/N-ry0Z8qaZ11iu
2. https://www.springer.com/gp/book/9783540791157
3. https://www.gpatonline.com/gpat/book-reference-pharmacognosy
4. https://www.researchgate.net/publication/334670695_Book_review_Herbal_Drug_Technolo
5. http://www.eurekaselect.com/node/173492/herbal-medicine-back-to-the-future

## Course Outcomes (COs)

On successful completion of the course, the students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Define and describe the principle of cultivation of herbal products. | K1 |
| CO2 | Explain about the phytochemistry of economically important medicinal herbs | K2 |
| CO3 | Apply techniques for evaluation of drug adulteration through biological testing. | K3 |
| CO4 | Formulate the value added processing / storage / quality control for the better use of herbal medicine. | K4 |
| CO5 | Develop the skills for cultivation of plants and their value added processing/storage/quality control. | K5 & K6 |

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

## Mapping of COs with POs

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 1 | 2 | 1 | 2 | 1 | 3 | 2 | 1 |
| **CO 2** | 3 | 3 | 2 | 1 | 1 | 2 | 2 | 2 | 2 | 2 |
| **CO 3** | 2 | 2 | 1 | 3 | 1 | 2 | 1 | 3 | 2 | 1 |
| **CO 4** | 3 | 2 | 1 | 2 | 1 | 2 | 3 | 3 | 2 | 3 |
| **CO 5** | 3 | 3 | 2 | 2 | 1 | 1 | 3 | 3 | 1 | 3 |

**S-Strong (3)  M-Medium (2)  L-Low (1)**

| Program: B.Sc. Botany | | | | |
|---|---|---|---|---|
| Non-Major Enhancement Course II | **Course Code: 24UBO2N06** | | **Course Title: GLOBAL CLIMATE CHANGE** | |
| **Semester** | **Hours/Week** | **Total Hours** | **Credits** | **Total Marks** |
| II | 2 | 30 | 2 | 100 |

## COURSE OBJECTIVES

1. To gain insights on the impact of greenhouse effect on global climate change and mitigation measures.
2. To understand the implications of carbon and ecological footprint.
3. To apply the knowledge to greenhouse effects.
4. To know the rain and its effects on plants.
5. To know about Global Environmental change issues.

**UNIT – I**

Global Environmental change issues. UNFCC, IPCC, Koyoto protocol, CDM, Carbon footprint and ecological footprint.

**UNIT – II**

Stratospheric ozone layer: Evolution of ozone layer; Causes of depletion and consequences; Effects of enhanced UV-B on plants, microbes, animals, human health and materials; Global efforts for mitigation ozone layer depletion.

**UNIT III**

Climate change: Greenhouse effects; causes; Greenhouse gases and their sources; Consequences of climate, oceans, agriculture, natural vegetation and humans; International efforts on climate change issues.

**UNIT IV**

Atmospheric deposition: Past and present scenario; Causes and consequences of excessive atmospheric deposition of nutrients and trace elements; Eutrophication.

**UNIT V**

Acid rain and its effects on plants, animals, microbes and ecosystems.

**Text Books**

1. Adger, N. Brown, K and Conway, D. 2012. Global Environmental Change: Understanding the Human Dimensions. The National Academic Press.
2. Turekian. K. K. 1996. Global Environmental Change-Past, Present, and Future. Prentice-Hall.
3. Eugene Odum, 2017. Fundamentals of Ecology 5th Ed. Cengage, Bengaluru.
4. Sharma P.D. 2019. Plant ecology and phytogeography, Rastogi Publications, Meerut.
5. Neeraj Nachiketa. 2018 Environmental & Ecology A Dynamic approach. 2nd Edition GKP Access Publishing.

**Reference Books**

1. Matthew. R.A. 2009. Jon Barnett, Bryan McDonald. Global Environmental Change and Human Security. MIT Press., USA.
2. Hester, R.E and Harrison, R.M. 2002. Global Environmental Change. Royal Society of Chemistry.
3. Keddy, P.A. 2017. Plant Ecology: Origins, processes, consequences. 2nd ed. Cambridge University Press. ISBN. 978-1107114234.
4. Krishnamurthy, K.V. 2004. An Advanced Text Book of Biodiversity- Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi.
5. Kormondy, E.J. 2017. Concepts of Ecology. Prentice Hall, U.S.A. 4th edition.

**Web Resources**

1. https://www.ebooks.com/en-us/subjects/the-environment-climate-change-ebooks/2074/
2. http://www.ebooks-for-all.com/bookmarks/detail/Climate-Change/onecat/Electronic-books+Environment-and-nature/0/all_items.html
3. https://www.smashwords.com/books/category/4727/newest/0/free/any
4. https://www.free-ebooks.net/environmental-studies-academic/Global-Warming
5. https://www.nap.edu/catalog/14673/climate-change-evidence-impacts-and-choices-pdf-booklet

## Course Outcomes (COs)

On successful completion of the course, the students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Relate to the anthropogenic pressure on the environment and carbon footprint. | K1 |
| CO2 | Explain about the physical basis of natural green gas house effect on man and materials. | K2 |
| CO3 | Evaluate human influenced driver of our climate system and its applications | K3 |
| CO4 | Analyze the causes and effects of depletion of the stratospheric ozone layer. | K4 |
| CO5 | Develop new strategies to mitigate issues of global environmental change. | K5 & K6 |

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

## Mapping of COs with POs

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 1 | 3 | 2 | 1 | 2 | 2 | 1 | 3 |
| **CO 2** | 3 | 2 | 1 | 2 | 3 | 3 | 2 | 3 | 1 | 2 |
| **CO 3** | 2 | 2 | 3 | 1 | 1 | 2 | 3 | 2 | 3 | 1 |
| **CO 4** | 3 | 3 | 3 | 2 | 1 | 1 | 3 | 2 | 3 | 2 |
| **CO 5** | 3 | 2 | 2 | 3 | 2 | 3 | 1 | 2 | 2 | 3 |

**S-Strong (3)  M-Medium (2)  L-Low (1)**

| Program: B.Sc. Botany | | | | |
|---|---|---|---|---|
| Skill Enhancement Course 1 | **Course Code: 24UBO2S01** | | **Course Title: BOTANICAL GARDEN AND LANDSCAPING** | |
| **Semester** | **Hours/Week** | **Total Hours** | **Credits** | **Total Marks** |
| VI | 2 | 30 | 2 | 100 |

## COURSE OBJECTIVES

1. To know about the fundamental concepts of gardening and landscaping.
2. To provide an overview of various gardening styles and its scope in recreation and bio-aesthetic planning.
3. To illustrate the significance of garden adornments and propagation structures.
4. To inculcate entrepreneurial skills in students for creative landscaping design using CAD software.
5. To create the design outdoor and indoor gardens and inculcate entrepreneurial skills for landscaping.

**UNIT – I**

Principles of gardening, garden components, adornments, lawn making, methods of designing rockery, water garden and Greenhouse. Special types of gardens, their walk-paths, bridges, constructed features - trees, their design, values in landscaping, propagation, planting shrubs and herbaceous perennials. Importance, design values, propagation, plating, climbers and creepers, palms, ferns, grasses and cacti succulents.

**UNIT – II**

Flower arrangement: importance, production experiments and cultural operations, constraints, postharvest practices. Bioaesthetic planning, definition, need, round country planning, urban planning and planting avenues, schools, villages, beautifying railway stations, dam sites, hydroelectric stations, colonies, river banks, planting material for play grounds.

**UNIT III**

Vertical gardens, roof gardens. Culture of bonsai, art of making bonsai. Parks and public gardens. Landscape designs, Styles of garden, formal, informal and free style gardens, types of gardens,

Urban landscaping, Landscaping for specific situations, institutions, industries, residents, hospitals, roadsides, traffic islands, damsites, IT parks, corporate.

**UNIT IV**

Establishment and maintenance, special types of gardens, Bio-aesthetic planning, ecotourism, theme parks, indoor gardening, therapeutic gardening, non-plant components, water scaping, xeriscaping, hardscaping.

**UNIT V**

Computer Aided Designing (CAD) for outdoor and indoorscaping Exposure to CAD (Computer Aided Designing).

**Text Books**

1. Acquaah, J. 2009. Horticulture – principles and practices, 4th edition, PHI learning Pvt. Ltd.

2. Rao Manibhushan K. 1991. Textbook of horticulture. MaC Millan India Ltd.

3. Gangulee H. C. and Kar A. K. 2004. College Botany Vol II, New Central Book Agency

4. Sharma V. K. 1999. Encyclopaedia of Practical Horticulture, Vol I –IV, Deep And Deep Publ. Pvt. Ltd.

5. Singh, J. 2018. Fundamentals of Horticulture. Kalyani Publishers.

**Reference Books**

1. Berry, F. and Kress, J. 1991. Heliconia: An Identification Guide . Smithsonian Books.

2. Butts, E. and Stensson, K. 2012.Sheridan Nurseries: One hundred years of People,Plans, and Plants. Dundurn Group Ltd.

3. Russell, T. 2012. Nature Guide: Trees: The world in your hands(Nature Guides).

4. Acquaah, J. 2009. Horticulture – principles and practices, 4th edition, PHI learning Pvt. Ltd.

5. Edment Senn Andrews. 1994. Fundamentals of Horticulture.Tata. McGraw Hill Publishing Co., Ltd., Delhi.

**Web resources**

1. https://www.amazon.in/Gardening-Landscape-Design-and-Botanical-Garden/s?rh=n%3A1318122031%2Cp_27%3Aand+Botanical+Garden
2. https://www.overdrive.com/subjects/gardening
3. https://www.scribd.com/book/530538456/Opportunities-in-Landscape-Architecture-Botanical-Gardens-and-Arboreta-Careers
4. https://www.scribd.com/book/305542619/Botanic-Gardens
5. https://www.overdrive.com/subjects/gardening

## Course Outcomes (COs)

On successful completion of the course, the students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Recognize fundamental concepts of gardening and landscaping. | K1 |
| CO2 | Explain about significance of garden adornments and propagation structures. | K2 |
| CO3 | Apply techniques of landscaping for aesthetic purposes and gardening for recreation. | K3 & K6 |
| CO4 | Distinguish between formal, informal and free style gardens and their applications. | K4 |
| CO5 | Develop and design outdoor and indoor gardens and inculcate entrepreneurial skills for landscaping. | K5 & K6 |

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

## Mapping of COs with POs

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 1 | 3 | 2 | 1 | 1 | 2 | 3 | 1 |
| **CO 2** | 3 | 3 | 2 | 2 | 1 | 3 | 2 | 3 | 3 | 2 |
| **CO 3** | 2 | 2 | 3 | 2 | 1 | 2 | 1 | 3 | 2 | 3 |
| **CO 4** | 3 | 3 | 2 | 3 | 1 | 2 | 3 | 3 | 3 | 2 |
| **CO 5** | 3 | 3 | 2 | 3 | 2 | 3 | 1 | 3 | 3 | 2 |

**S-Strong (3)  M-Medium (2)  L-Low(1)**

| Program: B.Sc. Botany | | | | |
|---|---|---|---|---|
| **Core – III** | **Course Code:** 24UBO3C03 | | **Course Title: Plant Diversity – III (Bryophytes and Pteridophytes)** | |
| **Semester** | **Hours/Week** | **Total Hours** | **Credits** | **Total Marks** |
| III | 5 | 75 | 6 | 100 |

## Course Objectives

1. To enable the students to have an overview of Non-vascular and Vascular cryptogams.
2. To understand the morphological diversity of Bryophytes and Pteridophytes.
3. To know the evolution of Bryophytes and Pteridophytes.
4. To understand the economic importance of the Bryophytes and Pteridophytes.
5. To understand anatomy and reproduction of Bryophytes and Pteridophytes.

## SYLLABUS

**UNIT - I**

**BRYOPHYTES**

General characters of Bryophytes, classification (Watson, 1971) (up to family). Economic importance of Bryophytes – Ecological importance (Pollution indicators and monitoring), Medicinal uses, horticulture, industrial uses and absorbent bandages.

**UNIT - II**

Structure, reproduction and life histories of the following classes each with a suitable example: Hepaticopsida - *Riccia*; Anthocerotopsida - *Anthoceros* and Bryopsida - *Polytrichum*). Evolution and Economic importance of Pteridophytes of Bryophytes.

**UNIT - III**

**PTERIDOPHYTES**

General Characters of Pteridophytes - Classification (Reimer, 1954). Apogamy and apospory, Homospory and Heterospory.

**UNIT - IV**

Morphology, anatomy and reproduction of reproduction of the taxa belonging to the following classes: Psilotopsida - *Psilotum*, Lycopsida - *Lycopodium*, Sphenopsida - *Equisetum*, Pteropsida - *Adiantum*.

**UNIT - V**

Origin and evolution of Pteridophytes. Stelar Evolution. Economic importance of Pteridophytes.

**Recommended Texts:**

1. Sharma, O.P. 2017. Bryophyta, MacMillan India Ltd. Delhi.
2. Alam, A. 2020. Contemporary Research on Bryophytes Book Series: Recent Advances in Botanical Science. 10.2174/97898114337881200101.
3. Alain Vanderpoorten. 2009. Introduction to Bryophytes, 1st Edition, Cambridge University Press.
4. Chopra, R. N. 2005. Biology of bryophytes. New Age International (P) Ltd. New Delhi, India.
5. Prem Puri. 2001. Bryophytes– morphology growth and differentiation. Atma Ram & Sons. Lucknow, India.

**References Books:**

1. Eames, A. 1963. Morphology of lower vascular plant, McGraw Hill, Chennai.
2. Parihar. N.S. 1967. An introduction of Embryophyta, Vol.III – Pteriodophyta, Central book depot, Allahabad.
3. Smith, G.M. 1955. Cryptogamic Botany, Volume-II– McGraw Hill, Chennai
4. Sporne, K.L. 1976. Morphology of Pteridophytes, 4th edition, B.I. Publication. Chennai.
5. Watson, E.V. 1963. The structure and Life of Bryophytes. Hutchinson & Co, UK.
6. Parihar, N.S. 1991. Bryophytes. Central Book Depot, Allahabad.
7. Parihar, N.S. 1996. The Biology and Morphology of Pteridophytes.Central Book Depot, Allahabad.

**Web Resources:**

1. http://www.bryoecol.mtu.edu/
2. https://www.amazon.in/Introduction-Bryophytes-Alain-Vanderpoorten-ebook/dp/B007NWFWQK
3. http://scitec.uwichill.edu.bb/bcs/bl14apl/bryo1.htm
4. http://www.bsienvis.nic.in/Database/Pteridophytes-in-India_23432.aspx
5. http://www.botany.ubc.ca/bryophyte/mossintro.html
6. aeTIUC&redir_esc=y

## Course Outcomes (COs)

On successful completion of the course, the students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Recognize morphological variations of Bryophytes and Pteridophytes. | K1 |
| CO2 | Explain the anatomy and reproduction of Bryophytes and Pteridophytes. | K2 |
| CO3 | Compare and contrast the variations in the internal cellular organization, gametophyte and sporophyte of Bryophytes and Pteridophytes. | K3 |
| CO4 | Decipher the stages of plant evolution and their transition to land habitat. | K4 |
| CO5 | Access the useful role of Bryophytes and Pteridophytes. | K5 |

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

## Mapping of COs with POs

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 2 | 3 | 2 | 1 | 2 | 2 | 1 | 2 |
| **CO 2** | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 3 | 2 | 2 |
| **CO 3** | 2 | 2 | 3 | 3 | 1 | 2 | 2 | 1 | 2 | 2 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 3 |
| **CO 5** | 3 | 3 | 2 | 2 | 2 | 1 | 3 | 3 | 1 | 3 |

**S-Strong (3)  M-Medium (2)  L-Low(1)**

| Program: B.Sc. Botany | | | | |
|---|---|---|---|---|
| **Core VI**<br>**Practical – III** | **Course Code:** 24UBO3P03 | | **Course Title: PLANT DIVERSITY III BRYOPHYTES AND PTERIDOPHYTES - PRACTICAL-III** | |
| **Semester** | **Hours/Week** | **Total Hours** | **Credits** | **Total Marks** |
| III | 5 | 45 | 3 | 100 |

## COURSE OBJECTIVES

- To enable students gain expertise in hand sectioning technique.
- To study diversity of Bryophytes and Pteridophytes.
- To understand the anatomical structure of the Bryophytes and Pteridophytes.
- Develop comprehensive skills in sectioning and micro preparation.
- Describe the structure of fossil forms prescribed in the syllabus.

**EXPERIMENTS**

**BRYOPHYTES**

1. Study of morphology, anatomy and structure of the vegetative and reproductive organs of Bryophytes genera included in the theory syllabus.
2. Hepaticopsida *Riccia*/*Marchantia*); Anthocerotopsida (*Anthoceros*) and Bryopsida (*Funaria*/*Polytrichum*

**PTERIDOPHYTES**

3. Study of morphology, anatomy and structure of the vegetative and reproductive organs of Pteridophytes genera and fossils included in the theory syllabus.
   Psilotopsida (*Psilotum*), Lycopsida (*Lycopodium/Selaginella*), Sphenopsida (*Equisetum*), Pteropsida (*Adiantum*/*Marsilea*
4. Identifying the micro slides relevant to the syllabus.
5. Botanical excursion.

**Recommended Texts:**

1. Sharma, O.P. 2017. Bryophyta, MacMillan India Ltd, New Delhi.
2. Sharma, O.P. 2012. Pteridophyta, Tata McGraw-Hills Ltd, New Delhi.
3. Ashok, M. Bendre and Kumar. 2010. A text book of Practical Botany, Algae, Fungi, Lichen, Bryophyta, Pteridophyta, Gymnosperms and Palaeobotany. Revised edition. Published by Rakesh Kumar Rastogi publication.
4. Prem Puri. 2001. Bryophytes– morphology growth and differentiation. Atma Ram & Sons. Lucknow, India.
5. Tuba Z., Slack N.G. and Stark L.R. 2011. Bryophyte Ecology and Climate Change. Cambridge university press, Cambridge..

**Reference Books:**

1. Ashok, M. Bendre and Kumar. 2010. A text book of Practical Botany, Algae, Fungi, Lichen, Bryophyta, Pteridophyta, Gymnosperms and Palaeobotany. Revised edition. Published by Rakesh Kumar Rastogi publication.
2. Mohammed Gufran Khan, Shite Gatew and Bedilu Bekele. 2012. Practical manual for Bryophytes and Pteridophytes. Lambert Academic Publishing.
3. Puri, P. 1980. Bryophytes. Atma Ram and Sons, New Delhi.
4. Sporne, K.R. 1991. The Morphology of Pteridophytes. B.I. Publ. Pvt. Ltd. Chennai.
5. Vashista.P.C. 1971. Botany for Degree students: Pteridophyta. S.Chand & Co. New Delhi..

**Web resources:**

1. https://www.amazon.in/Manual-Practical-Bryophyta-Suresh-Kumar/dp/B0072GNFX4
2. https://www.amazon.in/Practical-Manual-Pteridophyta-Rajan-Sundara/dp/8126106883
3. http://www.eeb.uconn.edu/people/goffinet/Classificationmosses.html
4. https://www.vitalsource.com/products/introduction-to-bryophytes-alain-vanderpoorten-v9780511738951?duration=perpetual
5. https://www.toppr.com/guides/biology/plant-kingdom/pteridophytes/.

***Bonafide record of practical work done should be submitted for the practical examination.**

## Course Outcomes (COs)

On successful completion of the course, the students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Recognize the major groups of Non-vascular and Vascular cryptogams | K1 |
| CO2 | Describe the structure of Bryophytes and Pteridophytes forms prescribed in the syllabus. | K2 |
| CO3 | Identify and illustrate the morphological and anatomical features of bryophytes and Pteridophytes. | K3 |
| CO4 | Develop comprehensive skills in sectioning and micro preparation. | K4 |
| CO5 | Interpret the significance of reproductive structures in Bryophytes and Pteridophytes. | K5 |

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

## Mapping of COs with POs

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 1 | 3 | 2 | 1 | 2 | 2 | 1 | 2 |
| **CO 2** | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 3 | 2 |
| **CO 3** | 2 | 2 | 3 | 3 | 1 | 2 | 1 | 3 | 2 | 1 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 3 |
| **CO 5** | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |

**S-Strong (3)  M-Medium (2)  L-Low (1)**

| Program: B.Sc. Botany | | | | |
|---|---|---|---|---|
| Skill Enhancement-4 | Course Code: 24UBO3S02 | | Course Title: HERBAL TECHNOLOGY | |
| **Semester** | **Hours/Week** | **Total Hours** | **Credits** | **Total Marks** |
| IV | 2 | 30 | 2 | 100 |

## COURSE OBJECTIVES

1. To provide students with knowledge of herbal drug industry, the quality of raw material, and guidelines for quality maintenance.
2. To gain an insight into the commercially important secondary products and significance of bioprospecting.
3. To understand various plants based drugs used in ayurvedha, unani, homeopathy, siddha etc.
4. To apply the knowledge to cultivate medical plants.
5. To know the pharmacological importance of medicinal plants.

**UNIT – I**

Herbal Technology: Definition and scope; Herbal medicines: history and scope; Traditional systems of medicine, and overview of AYUSH (Traditional Indian Systems of Medicine); Cultivation - harvesting - processing - storage of herbs and herbal products.

**UNIT – II**

Value added plant products: Herbs and herbal products recognized in India; Major herbs used as herbal medicines, nutraceuticals, cosmeticals and biopesticides, their Botanical names, plant parts used, major chemical constituents.

**UNIT III**

Pharmacognosy - Systematic position, botany of the plant part used and active principles of the following herbs: Tulsi, Ginger, Curcuma, Fenugreek, Indian Gooseberry, *Catharanthus roseus, Withania somnifera, Centella asiatica, Achyranthes aspera, Kalmegh, Giloe* (Tinospora), Saravar. Herbal foods, future of pharmacognosy.

**UNIT IV**

Analytical pharmacognosy: Morphological and microscopic examination of herbs, Evaluation of drug adulteration - types, methods of drug evaluation - Biological testing of herbal drugs - Phytochemical screening tests for secondary metabolites (alkaloids, flavonoids, steroids, triterpenoids, phenolic compounds).

**UNIT V**

Plant gene banks, Cultivation of Plants and their value added processing / storage / quality control for use in herbal formulations, Introductory knowledge of Tissue culture and Micro propagation of endangered species some medicinal plants (*Withania somnifera*, neem and tulsi).

**Text Books**

1. AYUSH (www.indianmedicine.nic.in). About the systems—An overview of Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homeopathy. New Delhi: Department of Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homoeopathy (AYUSH), Ministry and Family Welfare, Government of India.
2. Evans, W.C. 2009: Trease and Evans PHARMACOGNOSY. 16th Edition, SAUNDERS / Elsevier.
3. Sivarajan, V.V. and India, B. 1994. Ayurvedic Drugs and Their Plant Sources.. Oxford & IBH Publishing Company, 1994 - Herbs - 570 pages.
4. Miller, L. and Miller, B. 2017. Ayurveda & Aromatherapy: The Earth Essential Guide to Ancient Wisdom and Modern Healing. Motilal Banarsidass,; Fourth edition .
5. Kokate, C.K. 2003. Practical Pharmacognosy. Vallabh Prakashan, Pune.

**Reference Books**

1. 1.Agarwal, P., Shashi, Alok., Fatima, A. and Verma, A. 2013. Current scenario of Herbal Technology worldwide: An overview. Int J Pharm Sci Res; 4(11): 4105-17.
2. Arbe r, Agnes. 1999. Herbal Plants and Drugs. Mangal Deep Publications, Jaipur.
3. Varzakas, T., Zakynthinos, G, and Francis Verpoort, F. 2016. Plant Food Residues as a Source of Nutraceuticals and Functional Foods. Foods 5 : 88.
4. Aburjai, T. and Natsheh, F.M. 2003. Plants Used in Cosmetics. Phytotherapy Research 17 :987-1000.
5. Patri, F. and Silano, V. 2002. Plants in cosmetics: Plants and plant preparations used as ingredients for cosmetic products - Volume 1. ISBN 978-92-871-8474-0, pp 218.

**Web resources**

1. https://www.kopykitab.com/Herbal-Science
2. https://kadampa.org/books/free-ebook-download howtotyl?gclid=CjwKCAiA6vXw zBRBKEiwAYE7iS5t8yenurClUCTdV9olKo9TbyAh4fsoFqPYWGs5qBTbytD22z7lo0BoCYnUQAvD_BwE
3. https://www.barnesandnoble.com/b/free-ebooks/nook-books/alternative-medicine-natural-healing/herbal-medicine//N-ry0Z8qaZ11iu
4. http://cms.herbalgram.org/heg/volume8/07July/HerbalEBooks.html?t=1310004932&ts=1579066352&signature=1dd0d5aef818b19bcdcd6c063a78e404

5. https://www.dattanibookagency.com/books-herbs-science.html
6. https://www.springer.com/gp/book/9783540791157

## Course Outcomes (COs)

On successful completion of the course, the students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Define and describe the principle of cultivation of herbal products. | K1 |
| CO2 | List the major herbs, their botanical name and chemical constituents. | K2 |
| CO3 | Apply techniques for monitoring drug adulteration through the biological testing. | K3 |
| CO4 | Analyze and decipher the significance of various methods of harvesting, drying and storage of medicinal herbs. | K4 |
| CO5 | Develop the skills for cultivation of plants and their value added processing / storage | K5 & K6 |

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

## Mapping of COs with POs

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 2 |
| **CO 2** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 3 | 1 |
| **CO 3** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 2 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 3 | 1 |
| **CO 5** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 3 | 1 |

**S-Strong (3)  M-Medium (2)  L-Low(1)**

| Program: B.Sc. Botany | | | | |
|---|---|---|---|---|
| Skill Enhancement-3 | **Course Code: 24UBO3S03** | | **Course Title: ENTREPRENEURIAL OPPORTUNITIES IN BOTANY** | |
| **Semester** | **Hours/Week** | **Total Hours** | **Credits** | **Total Marks** |
| 3 | 1 | 30 | 2 | 100 |

## COURSE OBJECTIVES

1. To enable students to understand about establishment of various ventures after graduates in Botany using medicinal plants, Biotechniques and marketing of bioproducts.
2. To create a mindset among students to start their own companies for income generation.
3. The students may understand about various fields of botany.
4. To develop the concept of Entrepreneurial Opportunities in Botany.
5. Describe the new strategies to describe marketing and business management strategy.

**UNIT – I**

**INTRODUCTION TO ENTREPRENEURSHIP**

Introduction to Entrepreneurship, Scope and identification of new ventures using plant resources, Mechanism of product selection and commercialization, General concept about the Govt. formalities, rules & regulation, Entrepreneurship skill development.

**UNIT – II**

**TOOLS AND TECHNIQUES**

Production of commercially viable plants through Plant tissue culture technique, Production of secondary metabolites, solvents, organic acids, beverages, enzymes, antibiotics.

**UNIT III**

**NEW VENTURE CREATION**

Production of Biofertilizers, Vermicompost, Establishment of medicinal, herbal and zodiac gardens, Terrace & Kitchen garden, Spirulina and Azolla cultivation, Mushroom cultivation, Bonsai, Bouquet making, Terrarium.

**UNIT IV**

**PRODUCT DEVELOPMENT AND COMMERCIALIZATION**

Product commercialization and business strategy, Dyes, Cosmetics and Perfumes, Gums, Resins & Latex, Areca Leaf Plates, cups & bags, Jute Products.

**UNIT V**

**BIO-BUSINESS PLANS, IPR AND BIOETHICS**

Marketing and Business management strategy, Bank loan, Intellectual property rights, Patent laws - Bioethics and current legal issues, Marketing and public perceptions in product development – Technology licensing and branding concerns.

**Text Books**

1. Gurinder Shahi. 2004. Bio-Business in Asia: How countries Can Capitalize on the Life Science Revolution, Pearson Prentice Hall, New Delhi, India.

2. Karthikeyan, S. and Arthur Ruf. 2009. Biobusiness, MJP Publications. Chennai, India.

3. Richard Oliver. 2000. The coming Biotech age: The Business of Biomaterials, McGraw Hill Publications, New York, USA.

4. Adams, C.R. Banford, K.M. and Early, M.P. 1993. Principles of Horticulture.

5. Sathe,T.V. 2004. Vermiculture and Organic farming, Daya Publishers.

**Reference Books**

1. Robin Lowe and Sue Marriott 2009. Enterprise: Entrepreneurship and Innovation: Concepts, Contexts and Commercialization, Routledge Publisher, London, UK.
2. Peter F.Drucker, 2009. Innovation and Entrepreneurship, Harper Collins Publisher, New York, US.
3. Russell, T. 2012. Nature Guide: Trees: The world in your hands(Nature Guides). Mukherjee D. Gardening in India, Oxford IBH publishing co, New Delhi.
4. Kumar, N. 1997. Introduction to Horticulture, Rajalakshmi Publications, Nagercoil.
5. Webster, J and Weber, R. 2007. Introduction to Fungi, 3rd Ed. Cambridge UniversityPress, Cambridge.

**Web sources**

1. https://www.brainkart.com/article/Entrepreneurial-Botany_38321/
2. https://www.youtube.com/watch?v=hnBla1FfcLo
3. https://www.slideshare.net/krishnashah5891004/ram-power-point-presentation
4. http://www.brainkart.com/article/Economically-Useful-Plants-andEntrepreneurial-Botany_38301

5. https://www.ebooks.com/en-us/subjects/gardening/
6. https://www.amazon.in/Preservation-Techniques-Publishing-Technology-Nutrition ebook/dp/B00RXCXB3Q

## Course Outcomes (COs)

On successful completion of the course, the students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Relate to how various fields of botany could be understood with an entrepreneurial approach. | K1 |
| CO2 | Explain the concept of Entrepreneurial Opportunities in Botany. | K2 |
| CO3 | Make of the knowledge gained to start new venture using Plant tissue culture and plant products for commercial exploitations | K3 |
| CO4 | Decipher effective ways of making bioproducts like organic acids, solvents, beverages, enzymes, antibiotics, mushrooms, biogas and etc. | K4 |
| CO5 | Develop new strategies to describe marketing and business management strategy including the role of IPR and bioethics regulations for licensing. | K5 & K6 |

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

## Mapping of COs with POs

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 1 | 1 | 2 | 1 | 2 | 2 | 1 | 2 |
| **CO 2** | 3 | 3 | 2 | 2 | 3 | 1 | 2 | 3 | 1 | 2 |
| **CO 3** | 2 | 2 | 3 | 1 | 2 | 2 | 1 | 3 | 2 | 1 |
| **CO 4** | 3 | 3 | 1 | 2 | 3 | 2 | 3 | 3 | 2 | 3 |
| **CO 5** | 3 | 3 | 2 | 3 | 1 | 3 | 3 | 3 | 3 | 3 |

**S-Strong (3)  M-Medium (2)  L-Low (1)**

| Program: B.Sc. Botany | | | | |
|---|---|---|---|---|
| **Core – VII** | **Course Code:** 24UBO4C04 | | **Course Title: Plant Diversity – IV (Gymnosperms, Paleobotany and Evolution )** | |
| **Semester** | **Hours/Week** | **Total Hours** | **Credits** | **Total Marks** |
| 4 | 5 | 75 | 6 | 100 |

## Course Objectives

1. To enable the students to understand thallus organization.
2. To enable the students to understand internal and the reproductive structures of Gymnosperms and the importance of evolution.
3. to acquaint students with evidences of the past history of plant groups and significance of the fossilization.
4. To know the scope of pleobotany, types of fossils and geological time scale.
5. Understand the various fossil genera representing different fossil groups.

## SYLLABUS

**UNIT - I**

**GYMNOSPERMS**

Classification of Gymnosperms (Sporne, 1954) (up to family). General characteristics, Economic importance of Gymnosperms with special reference to oil, resin, timber.

**UNIT - II**

**GYMNOSPERMS**

Morphology, anatomy and reproduction of the taxa belonging to each of the following orders: Cycadales (*Cycas*), Coniferales (*Pinus*). Gnetales (*Gnetum*).

**UNIT - III**

**PALEOBOTANY**

Introduction to fossils and fossilization processes such as compression, casts, molds, petrification, impressions and coal balls. Geological time scale. Radiocarbon dating. Contribution of Birbal Sahni

**UNIT - IV**

**PALEOBOTANY**

Study of the following fossils: Rhynia, Lepidodendron, Lepidocarpon, Calamites and *Williamsonia sewardiana*.

**UNIT - V**

**EVOLUTION**

Evolution - origin of life, chemosynthetic theory - evidences (any five). Theories of evolution - Darwin, Lamark and De veries, modern synthetic theory. Variation - analysis and sources, adaptive radiation, Concept of species - Allopatric and sympatric.

**Recommended Texts:**

1. Gupta, M.N. 1972. The Gymnosperms (2nd Edition) Shiva Lal Agarwala & Co., Agra.
2. Vashista, P.C. 1976. Gymnosperms, S.Chand & Co. New Delhi.
3. Bhatnagar, S.P and Moitra, A. 1996. Gymnosperms. New Age International Publishers, New Delhi, India.
4. Anil Kumar. 2006. Gymnosperms. S. Chand & Company Pvt. Ltd. New Delhi.
5. Bhatnagar S.P and Alok Moitra. 2013. Gymnosperms. Publisher: New Age International Pvt Ltd Publishers. New Delhi.

**References Books:**

1. Sporne, K.R.1991. The Morphology of Gymnosperme. B.I. Publications, New Delhi.
2. Bhatnagar, S.P and Moitra, A. 1996. Gymnosperms, New Age Int. Pvt. Ltd., New Delhi.
3. Stewart, W.N and Rathwell, G.W. 1993. Paleobotany and the Evolution of Plants. Cambridge University Press.
4. Raup, D.M and Steven, M. Stanley. 2004. Principles of paleontology. San Francisco: W.H. Freeman, 1971.
8. Bhatnagar S.P and Alok Moitra. 2013. Gymnosperms. Publisher: New Age International Pvt Ltd Publishers. New Delhi.

**Web Resources:**

1. https://books.google.co.in/books?hl=en&lr=&id=Pn7CAAAQBAJ&oi=fnd&pg=PA1&dq=Introduction+to+Gymnosperms&ots=sfYSzCL02&sig=ysX1KRvetV0bAza4Sq6RWau4XU8&redir_esc=y#v=onepage&q=Introduction%20to%20Gymnosperms&f=false
2. https://books.google.co.in/books/about/Botany_for_Degree_Gymnosperm_Multicolor.html?id=HTdFYFNxnWQC&redir_esc=y
3. https://books.google.co.in/books/about/Gymnosperms.html?id=4dvyNckni8wC
4. https://arboretum.harvard.edu/wp-content/uploads/2013-70-4-beyond-pine-cones-an-introduction-to-gymnosperms.pdf

5. https://www.palaeontologyonline.com/

## Course Outcomes (COs)

On successful completion of the course, the students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Relate to the general characteristics of Gymnosperms and fossil forms | K1 |
| CO2 | Explain about the morphology and anatomy Gymnosperms. | K2 |
| CO3 | Compare and contrast the reproductive structures of Gymnosperms & fossil forms | K3 |
| CO4 | Analyze the anatomy and reproduction Gymnosperms along with their ecological and economical importance. | K4 |
| CO5 | Determine the various fossilization methods and their significance in paleobotany | K5 |

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

## Mapping of COs with POs

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 2 | 2 | 1 | 1 | 2 | 2 | 2 | 2 |
| **CO 2** | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 2 | 3 |
| **CO 3** | 3 | 3 | 2 | 2 | 1 | 2 | 1 | 3 | 1 | 3 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| **CO 5** | 3 | 3 | 2 | 3 | 2 | 2 | 1 | 3 | 1 | 3 |

**S-Strong (3)  M-Medium (2)  L-Low (1)**

| Program: B.Sc. Botany | | | | |
|---|---|---|---|---|
| **Core VIII Practical – IV** | **Course Code:** 24UBO4P04 | | **Course Title: PLANT DIVERSITY IV (GYMNOSPERMS, PALEOBOTANY AND EVOLUTION) - PRACTICAL-IV** | |
| **Semester** | **Hours/Week** | **Total Hours** | **Credits** | **Total Marks** |
| 4 | 5 | 45 | 5 | 100 |

## COURSE OBJECTIVES

- To enable students observe and record the morphological features of selected species of Gymnosperms.
- To enable students observe and record the anatomical features of selected species of Gymnosperms.
- To develop the skill of preparation of microslides of the gymnosperm samples.
- To enable students to gain insights into the basics of paleobotany and methods of fossilization.
- To understand the anatomy of the fossil plants through microscopy.

**EXPERIMENTS**

1. Study of morphology, anatomy and structure of the vegetative and reproductive organs of *Cycas*, *Pinus* and *Gnetum.*
2. Identifying the micro slides relevant to the syllabus.
3. Field visit to study the habitat (Hill station).
4. Study the following fossil members: *Rhynia*, *Lepidodendron*, *Lepidocarpon*, *Calamites* and *Williamsonia sewardiana* through permanent slides.
5. Photograph of evolution scientists.

**Recommended Texts:**

1. Sharma O.P and S, Dixit. 2002. Gymnosperms. Pragati Prakashan.
2. Gangulee, H.C and A.K. Kar. 2013. College Botany. Vth Edition. S. Chand.
3. Sharma, O.P. 2012. Textbook of Pteridophyta, TATA MacMillan India Ltd., New Delhi.

4. Chamberlain, C.J. 1934. Gymnosperms: Structure and Evolution. Chicago Reprinted 1950). New York.
5. Bhatnagar, S.P and Moitra, A. 1996. Gymnosperms. New Age International Publishers, New Delhi, India.

**Reference Books:**

1. Smith, G.M. 1955. Cryptogamic Botany Vol.II. Tata McGraw Hill. New Delhi.
2. 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.
3. Sharma, O.P. 2012. Textbook of Pteridophyta, TATA MacMillan India Ltd., New Delhi.
4. Chamberlain, C.J. 1934. Gymnosperms: Structure and Evolution. Chicago Reprinted 1950). New York.
5. Kirkaldy, J.E. 1963. The study of Fossils. Hutchinson Educational, London.

**Web resources:**

1. https://www.google.co.in/books/edition/Gymnosperms/3YrT5E3Erm8C?hl=en&gbpv=1&dq=gy mnosperms&printsec=frontcover
2. https://www.amazon.in/Paleobotany-Biology-Evolution-Fossil-Plants/dp/0123739721
3. https://books.google.co.in/books/about/Paleobotany.html?id=HzYUAQAAIAAJ
4. https://trove.nla.gov.au/work/11471742?q&versionId=46695996
5. http://www.freebookcentre.net/Biology/Evolutionary-Biology-Books.html.

***Bonafide record of practical work done should be submitted for the practical examination.**

## Course Outcomes (COs)

On successful completion of the course, the students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Analyze and observe and record the morphological features of selected species of Gymnosperms. | K1 |
| CO2 | Describe the structure of fossil forms prescribed in the syllabus. | K2 |
| CO3 | Identify and Illustrate the morphological and anatomical features of gymnosperms. | K3 |

| | | |
|---|---|---|
| CO4 | Develop comprehensive skills in sectioning and micro preparation. | K4 |
| CO5 | Interpret the significance of reproductive structures in gymnosperms. | K5 |

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

**Mapping of COs with POs**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 2 | 3 | 2 | 1 | 2 | 2 | 2 | 3 |
| **CO 2** | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 2 | 2 |
| **CO 3** | 2 | 2 | 3 | 3 | 1 | 2 | 1 | 3 | 3 | 3 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 |
| **CO 5** | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 2 | 2 |

**S-Strong (3)** **M-Medium (2)** **L-Low(1)**

| Program: B.Sc. Botany | | | | |
|---|---|---|---|---|
| **ELECTIVE – INDUSTRY MODULE** | **Course Code: 23UBO4E01** | | **Course Title: INDUSTRY MODULE-CULTIVATION OF ALGAE** | |
| **Semester** | **Hours/Week** | **Total Hours** | **Credits** | **Total Marks** |
| IV | 4 | 30 | 2 | 100 |

## COURSE OBJECTIVES

1. To impart sufficient information about the culture and cultivation of algae under laboratory andoutdoor conditions.
2. To study the media composition for algae cultivation and high value products and its applications.
3. To know about the important seaweeds and its cultivation practices.
4. To study the SLF production and applications in agriculture crops.
5. To understand about the Environment Impact Assessment of algal cultivation.

**UNIT – I**

Morphology and mass culture of microalgae: *Spirulina, Chlorella,Dunaliella* and *Botryococcus.*

**UNIT – II**

High value products: Single Cell Protein (SCP), phycocyanin, β-carotene, astaxanthin –biofuel, media composition - scale up - lab to land - raceway ponds and photobioreactor.

**UNIT III**

Marine macroalgae: Morphology and mass cultivation of *Gracilaria, Kappaphycus, Sargassum* and *Ulva.*

**UNIT IV**

Polysaccharides: agar, carrageen, alginate - economic importance - seaweed as food, feed and Seaweed Liquid Fertilizer (SLF).

**UNIT V**

Role of seaweeds in aquaculture: Environment Impact Assessment of algal cultivation.

**Text Books**

1. Kumar H.D. and Singh, H.N. 1976. A Text Book of Algae Affiliated East West Press Pvt. Ltd., New Delhi, Madras.
2. Kumar, H.D. 1990. Introductory Phycology, Affiliated East West Press (P) Ltd., New Delhi,Madras, Hyderabad, Bangalore.
3. Pandey, B.P. 1993. A Text book of Botany-Algae S. Chand & Co., (P) Ltd., New Delhi.
4. Sharma, O.P. 1990. Text Book of Algae Tata McGraw Hill Publishing Co., Ltd., New Delhi.
5. Vashista, B.R. 1988. Botany for degree students-Algae. S. Chand & Co., (P) Ltd., New Delhi

**Reference Books**

1. Bilgrami, K.S., and L.C. Saha. 1996. A Text Book of Algae, CBS Publishers & Distributors (P)Ltd., New Delhi.
2. Chapman, V.J. and Chapman, D.J., 1973. The Algae. 2nd Ed. ELBS & MacMillan, 498 pp.,
3. Fritsch F.E. 1935. The Structure and Reproduction of Algae 1945. Cambridge University Press,Cambridge, U.K. Vol. I-791 pp., Vol. II-939 pp.,
4. Round, F.E. 1973. Biology of the Algae. 2nd Ed. Edward Arnold, London. 278 pp.,
5. Sharma, O.P. 1990. Text Book of Algae. Tata McGraw Hill Publishing Co., Ltd., New Delhi, 396

**Web Resources**

1. https://www.aiche.org/academy/videos/conference-presentations/study-culture-strategies-microalgae-continuous-photobioreactor-system-biofuel-production
2. https://link.springer.com/article/10.1007/s10811-013-9983-9
3. https://www.nrel.gov/docs/legosti/old/2360.pdf
4. file:///C:/Users/Lenovo/AppData/Local/Temp/alba2018.pdf
5. file:///C:/Users/Lenovo/AppData/Local/Temp/Seaweed_aquaculture_Cultivation_technologies_ch all.pdf

## Course Outcomes (COs)

On successful completion of the course, the students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Obtain an in-depth knowledge on culture and mass cultivation of algae and its differentmethods. | K1 |
| CO2 | Exploration and recommendation of the commercial potential of algal products. | K2 |
| CO3 | Understand the applied facet of algology and acquire a complete knowledge about thecultivation methods in algae. | K3 |
| CO4 | Describe the preparation of seaweed liquid fertilizers and their applications in agricultureand horticulture. | K4 |
| CO5 | Acquiring the information about algal applications in different industries and agriculturefields in the current scenario. | K5 & K6 |

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

## Mapping of COs with POs

| Cos | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 1 | 3 | 2 | 1 | 2 | 2 | 2 | 1 |
| **CO 2** | 3 | 2 | 1 | 2 | 1 | 3 | 2 | 3 | 1 | 3 |
| **CO 3** | 2 | 1 | 1 | 3 | 2 | 1 | 2 | 3 | 2 | 1 |
| **CO 4** | 3 | 3 | 3 | 3 | 1 | 2 | 1 | 3 | 1 | 2 |
| **CO 5** | 3 | 3 | 2 | 2 | 1 | 1 | 3 | 3 | 1 | 1 |

**S-Strong (3)  M-Medium (2)  L-Low (1)**

| Program: B.Sc. Botany | | | | |
|---|---|---|---|---|
| Skill Enhancement | **Course Code: 23UBO4S06** | | **Course Title: FERMENTATION TECHNOLOGY** | |
| **Semester** | **Hours/Week** | **Total Hours** | **Credits** | **Total Marks** |
| VI | 2 | 30 | 1 | 100 |

## COURSE OBJECTIVES

1. To appreciate the significance of microbes synthesizing fermented products.
2. To gain insights on safety and quality control in large scale production of fermentative products.
3. To design and operation of industrial practices in mass production of fermented products.
4. To know about the various fermentation technology.
5. To learn about the bioproduct recovery.

**UNIT – I**

Preparation of microbial culture, Preparation and sterilization of fermentation media. Isolation and improvement of industrially important microorganisms.

**UNIT – II**

Maintenance and preservation of microorganisms, Metabolic regulations and overproduction of metabolites. Kinetics of microbial growth and product formation.

**UNIT III**

Scope and opportunities of fermentation technology. Principles of fermentation: Submerged, solid state, batch, fed-batch and continuous culture.

**UNIT IV**

Fermentative production of vinegar, alcohol (ethanol, wine, beer), acids (citric acid and gluconic acid), amino acids (lysine and glutamic acid) and antibiotics (penicillin and streptomycin).

**UNIT V**

Microbial production of enzymes: Amylase and Protease. Bioproduct recovery.

**Text Books**

1. Waites M.J. 2008. Industrial Microbiology: An Introduction, 7th Edition, Blackwell Science, London, UK.
2. Prescott S.C., Dunn C.G., Reed G. 1982. Prescott & Dunn's Industrial Microbiology, 4th Edition, AVI Pub. Co., USA.
3. Reed G. 2004. Prescott & Dunn's industrial microbiology, 4th Edition, AVI Pub. Co., USA.
4. JR Casida L.E. 2015. Industrial Microbiology, 3rd Edition, New Age International (P) Limited Publishers, New Delhi, India.
5. Waites M.J., Morgan N.L., Rockey J.S. and Higton G. 2001. Industrial Microbiology: An Introduction. 1st Edition, Blackwell Science, London, UK.
6. Pelczar M.J., Chan E.C.S. and Krieg N.R. 2003. Microbiology. 5th Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi.

**Reference Books**

1. Peter F Stanbury, Allan Whitaker, Stephen J Hall. 2016. Principles of Fermentation Technology. Butterworth-Heinemann Press. UK.
2. Peppler, H. J. D. Perlman. 2014. Microbial Technology: Fermentation Technology. Academic Press.
3. T. El-Mansi, C. Bryce, Arnold L. Demain, A.R. Allman. Fermentation Microbiology and Biotechnology. Second Edition. 2006. CRC Press, USA.
4. Hongzhang Chen. Modern Solid State Fermentation: Theory and Practice. 2013. Springer Press, Germany.
5. John E. Smith. Biotechnology. 2009. Cambridge University Press.UK.
6. Celeste M. Todaro, Henry C. Vogel. 2014. Fermentation and Biochemical Engineering Handbook. William Andrew Press. Norwich, NY.
7. Lancini, G. R. Lorenzetti. 2014. Biotechnology of Antibiotics and other Bioactive Microbial Metabolites. Springer publications, Germany.

**Web resources**

1. https://ebooks.foodtechlearning.xyz/2020/12/principal-of-fermentation-technology-by.html
2. https://www.amazon.in/Principles-Fermentation-Technology-Peter-Stanbury-ebook/dp/B01LMDYFNQ
3. https://www.amazon.in/Principles-Fermentation-Technology-Peter-Stanbury-ebook/dp/B01E3IC73W
4. https://www.pdfdrive.com/principles-of-fermentation-technology-e189052809.html

5. https://www.ebooks.com/en-us/book/2698294/principles-of-fermentation-technology/peter-f-stanbury/

## Course Outcomes (COs)

On successful completion of the course, the students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Enumerate the significance of industrially useful microbes. | K1 |
| CO2 | Explain the design and operation of industrial practices in mass production of fermented products. | K2 |
| CO3 | Explain the process of maintenance and preservation of microorganisms. | K3 |
| CO4 | Analyze the various aspects of the fermentation technology and apply for fermentative production. | K4 |
| CO5 | Validate the experimental techniques for microbial production of enzymes: amylase and protease, bio product recover. | K5 & K6 |

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

## Mapping of COs with POs

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 1 | 3 | 2 | 1 | 2 | 2 | 1 | 2 |
| **CO 2** | 3 | 3 | 2 | 2 | 1 | 2 | 3 | 2 | 2 | 3 |
| **CO 3** | 2 | 2 | 3 | 1 | 1 | 1 | 2 | 3 | 1 | 2 |
| **CO 4** | 3 | 3 | 2 | 1 | 3 | 2 | 1 | 3 | 2 | 1 |
| **CO 5** | 3 | 3 | 2 | 1 | 2 | 2 | 3 | 3 | 2 | 3 |

**S-Strong (3)  M-Medium (2)  L-Low (1)**

| Program: B.Sc. Botany | | | | |
|---|---|---|---|---|
| Skill Enhancement | **Course Code: 24UBO4S07** | | **Course Title: ENVIRONMENTAL IMPACT ANALYSIS** | |
| **Semester** | **Hours/Week** | **Total Hours** | **Credits** | **Total Marks** |
| VI | 2 | 30 | 1 | 100 |

## COURSE OBJECTIVES

1. To understand about the theory and practice of environmental impact assessment.
2. To develop skills in identifying and solving problems of environmental concerns.
3. Define and classify Environmental Impacts and the terminology.
4. Understands the environmental Impact assessment procedure.
5. List and describe environmental audits.

**UNIT – I**

Origin and Development Purpose and aim, core values and principles, History of EIA development, Environmental Management Plan, Environmental Impact Statement, Scope of EIA in Project planning and Implementation.

**UNIT – II**

EIA Process Components of EIA, EIA Methodology- Screening, Scoping, Baseline data, Impact Identification, Prediction, Evaluation and Mitigation, Appendices and Forms of Application,

**UNIT III**

Techniques of Assessment-Cost-benefit Analysis, Matrices, Checklist, Overlays, Impact on Environmental component: air, noise, water, land, biological, social and environmental factors. EIA Document.

**UNIT IV**

Main participants in EIA Process Role of Project proponent, environmental consultant, PCBs, PCCs, public and IAA. Public participation.

**UNIT V**

Environmental Appraisal and Procedures in India and EIA Methodology, indicators and mitigation, Environmental Audit of different environmental resources, Risk Analysis, Strategic environmental assessment, ecological impact assessment: legislation.

**Text Books**

1. Morris, P. and Therivel, R. 1995. Methods of Environmental Impact Assessment, UCL Press, London.

2. Petts, J. 1999. Handbook of Environmental Impact Assessment, volume 1 and 2, Blackwell Science, Oxford.

3. Therivel, R. and Partidario, M.R. 1996. The Practice of Strategic Environmental Assessment, Earthscan, London.

4. Vanclay, F. and Bronstein, D.A. 1995. Environmental and Social Impact Assessment, Wiley & Sons, Chichester.

5. Rau, J.G. and Wooten, D.C., Environmental Impact Assessment, McGraw Hill Pub. Co., New York, 1996

**Reference Books**

1. Kulkarni, V. and Ramachandra, T.V. 2006. Environmental Management, Capital Pub. Co. New Delhi.

2. Petts, J. 2005. Handbook of Environmental Impact Assessment- Volume 1 and 2. Blackwell Publishers, UK.

3. Glasson, J. Therivel, R. and Chadwick. 2006. A. Introduction to Environmental Impact Assessment. Routledge, London.

4. Canter, W.L. 1995. Environmental Impact Assessment, McGraw-Hill Science/ Engineering/ Math, New York.

5. Jain, R.K., Urban, L.V., Stracy, G.S., Environmental Impact Analysis, Van Nostrand Reinhold Co., New York, 1991.

**Web resources**

1. https://ebooks.foodtechlearning.xyz/2020/12/principal-of-fermentation-technology-by.html
2. https://www.amazon.in/Principles-Fermentation-Technology-Peter-Stanbury-ebook/dp/B01LMDYFNQ
3. https://www.amazon.in/Principles-Fermentation-Technology-Peter-Stanbury-ebook/dp/B01E3IC73W
4. https://www.pdfdrive.com/principles-of-fermentation-technology-e189052809.html
5. https://www.ebooks.com/en-us/book/2698294/principles-of-fermentation-technology/peter-f-stanbury/

## Course Outcomes (COs)

On successful completion of the course, the students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Enumerate the fundamental concepts and significance of environmental impact assessment. | K1 |
| CO2 | Explain the important steps of EIA process. | K2 |
| CO3 | Interpret the environmental appraisal and procedures in India. | K3 |
| CO4 | Decipher how to prepare the various documents required by state and federal regulations. | K4 |
| CO5 | Develop their own perspectives on impact assessment and be able to solve problems related to environment. | K5 & K6 |

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

## Mapping of COs with POs

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 1 | 3 | 2 | 1 | 2 | 2 | 2 | 2 |
| **CO 2** | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 2 | 3 |
| **CO 3** | 2 | 2 | 1 | 3 | 1 | 1 | 2 | 3 | 2 | 3 |
| **CO 4** | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 3 |
| **CO 5** | 3 | 2 | 2 | 3 | 1 | 3 | 3 | 3 | 3 | 3 |

**S-Strong (3)  M-Medium (2)  L-Low (1)**

| Program: B.Sc. Botany | | | | |
|---|---|---|---|---|
| **Core – IX** | **Course Code:** 23UBO5C05 | | **Course Title:** PLANT MORPHOLOGY, TAXONOMY AND ECONOMIC BOTANY | |
| **Semester** | **Hours/Week** | **Total Hours** | **Credits** | **Total Marks** |
| V | 5 | 75 | 4 | 100 |

## Course Objectives

1. Students will have extensive knowledge of the morphology (vegetative structures and floral structures) of flowering plants.
2. Students will know about the basic concepts of classification of plants.
3. Understand major evolutionary trends in Angiospermic plants.
4. To know the characteristic features of the selected families.
5. To know the economic importance of plants.

## SYLLABUS

**UNIT - I**

Morphology – root system – modifications. Shoot system – modifications – (Aerial, sub-aerial and underground). Leaf – Types - simple and compound - phyllotaxy, modifications (phyllode, pitcher), tendrils, stipules. Inflorescences – types – racemose, cymose, mixed and special types. Fruits - classification.

**UNIT - II**

History of Angiosperm classification – Artificial, Natural and Phylogenetic system of classification. An outline of Bentham and Hooker system of classification, an overview of APG Classification. Botanical nomenclature–rules, typification and author citation. Herbarium technique–collection, pressing, drying, mounting and preservation of plant specimens, digital herbarium. Botanical Survey of India.

**UNIT - III**

Study of the following families based on the Natural system and their economic importance: Anonaceae, Nymphaeaceae, Capparidaceae, Rutaceae, Caesalpinaceae, Cucurbitaceae, Asteraceae, Apocynaceae and Asclepiadaceae.

**UNIT - IV**

Study of the following families based on the natural system and their economic importance: Convolvulaceae, Acanthaceae, Lamiaceae, Amaranthaceae, Euphorbiaceae, Liliaceae, Orchidaceae and Poaceae.

**UNIT - V**

Source, cultivation method (brief) and the extraction/processing of the economically important products of the following – Cereal (Rice), Pulses (Black gram), Sugar (Sugarcane), Beverage (Coffee), Oil seed (Groundnut), spices (Cardamom), essential oil (Rose), natural rubber and timber plants (Teak) and Fibre (Cotton).

**Recommended Texts:**

1. Lawrence, G.H.M. 1985. An Introduction to Plant Taxonomy, Central Book Depot, Allahabad.
2. Porter, C.L. 1982. Taxonomy of Flowering Plants, Eurasia Publications House, New Delhi
3. Solbrig, O.T. 1970. Principles and Methods of Plant Biosystematics. The MacMillan Co-collier-MacMillan Ltd., London.
4. Solbrig, O.T and Solbrig, D.J. 1979. Population Biology and Evolution, Addison-Weslley Publicating Co. Ind USA.
5. Takhtajan, A.L. 1997. Diversity and Classification of Flowering Plants. Columbia University Press, New York.
6. Woodland, D.W. 1991. Contemporary Plant Systematics. Prentice Hall. New Jersey.
7. Rajni Gupta. 2012. Plant Taxonomy: Past, Present and Future. Vedams (P) Ltd. New Delhi.

**References Books:**

1. Hutchinson, J. 1973. The Families of Flowering plants , Oxford University press, London.
2. Gamble, J.S., Fisher, L.E.F.1967. The Flora of The presidency of Madras (Vol-III) BSI, Calcutta
3. Davis, P.H and Heywood, V.M. 1965. Principles of Angiosperm Taxonomy, Oliver and Boyd Edinburgh.
4. Clive AS.1989. Plant Taxonomy and Biosystematics, Chapman and Hall Inc. New York.
5. Harborne, J.B and Turner, B.L. 1984. Plant Chemosystematics, Acad. Press, London.
6. Lawrence, G.H. 1955. Taxonomy of Vascular Plants, MacMillan Co., USA.

7. Jones, S.B. Jr. and Luchsinger, A.E. 1986. Plant Systematics (2nd edition). McGraw-HilI Book Co., New York.

**Web Resources:**

1. https://books.google.co.in/books/about/Plant_Taxonomy_2E.html?id=_px_WAwHiZIC&redir https://books.google.co.in/books/about/Plant_Taxonomy_and_Biosystematics.html?id=VfQnuwh3bw8C&redir_esc=y_esc=y
2. https://books.google.co.in/books/about/PLANT_TAXONOMY_2E.html?id=Roi0lwSXFnUC&redir_esc=y
3. https://books.google.co.in/books/about/Plant_Taxonomy.html?id=0bYs8F0Mb9gC&redir_esc=y
4. https://books.google.co.in/books/about/Economic_Botany.html?id=2ahsDQAAQBAJ&redir_esc=y
5. https://books.google.co.in/books/about/Textbook_Of_Economic_Botany.html?id=XmZFJO_JHv8C&redir_esc=y

## Course Outcomes (COs)

On successful completion of the course, the students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Define the concepts in plant morphology and rules of IUCN in botanical nomenclature. | K1 |
| CO2 | Classify systems of plant classification and recognize the importance of herbarium and virtual herbarium. | K2 |
| CO3 | Describe the core concepts of economic Botany and relate its applications in human life. | K3 |
| CO4 | Analyze the characters of the families according to the Bentham and Hooker's system of classification. | K4 |
| CO5 | Assess terms and concepts related to Phylogenetic Systematics. | K5 |

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

## Mapping of COs with POs

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 1 | 3 | 2 | 1 | 2 | 2 | 1 | 2 |
| **CO 2** | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 3 | 2 |
| **CO 3** | 2 | 2 | 3 | 3 | 1 | 2 | 1 | 3 | 2 | 1 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 3 |
| **CO 5** | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |

**S-Strong (3)  M-Medium (2)  L-Low(1)**

| Program: B.Sc. Botany | | | | |
|---|---|---|---|---|
| **Core X**<br>**Practical – V** | **Course Code:** 23UBO5P05 | | **Course Title: Plant Morphology, Taxonomy and Economic Botany-Practical-V** | |
| **Semester** | **Hours/Week** | **Total Hours** | **Credits** | **Total Marks** |
| V | 5 | 45 | 3 | 100 |

## COURSE OBJECTIVES

1. To study morphological characters of the families.
2. Able to describe the plant technically using the floral characteristics.
3. To preserve the plants and prepare herbarium sheets.
4. To be able to identify the local flora.
5. To understand the economic importance of the plants.

**EXPERIMENTS**

1. Morphology of root, stem and leaf modification, types of inflorescence.
2. Plants of local flora included under theory syllabus and family identification and derivation based on reasoning.
3. Dissection, identification, observation and sketching the floral parts of the plants belonging to the families included in the syllabus.
4. Students must describe the floral parts, draw the L.S., floral diagram and write the floral formula of at least one flower from each family.
5. Twenty (20) Herbarium sheets, field notebook and bonafide record to be submitted.
6. Study the products of plants mentioned in the syllabus of economic botany with special reference to the morphology, botanical name and family.
7. Field trips to places for observation, study and collection of plants prescribed in the syllabus for 2 to 5 days under the guidance of faculties.

**Recommended Texts:**

1. Subramaniam, N.S. 1996. Laboratory Manual of Plant Taxonomy. Vikas Publishing House Pvt. Ltd., New Delhi.
2. Gokhale, S.B., Kokate, C.K. and Gokhale, A. 2016. Pharmacognosy of Traditional Drugs. Nirali Prakashan, 1st Edition. ISBN: 9351642062.
3. Rendle, A.B. 1980. The Classification of Flowering Plants (Vol. I & II), Vikas Students Education.
4. Pandely, B.P. 1987. Taxonomy of Angiosperms.
5. Nordenstam, B., EI Gazaly, G and Kassas, M. 2000. Plant Systematics for 21st Century. Portlant Press Ltd., London.

**Reference Books:**

1. Mann J. Davidson, R.S and J.B. Hobbs, D.V. Banthorpe, J.B. Harborne. 1994. *Natural Products*. Longman Scientific and Technical Essex.
2. Gopalan, C., B.V. Ramasastri and S.C. Balasubramanian. 1985. Nutritive Value of Indian Foods. National Institute of Nutrition, Hyderabad.
3. Grant, W.E. 1984. Plant Biosystematics. Academic Press, London.
4. Harrison, H.J. 1971. New Concepts in Flowering Plant Taxonomy. Rieman Educational Book Ltd., London.
5. Jones, A.D. and Wilbins, A.D. 1971. Variations and Adaptations in Plant Species. Hiemand & Co. Educational Books Ltd. London.

**Web resources:**

1. https://www.amazon.in/Practical-Taxonomy-Angiosperms-R-Sinha/dp/9380578210
2. https://www.wileyindia.com/plant-science/practical-taxonomy-of-angiosperms-2ed.html
3. https://www.flipkart.com/practical-taxonomy-angiosperms/p/itm194794e7a76e8
4. https://books.google.co.in/books/about/Plant_Taxonomy.html?id=uWg76rCqA68C
5. https://www.amazon.in/PLANT-TAXONOMY-Sharma/dp/0070141592
6. https://www.kopykitab.com/Economic-Botany-By-Manoj-Kumar-Sharma-eBook.

***Bonafide record of practical work done should be submitted for the practical examination.**

**Course Outcomes (COs)**

On successful completion of the course, the students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Recognize the distinguishing plant morphological characters. | K1 |
| CO2 | Identify locally available plants to their respective families. | K2 |
| CO3 | Develop comprehensive skills in field identification, collection of specimens, writing technical description, botanical drawings and herbaria preparation. | K3 |
| CO4 | Construct floral diagram and write floral formula for a given flower. | K4 |
| CO5 | Validate the plant specimen by analyzing and dissecting the vegetative and floral characters. | K5 |

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

**Mapping of COs with POs**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 1 | 3 | 2 | 1 | 2 | 2 | 1 | 3 |
| **CO 2** | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 2 | 2 |
| **CO 3** | 2 | 2 | 3 | 3 | 1 | 2 | 1 | 2 | 3 | 3 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| **CO 5** | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 2 | 3 |

**S-Strong (3)** **M-Medium (2)** **L-Low (1)**

| Program: B.Sc. Botany | | | | |
|---|---|---|---|---|
| **Core – XI** | **Course Code:** 24UBO5C06 | | **Course Title:** PLANT ANATOMY AND EMBRYOLOGY | |
| **Semester** | **Hours/Week** | **Total Hours** | **Credits** | **Total Marks** |
| V | 5 | 75 | 4 | 100 |

## Course Objectives

1. To know fundamental concepts of plant anatomy and embryology.
2. To understand the internal tissue organization of various plant organs.
3. To differentiate normal and abnormal secondary growth.
4. To comprehend the structural organization of flower with relevance to the process of pollination and fertilization.
5. To know embryology of plants.

## SYLLABUS

**UNIT - I**

Cell wall - structure and function. Tissues - types - Simple tissue system - parenchyma, collenchyma and sclerenchyma (fibers and sclereids). Complex tissue system - xylem and phloem. Meristem - structure function and classification. Apical organization and theories: Apical cell theory, Histogen theory and Tunica-Corpus theory. Root apex: Histogen theory and Korper-Kappe theory.

**UNIT - II**

Primary structure of root and stem (Dicot and monocot). Epidermal tissue system: epidermis, cuticle, trichome, bulliform cells, periderm and silica cells. Ground tissue systems: cortex, endodermis, pericycle, pith and pith rays. Vascular tissue systems: different types of vascular bundles and their arrangement in root and stem. Nodal anatomy: leaf trace, leaf gap, branch trace and branch gap-types.

**UNIT - III**

Secondary thickening in monocots and dicots root, Secondary thickening in monocot and dicot stem. Anomalous secondary growth of stem- *Boerhaavia*, *Nyctanthes* and *Dracaena*. Leaf - anatomy of dicot and monocot leaf. Periderm structure and development: Phellem, Phellogen, Phelloderm, Rhytidome and lenticels. Stomatal types.

**UNIT - IV**

Structure and development of anther - development of male gametophyte. Ovule: Structure of mature ovule**,** types of ovules; female gametophyte– megasporogenesis (monosporic, bisporic and tetrasporic) and megagametogenesis (*Polygonum* type); Organization and ultra structure of mature embryo sac.

**UNIT - V**

Double fertilization and triple fusion. Endosperm and its types - free nuclear, cellular, helobial, endosperm haustoria. Polyembryony - types, apomixis, parthenogenesis and parthenocarpy. Seed structure and its importance.

**Recommended Texts:**

1. Bhojwani, S.S and Bhatnagar, S.P. 1994. Embryology of Angiosperms, Vikas.
2. Bhojwani, S.S and Bhatnagar, S.P. 2000. The Embryology of Angiosperms (4th revised and enlarged edition). Vikas Publishing House, New Delhi.
3. Burgess, J. 1985. An Introduction to Plant Cell Development. Cambridge University Press, Cambridge.
4. Raghavan, V. 1999. Developmental Biology of Flowering Plants. Springer-Verlag, New York.
5. Vimla Singh and Alok Abhishek. 2019. Plant Embryology and Experimental Biology. Educational Publishers and Distributors. New Delhi.
6. Pandey, B.P.2015. Plant Anatomy S. Chand Publ. New Delhi.
7. Bhatnagar,S.P., Dantu, P.K, Bhojwani, S.S. 2014. The Embryology of Angiosperms 6th edition Vikas Publishing House. Delhi.
8. Waisel, Y., Eshel, A and Kafkaki, U. (eds.). 1996. Plant Roots : The Hidden Hall (2nd edition). Marcel Dekker, New York.

**References Books:**

1. Esau, K. 1985. Anatomy of Seed Plants –John Willey.
2. Cutter, E.G. 1989. Plant Anatomy – Part I – Addison – Wesley Publishing Co..
3. Maheswari, P.1991. An Introduction to Embryology of Angiosperms, Tata McGraw Hill Publishing Co. Ltd.,
4. Swamy, B.G.L and Krishnamoorthy. K.V.1990. From Flower to Fruits, Tata McGraw Hill Publishing Co. Ltd.
5. Dickison, W.C. 2000. Integrative Plant Anatomy. Harcourt Academic Press, USA.
6. Fahn, A. 1974. Plant Anatomy. Pergmon Press, USA.
7. Mauseth, J.D. 1988. Plant Anatomy. The Benjammin/Cummings Publisher, USA.

8. Evert, R.F. 2006. Esau's Plant Anatomy: Meristems, Cells, and Tissues of the Plant Body: Their Structure, Function and Development. John Wiley and Sons, Inc. Any local/state/regional flora published by BSI or any other agency.
9. Swamy, B.G.L and Krishnamurthy,K.V.1980. From flower to fruit .Tata McGraw Hill Co. Pvt. Ltd, New Delhi

**Web Resources:**

1. https://www.amazon.in/plant-anatomy-embryology-biotechnology-ebook/dp/b07h5jyfbj/ref=asc_df_b07h5jyfbj/?tag=googleshopdes-2
2. https://www.kobo.com/us/en/ebook/a-textbook-of-plant-anatomy
3. https://archive.org/experiments/plantanatomy031773mbp
4. https://www.amazon.in/embryology-angiosperms-6th-s-p-bhatnagar-ebook/dp/b00un5kpqg
5. https://www.worldcat.org/title/embryology-of-angiosperms/oclc/742342811
6. https://books.google.co.in/books/about/embryology_of_angiosperms.html?id=uyfwaaaamaaj&redir_esc=y.

## Course Outcomes (COs)

On successful completion of the course, the students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Relate to the fundamental concepts of plant anatomy and embryology. | K1 |
| CO2 | Describe the internal tissue organization of various plant organs. | K2 |
| CO3 | Elucidate the stages of normal and abnormal secondary growth. | K3 |
| CO4 | Compare the structural organization of flower in relation to the process of pollination and fertilization. | K4 |
| CO5 | 1. Access<br>the various anatomical adaptations in plants. | K5 |

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

## Mapping of COs with POs

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 1 | 3 | 2 | 1 | 2 | 2 | 2 | 1 |
| **CO 2** | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 3 | 3 |
| **CO 3** | 2 | 2 | 3 | 3 | 1 | 2 | 1 | 3 | 1 | 2 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 2 |
| **CO 5** | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 2 | 3 |

**S-Strong (3)** **M-Medium (2)** **L-Low (1)**

| Program: B.Sc. Botany | | | | |
|---|---|---|---|---|
| **Core – XII** | **Course Code:** 23UBO5C07 | | **Course Title:** CELL BIOLOGY, GENETICS AND PLANT BREEDING | |
| **Semester** | **Hours/Week** | **Total Hours** | **Credits** | **Total Marks** |
| V | 5 | 75 | 4 | 100 |

## Course Objectives

1. To enable students to gain insights into cell wall organization and its functions.
2. To familiarize with various cell organelles and their functions.
3. To gain knowledge in classical genetics.
4. To know about sex linked inheritance.
5. To have knowledge about plant breeding techniques for crop improvement.

## SYLLABUS

**UNIT - I**

Introduction- scope- cell organisation- Ultra structure of Prokaryotic cell and Eukaryotic cell. Plant cell structure and function. Cell inclusion, Cell cycle, Cell division, Mitosis and Meiosis- their significance. Cell boundaries - cell wall- gross layer i.e. middle lamella, primary wall, secondary wall- Structure, chemistry and functions of cell wall, pits- (simple and bordered), Plasmodesmata. Plasma membrane- occurrence, structure (fluid mosaic model) chemistry, function and origin. Properties of Cytoplasm Membrane transport – Passive, active and facilitated transport, endocytosis and exocytosis.

**UNIT - II**

Occurrence, structure, function and origin of Endoplasmic reticulum, Golgi apparatus, Lysosomes, Ribosomes, Mitochondria, Chloroplast and Micro bodies. Semi genetic autonomy of Mitochondria and Chloroplast. Ultrastructure and functions of Nucleus, nuclear envelope, nuclear pore complex, nucleolus, chromosomes structure molecular organization of chromatin, Euchromatin, heterochromatin, Polytene and Lampbrush chromosomes, Centromere - types.

**UNIT - III**

Mendelian genetics – monohybrid, dihybrid crosses. Laws of Mendel, Reciprocal cross - Back cross and Test cross. Incomplete dominance - *Mirabilis jalaba.* Interaction of factors – Complementary genes, Supplementary genes, inhibitory genes, epistasis (dominant and recessive), duplicate genes and multiple alleles. ABO Blood grouping in Human. Chromosome theory of linkage, crossing over, recombinations and mapping of genes on chromosomes. Sex

determination in plants.

**UNIT - IV**

Sex linked inheritance – Haemophilia and colour blindness. Polyploidy origin, types and significance. Mutation-types and significance. chromosomal aberration – addition, deletion, inversion, duplication and translocation. Extra nuclear inheritance and its significance - Male sterility in corn, Maternal inheritance – Plastid Inheritance in *Mirabilis jalaba*. Genetics of *Neurospora*. Population genetics – Hardy – Weinberg principle.

**UNIT - V**

Principles involved in plant breeding. Plant introduction and acclimatization. Methods of crop improvement: selection (mass, pure line and clonal), hybridization techniques. Heterosis – Interspecific and intergeneric, causes and effects. Mutation in plant breeding (Physical and chemical method), polyploidy in plant breeding and its applications. Breeding for crop improvement for paddy and sugarcane. Biotechnology in crop improvement: Transgenics – scope and limitations; Bt-Cotton.

**Recommended Texts:**

1. Verma, P.S and V.K. Agarwal. 2002. Cytology. S. Chand & Co. Ltd., New Delhi-55.
2. Sinnott, EW., Dunn, L.L and Dobzhansky, T. 1997. Principles of Genetics, Tata Mc Graw Hill Publishing Co. New Delhi.
3. Cohn.N.S.1979, Elements of Cytology, Freeman Book Co.
4. Singh, R. J. 2016. Plant Cytogenetics, 3rd Edition. CRC Press, Boca Raton, Florida, USA.
5. Singh, R.J. 2017. Practical Mannual on Plant Cytogenetics. CRC Press, Boca Raton, Florida, USA.

**References Books:**

1. De Robertis and De Robertis. 1990. Cell and Molecular Biology, Saunders College, Philadelphia, USA.
2. Gardner, E.J., Simmons, M.J and Snustad, D. 1991. Principles of Genetics, John Wiley Sons Inc., 8th Edn., New York.
3. Hackett, P.B., Fuchs, J.A and Messing, J.W. 1988. An Introduction to Recombinant. DNA Techniques: Basic Experiments in Gene Manipulation. The Benjamin/Cummings Publishing Co. Inc., Menlo Park, California.
4. Cooper, G.M and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C. Sinauer Associates, MA.
5. Becker, W.M., Kleinsmith, L.J., Hardin. J and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.
6. Klug, W.S., Cummings, M.R., Spencer, C.A. 2009. Concepts of Genetics. 9th edition. Benjamin Cummings, U.S.A.
7. Lewin. 2007. Gene IX. Jones and Barlett Pub. ISBN. O 7637 52223.

8. Strickberger, M.W. 1999.Genetics.Prentice Hall of India Pvt Ltd, New Delhi.

**Web Resources:**

1. http://www.freebookcentre.net/Biology/Cell-Biology-Books.html
2. https://www.us.elsevierhealth.com/medicine/cell-biology
3. https://www.amazon.in/Cell-Biology-Thomas-D-Pollard-ebook/dp/B01M7YAL2A
4. http://www.freebookcentre.net/medical_text_books_journals/genetics_ebooks_online_texts_download.html
5. https://www.us.elsevierhealth.com/medicine/genetics
6. https://libguides.uthsc.edu/genetics/ebooks
7. https://www.kobo.com/us/en/ebook/principles-of-plant-genetics-and-breeding
8. http://sharebooks.com/content/plant-breeding-ebooks-raoul-robinson

## Course Outcomes (COs)

On successful completion of the course, the students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Enumerate the structure and functions of cells, cellular structures and organelles. | K1 |
| CO2 | Explain about cell cycle, cell division and laws of inheritance with suitable examples. | K2 |
| CO3 | Elucidate concepts of sex determination and sex linked inheritance. | K3 |
| CO4 | Analyze the importance of genes interactions at population and evolutionary levels. | K4 |
| CO5 | Develop conceptual understanding of plant genetic resources, plant breeding, gene bank and gene pool. | K5 |

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

## Mapping of COs with POs

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 1 | 3 | 2 | 1 | 2 | 2 | 3 | 1 |
| **CO 2** | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 3 | 2 |
| **CO 3** | 3 | 3 | 2 | 3 | 1 | 2 | 1 | 3 | 3 | 2 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| **CO 5** | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 2 |

**Strong (3)  M-Medium (2)  L-Low(1)**

| Program: B.Sc. Botany | | | | |
|---|---|---|---|---|
| **Core XIII**<br>**Practical – VI** | **Course Code:** 23UBO5P06 | | **Course Title: PRACTICAL COVERING – CORE XI AND XII- PRACTICAL-VI** | |
| **Semester** | **Hours/Week** | **Total Hours** | **Credits** | **Total Marks** |
| V | 5 | 45 | 3 | 100 |

## COURSE OBJECTIVES

1. To study the anatomy of the plant organs using various techniques.
2. To study the embryology of the plant.
3. To identify the structure of various cell organelles.
4. To understand genetics through problem solving.
5. To study various plant breeding techniques.

**EXPERIMENTS**

**Anatomy**

1. Study of simple and complex (Primary and Secondary) tissues by maceration.
2. Study the internal structure of primary (young) and secondary (old) stems. Internal structure of dicot and monocot stem. Internal structure of dicot and monocot root.
3. Anomalous secondary growth in the stems of *Boerhaavia, Nycthanthes* and *Dracaena*.
4. T.S of dicot and monocot leaves.
5. Study of stomatal types.

**Embryology**

1. T.S of (young and mature) anther (section from *Datura* or *Cassia* flower).
2. Observation of pollinia (slide only).
3. Types of ovules- Anatropous, Orthotropous, Circinotropous, Amphitropous, Campylotropous (Permanent slides).
4. Types of Endosperm - Nuclear, cellular and helobial.
5. Dissection and display of any two stages of embryo in *Tridax*

**Cell biology**

1. Study of the photomicrographs of cell organelles.
2. Ergastic substances - starch grains, aleurone grains, crystals – cystolith and raphide.
3. Study the polytene and lamp brush chromosome structure through photograph.
4. Identification of different stages of mitosis by using squash and smear techniques – Onion root tip.

**Genetics**

1. Genetic problems – test cross, back cross and allelic interaction.
2. Construction of chromosome map – three point test cross
3. Multiple alleles problems.

**Plant Breeding**

1. Emasculation technique.
2. To test the viability of seeds using Tetrazolium chloride.
3. Genetic models of heterosis.
4. Phenotype of heterosis (Maize).

**Recommended Texts:**

1. Sundara, R. S. 2000. Practical manual of plant anatomy and embryology. Anmol Publ. PVT LTD, New Delhi.
2. Panshin, A.J and C. de Zeeuw.1980.Textbook of wood technology. Structure, identification and uses of the commercial woods of the United States and Canada. Fourth Edition. New York: McGraw-Hill Book Company.
3. Sharma, H.P. 2009. Plant Embryology: Classical and Experimental, Bombay Popular Prakashan, ISBN-8173199698, 9788173199691.
4. Gupta P.K. 2017. Cell and Molecular Biology (5th ed.), Rastogi Publications, Meerut.
5. Krebs J.E., Goldstein E.S and Kilpatrick S.T. 2017. Lewin's GENES XII (12thed.). Jones & Bartlett Learning.
6. Jackson, S.A., Kianian, S.F., Hossain, K.G and Walling, J.G. 2012. Practical laboratory exercises for plant molecular cytogenetics. In Plant Cytogenetics (pp. 323-333). Springer, New York.

**Reference Books:**

1. Sundara Rajan, S, 2003. Practical Manual of Plant Anatomy and Embryology 1st ed, Anmol Publications, ISBN-812610668.
2. Katherine Esau. 2006. Anatomy of Seed Plants. 2nd edition, John Wiley and Sons.
3. Allen, Sarah et al., 2016. Plant Anatomy Lab Manual, Fall.

4. Gardener, J, Simmons, H.J and Snustad, D.P. 2006. Principle of Genetics, John Wiley & Sons, New York.
5. De Robertis E.D.P. and De Robertis E.M.P. 2017. Cell and Molecular Biology (8thed.) (South Asian Edition), Lea and Febiger, Philadelphia, USA.
6. Jackson, S.A., Kianian, S.F., Hossain, K.G., and Walling, J. G. 2012. Practical laboratory exercises for plant molecular cytogenetics. In Plant Cytogenetics (pp. 323-333). Springer, New York, NY.

**Web resources:**

1. https://www.amazon.in/Practical-Anatomy-Adriance-1901-1973-Foster/dp/1341784509
2. https://books.google.co.in/books/about/Practical_Manual_Of_Plant_Anatomy_And_Em.html?id =Cq1KPwAACAAJ&redir_esc=y
3. https://www.amazon.in/Cell-Biology-Dr-Renu-Gupta/dp/8193651219
4. https://www.amazon.in/Practical-Handbook-Genetics-Vikas-Pali/dp/932727248X
5. https://www.amazon.in/Practical-Handbook-Plant-Breeding-Vikas/dp/9327272498

***Bonafide record of practical work done should be submitted for the practical examination.**

**Course Outcomes (COs)**

On successful completion of the course, the students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Identify the structure of cell organelles and stages of cell division. | K1 |
| CO2 | Classify the types of stomata and ovules. | K2 |
| CO3 | Compare the functions of various ergastic substances present in plant tissues. | K3 |
| CO4 | Perform free hand sectioning of plant materials and decipher the internal tissue organization. | K4 |
| CO5 | Interpret the given genetic data to develop genetic map based on the principles of Mendelian inheritance and gene interaction. | K5 |

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

**Mapping of COs with POs**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 1 | 3 | 2 | 1 | 2 | 2 | 1 | 3 |
| **CO 2** | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 2 | 2 |
| **CO 3** | 2 | 2 | 3 | 3 | 1 | 2 | 1 | 3 | 3 | 3 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| **CO 5** | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 2 | 3 |

**S-Strong (3)** **M-Medium (2)** **L-Low (1)**

| Program: B.Sc. Botany | | | | |
|---|---|---|---|---|
| Elective-I | Course Code: 23UBO5E02 | | Course Title: BIO-ANALYTICAL TECHNIQUES | |
| **Semester** | **Hours/Week** | **Total Hours** | **Credits** | **Total Marks** |
| V | 4 | 30 | 3 | 100 |

## COURSE OBJECTIVES

1. To understand the principle, operation and maintenance of various tools/equipment in the laboratory.
2. Perform experiments using the laboratory instruments, formulate experiments for project work and evaluate critically the acquisition of data.
3. To equip students to collect, analyze and evaluate data generated by their own inquiries in a scientific manner.
4. To give an exposure to various forms of field research and data analysis techniques.
5. To provide an overview on modern equipments that they would help students gain confidences to instantly commence research careers and/or start entrepreneurial ventures.

**UNIT – I**

**MICROSCOPY:**

Principles of microscopy; Light microscopy; Compound microscopy, bright field microscope, dark field microscope, phase-contrast microscope, Fluorescence microscopy; Transmission and Scanning electron microscopy. Microscopic measurements - micrometry, Microscopy drawing (Camera Lucida).

**UNIT – II**

**CHROMATOGRAPHIC PRINCIPLES AND APPLICATIONS:**

Principle; Paper chromatography, Thin Layer Chromatography (TLC), Column chromatography, Gas chromatography – Mass spectrometry (GCMS), High Performance Liquid Chromatography (HPLC), LCMS.

**UNIT III**

**ELECTROPHORESIS AND PH METER:**

Basic principle, construction and operation of pH meter. Polyacrylamide gel electrophoresis (PAGE), Agarose Gel Electrophoresis.

**UNIT IV**

**SPECTROPHOTOMETRY AND CENTRIFUGATION TECHNIQUE:**

Principle and law of absorption, construction, operation and uses of colorimeter and UV–Visible spectrophotometer, Principles, methods of centrifugation, types of centrifuge and applications.

**UNIT V**

**BIOSTATISTICS:**

Data collection methods, population, samples, parameters; Representation of Data: Tabular, Graphical– Histogram – frequency curve – Bar diagram–measures of central tendency – Mean, Median and Mode; Standard deviation, Standard error, Chi-square test and goodness of fit –t–test.

**Text Books**

1. Sharma, V.K. 1991. Techniques in microscopy and cell biology, Tata McGraw Hill, New Delhi.
2. Sawhney, S.K and Randhir Singh. 2000. Introductory practical biochemistry, Narosa Publishing House.
3. Asokan, P. 2001. Basics of analytical biochemistry. Chinna Publications.
4. Bajpai, P.K. 2006. Biological instrumentation and methodology. S. Chand & Company, New Delhi.
5. Veerakumari, L. 2009. Bioinstrumentation. MJP Publications.
6. Palanivelu, P. 2013. Analytical Biochemistry and Separation techniques, 20th century publications, Palkalai nagar, Madurai.

**Reference Books**

1.Rana, S.V.S. 2009. Biotechniques: Theory and Practice. Rastogi Publications.
2. Zar, J.H. 2012. Biostatistical Analysis. 4th edition. Pearson Publication. U.S.A.
3. Sundar Rao, P.S.S and Richard, J. 2011. Introduction to Biostatistics and research methods, PHI learning Private Ltd., New Delhi.
4. Johansen, D.A. 1940. Plant Micro technique, TATA McGraw Hill Book Co., Ins., New Delhi.
5. Peter Gray. 1964. Handbook of Basic Micro technique. McGraw hill publication, New York.
6. Cooper, T.G. 1991. The Tools of Bio - chemistry, John Wiley & sons, London.
7. Dey, P.M and Harborne, J.B. 2000. Plant Biochemistry Harcourt Asia Pvt. Ltd.
8. Plummer, D.T. 2003. An introduction to practical Biochemistry. 3rd Edn. Tata McGraw Hill Publishing Company Ltd. New Delhi.
9. Zar, J.H. 1984. Biostatistics Analysis, Prentice Hall International, England Cliffs, New Jersy.

**Web Resources**

1. **https://www.kobo.com/in/en/ebook/bioinstrumentation-1**
2. **https://www.worldcat.org/title/bioinstrumentation/oclc/74848857**
3. **https://www.amazon.in/bioinstrumentation-m-h-fulekar-bhawana-pandey-ebook/dp/b01jp3m9tw**
4. **https://www.amazon.in/handbook-biomedical-instrumentation-r-s-khandpur ebook/dp/b0129zdo9w?ref=kindlecontentin50-21&tag=kindlecontentin50-21&gclid=cjwkcaiax_dwbrafeiwa3vwzykqkwrb_egf73exawpy8d9jnpjzsocxqcq4pzlrztryh2lopavp1xxoclpgqavd_bwe**
5. https://www.kobo.com/us/en/ebooks/biostatistics
6. https://www.amazon.in/biostatistics-veer-bala-rastogi-ebook/dp/b07ldcpxdg

## Course Outcomes (COs)

On successful completion of the course, the students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Relate to the various biological techniques and its importance. | K1 |
| CO2 | Explain the principles of Light microscopy, compound microscopy, Fluorescence microscopy and electron microscopy. | K2 |
| CO3 | Apply suitable strategies in data collections and disseminating research findings. | K3 & K6 |
| CO4 | Compare and contrast the significance of different types of chromatography techniques. | K4 |
| CO5 | Develop methodologies for extraction and analysis of biochemical compounds. | K5 |

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

## Mapping of COs with POs

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 2 | 3 | 2 | 1 | 2 | 2 | 3 | 2 |
| **CO 2** | 3 | 3 | 2 | 2 | 1 | 3 | 2 | 3 | 3 | 3 |
| **CO 3** | 2 | 2 | 3 | 2 | 1 | 2 | 1 | 3 | 2 | 2 |
| **CO 4** | 3 | 2 | 1 | 1 | 3 | 2 | 1 | 3 | 3 | 2 |
| **CO 5** | 3 | 2 | 1 | 3 | 2 | 2 | 3 | 3 | 3 | 2 |

**S-Strong (3)** **M-Medium (2)** **L-Low(1)**

| Program: B.Sc. Botany | | | | |
|---|---|---|---|---|
| Elective-I | Course Code: 23UBO5E02 | | Course Title: AQUATIC BOTANY | |
| **Semester** | **Hours/Week** | **Total Hours** | **Credits** | **Total Marks** |
| V | 4 | 30 | 3 | 100 |

## COURSE OBJECTIVES

1. To give an overview of the distribution of lower plants forms and its ecological significance.
2. To enable students to understand the ecological functions and economic uses of aquatic plants.
3. To equip students to collect, analyze and identify the planktons.
4. To give an exposure to various forms seaweeds.
5. To know about the values and uses of aquatic plants.

**UNIT – I**

**MARINE AND LIMNETIC MACRO ALGAE:**

Common seaweeds of Indian subcontinent: *Ulva, Caulerpa, Sargassum, Gracilaria,* etc. Common terrestrial algae, including cyanobacteria and lichen photobionts of Indian subcontinent and its life cycle, ecology and taxonomy: *Anabaena, Chlorella*, *Scenedesmus.*

**UNIT – II**

**MANGROVES:**

Mangrove forests of India, including Sundarbans, Pichavaram, Kerala mangroves, Rathnagiri mangroves. Common species of mangroves and mangrove associated plants, including *Avicennia, Rhizophora, Acanthus* and *Aegiceras*. Ecological significance of mangroves.

**UNIT III**

**PHYTOPLANKTONS, CYANOBACTERIA, DINOFLAGELLATES AND DIATOMS:**

Common marine microalgae of India, including phytoplanktons and picoplanktons, Common diatoms and dinoflagellates of Indian Ocean, Common limnetic and terrestrial cyanobacteria of India.

**UNIT IV**

**AQUATIC ANGIOSPERMS:**

Common aquatic angiosperms of India, including Lotus, Water Lilly, Water hyacinth. Ecology, life cycle, taxonomy and economic importance of aquatic angiosperms.

**UNIT V**

**VALUES AND USES OF AQUATIC PLANTS:**

Economic importance of aquatic plants, Ecosystem services of aquatic plants, including biogeochemical cycles, oxygen production and carbon sequestration and so on, edible seaweed and algal resources of India, aesthetic, cultural, spiritual importance of aquatic plants.

**Text Books**

1. Lee, R.E. 2008. Phycology. 4th edition. Cambridge University Press, Cambridge.
2. Wile, J.M, Sherwood, L.M and Woolverton, C.J. 2013.. Prescott's Microbiology. 9th Edition. Mc Graw Hill International.
3. Kumar, H.D. 1999. Introductory Phycology. Affiliated East-West Press, Delhi.
4. Hoek, C. Van, D. 1999. An Introduction to Phycology. Cambridge University Press.
5. Daubenmire, R.F.1973. Plant and Environment. John Willey.
6. Sharma, J.P.2004. Environmental Studies, Laxmi Publications (P) Ltd. New Delhi.
7. Bast, F. 2014. Seaweeds: Ancestors of land plants with rich diversity. Resonance, 19(2) 1032-1043 *ISSN*: 0971-8044.

**Reference Books**

1. Kathiresan, K and S.Z. Qasim 2005. Biodiversity of Mangrove Ecosystems. Hindustan Lever Limited.
2. Allan, J.D. and Castillo, M.M. 2009. Stream Ecology (Second Ed.). Springer, Netherlands.
3. Barnes, R.S.K. 1974. Fundamentals of Aquatic Ecosystems, (R.S.K. Barnes & K.H. Mann,eds.), Blackwell Sci. Publ., London, 229 pp.
4. Bennet, G.W. 1971 Management of Lakes and Ponds. von Nostrand Reinhold Co.,NY.375 pp.
5. Goldman, C.R. & A.J. Horne 1983. Limnology.McGraw Hill Internat.Book.Co.Tokyo,464 pp.
6. Boney, A.D., 1975. Phytoplankton. Edward, Arnold, London.

**Web Resources**

1. http://kyry6.gq/73447c/aquatic-botany-published-by-elsevier-science.pdf
2. http://fuls7.gq/82442e/aquatic-botany-published-by-elsevier-science.pdf
3. https://www.springer.com/gp/book/9788132221777
4. http://dwit21.cf/7744a1/aquatic-botany-published-by-elsevier-science.pdf
5. https://www.amazon.in/Aquatic-Plants-iFlora-Plant-Guide-ebook/dp/B07NS9V7LN

## Course Outcomes (COs)

On successful completion of the course, the students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Recognize aquatic plants and their ecological importance. | K1 |
| CO2 | Explain about commonly occurring marine and limnetic algae of the Indian coasts. | K2 |
| CO3 | Apply techniques for conservation of aquatic plants for value addition. | K3 |
| CO4 | Analyze and decipher the significance and properties of mangroves, other aquatic angiosperms and microalgae. | K4 |
| CO5 | Develop new strategies to conserve mangroves and device innovative methods for cultivation of aquatic plants. | K5 & K6 |

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

## Mapping of COs with POs

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 1 | 3 | 2 | 1 | 2 | 2 | 2 | 1 |
| **CO 2** | 3 | 2 | 1 | 1 | 2 | 3 | 2 | 3 | 2 | 3 |
| **CO 3** | 2 | 2 | 3 | 1 | 1 | 2 | 1 | 3 | 1 | 2 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 3 | 2 |
| **CO 5** | 3 | 2 | 1 | 1 | 2 | 3 | 3 | 3 | 2 | 3 |

**S-Strong (3)  M-Medium (2)  L-Low (1)**

| Program: B.Sc. Botany | | | | |
|---|---|---|---|---|
| Elective-I | Course Code: 23UBO5E02 | | Course Title: ENTREPRENEURIAL BOTANY | |
| **Semester** | **Hours/Week** | **Total Hours** | **Credits** | **Total Marks** |
| V | 4 | 75 | 3 | 100 |

## COURSE OBJECTIVES

1. To enable students to develop innovative ideas to exploit the economically useful plant products for commercial purposes.
2. To inculcate entrepreneurial values to start a new business. To enlighten people about bioventure.
3. To comprehend the molecular processes.
4. To expose the students a fundamental of the various value added products.
5. To introduce the entrepreneurial opportunities.

**UNIT – I**

**INTRODUCTION:**

Need - definition and concept - Types and characterization - entrepreneurial values - motivation and barriers - entrepreneurship as innovation, risk assessment and solutions.

**UNIT – II**

**BIOVENTURE:**

Industry - overview of *Spirulina*, *Pleurotus*, Natural dyes, Banana fibers, Wine, Hydroponics, Drumstick and coconut - Straight Vegetable Oil (SVO) and Pure Plant Oil (PPO) - methods and marketing - fresh and dry flowers for aesthetics.

**UNIT III**

**VALUE ADDED PRODUCTS:**

Canning of fruits - process and equipment, fruit and vegetable based products (squash) - ready to serve (RTS) (syrup, pulp, paste, ketchup, soup, vegetable sauces, jam and jellies), Palmyrah Palm products, Perfumes from Rose/Jasmine - Bamboo and cane based products-virgin coconut oil, jasmine oil production, nutraceuticals, standards and quality management.

**UNIT IV**

**ORGANIZATIONS AND AGENCIES:**

TIIC, DIC, NABARD, MICROSTAT, DBT - case study - sarvodaya – SIDCO – Micro Small and Medium Enterprises – support structure for promoting entrepreneurship – various government schemes.

**UNIT V**

**ENTREPRENEURIAL OPPORTUNITIES:**

Understanding a market and assessment, selection of an enterprise, business planning, mobilization of resources, Break Even Analysis, project proposal (guidelines, collection of information and preparation of project report), Intellectual Property Rights - steps in filing patents, trademarks and copyright, export and import license.

**Text Books**

1. Taneja,S.and Gupta,S.L.2015. Entrepreneurship development, New venture creation, Galgeha publication company, New Delhi.ISSN: 2321-8916.
2. Desai,V.,2015. Entrepreneurship development, First edition.Himalaya publication house, Mumbai. ISBN:9789350973837.
3. Khanna,S.S. 2016. Entrepreneurial development.S.Chand company limited, New Delhi.ISBN:9788121918015.
4. Bendre, M. Ashok and Ashok Kumar, A. 2020. Text Book of Practical Botany 1 ( 10th ed).Rastogi Publications, Meerut.
5. Singh, R and U.C. Singh 2020. Modern mushroom cultivation, 3d Edition Agrobios (India), Jodhpur.

**Reference Books**

1. Manohar,D.1989. Entrepreneurship of small scale industries,vol.III.Deepanddeep publication, New Delhi. ISSN: 09735925.
2. Lal,G.,Siddhapa,G.S.andTandon,G.L.,1988.Preservation of fruits and vegetables. Indian Council of Agricultural Research (ICAR). ISSN:0101-2061.
3. Ranganna,S.,2001.Handbook of analysis and quality control of fruits and Vegetable products, Second edition, Tata Mc Graw hill, New Delhi.ISBN: 780074518519.
4. Gupta. P.K.,1998. Elements of Biotechnology. Rastogi publications, Meerut. Edmond Musser and Andres, Fundamentals of Horticulture, McGraw Hill Book Co.New Delhi.

**Web resources**

1. https://store.pothi.com/book/ebook-priya-lokare-botanical-entrepreneurship/
2. https://www.taylorfrancis.com/chapters/mono/10.1201/b14920-15/value-added-products-microalgae-faizal-bux
3. https://www.amazon.in/Microalgae-Biotechnology-Health-Value-Products-ebook/dp/B0845QXPY3
4. https://www.elsevier.com/books/value-addition-in-food-products-and-processing-through-enzyme-technology/kuddus/978-0-323-89929-1
5. https://www.oreilly.com/library/view/selling-today-partnering/9780134477404/xhtml/fileP70010119400000000000000001DEB.xhtm

## Course Outcomes (COs)

On successful completion of the course, the students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Recognize the significance of government agencies for entrepreneurship development. | K1 |
| CO2 | Explain about entrepreneurial values, risk assessment and solutions | K2 |
| CO3 | Make use of entrepreneurial opportunities. | K3 |
| CO4 | Analyze and decipher the significance of bioventure and value added products. | K4 |
| CO5 | Devise innovative methods for making value added products. | K5 & K6 |

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

## Mapping of COs with POs

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 1 | 3 | 2 | 1 | 2 | 2 | 1 | 2 |
| **CO 2** | 3 | 1 | 3 | 2 | 1 | 3 | 1 | 3 | 3 | 1 |
| **CO 3** | 2 | 2 | 3 | 3 | 1 | 1 | 2 | 3 | 1 | 2 |
| **CO 4** | 3 | 3 | 2 | 2 | 3 | 2 | 3 | 3 | 2 | 3 |
| **CO 5** | 3 | 3 | 2 | 3 | 1 | 2 | 3 | 3 | 2 | 3 |

**S-Strong (3)  M-Medium (2)  L-Low(1)**

| Program: B.Sc. Botany | | | | |
|---|---|---|---|---|
| **Core – XIV** | **Course Code:** 23UBO6C08 | | **Course Title:** PLANT ECOLOGY AND PHYTOGEOGRAPHY | |
| **Semester** | **Hours/Week** | **Total Hours** | **Credits** | **Total Marks** |
| VI | 5 | 75 | 4 | 100 |

## Course Objectives

1. To relate to the significance of the biotic and abiotic components of the ecosystems.
2. To understand the energy flow in ecosystem.
3. To conceptualize the biodiversity.
4. To know implication of pollution on the environment.
5. To familiarize with the phytogeography.

## SYLLABUS

### UNIT - I

Biotic and abiotic factors and their influence on vegetation – a brief account of microbes, plants, animals, soil, wind, light, temperature, rainfall, and fire. Autecology and Synecology – Vegetation – Units of Vegetation – Formation, Association, Consociation, Society – development of vegetation. Migration – ecesis, colonization, Methods of study of vegetation (Quadrat and transect). Plant succession – Hydrosere and Xerosere. Ecological classification of plants: Morphological and anatomical features of plants and their correlation to the habitat factors.

### UNIT - II

Structure, trophic organization; food chains and food web, energy flow in an ecosystem. Types of ecosystems: pond, forest and grassland. Ecological pyramids and Biogeochemical cycles of carbon and nitrogen and phosphorus.

### UNIT - III

Biodiversity: Ecosystem/community, species and genetic diversity. Endemism and hotspots, Natural resources and its conservation. Plant Biodiversity and its importance. Definition - levels of biodiversity - genetic, species and ecosystem. Biodiversity hotspots- Criteria, Biodiversity hotspots of India. Loss of biodiversity – causes and conservation (*In situ* and *ex situ* methods).

**UNIT - IV**

**Pollution:** Types of pollution: Primary and secondary and their impacts: Air - Greenhouse effect, global warming, ozone depletion, acid rain, Water, soil-causes and consequences. Remedial measures – Green building. Disaster management.

**UNIT - V**

**Phytogeography Introduction**, continuous and discontinuous distribution, Phytogeography of India, Vegentational regions of India,. Plant indicators. Diversification of land plants. Speciation Changing Earth. Island Biogeography. Seed banks - conservation of genetic resources and their importance. Deforestation and exploitation; Forest conservation, Social forestry and Participatory Management of Forest. Concept of degeneration and regeneration of plants.

**Recommended Texts:**

1. Singh, J.S., Singh, S.P., Gupta, S. 2006. Ecology Environment and Resource Conservation. Anamaya Publications, New Delhi, India.
2. Sharma, P.D. 2010. Ecology and Environment. Rastogi Publications, Meerut, India.8th edition.
3. Krishna Iyer.V.R. 1992. Environmental protection and legal defence. Sterling Publishers Pvt. Ltd.,
4. Shukla, R.S and Chandel,PS.1990. Plant Ecology, S.Chand & Co. Pvt. Ltd.,
5. Krishnamurthy, K.V. 2003. An advanced text book on Biodiversity - Principle and Practice. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
6. Sharma, P.D. 2009. Ecology and Environment, Rastogi Publications.

**References Books:**

1. Odum, E.P. 2005. Fundamentals of ecology. Cengage Learning India Pvt. Ltd., New Delhi. 5th edition.
2. Wilkinson, D.M. 2007. Fundamental Processes in Ecology: An Earth Systems Approach. Oxford University Press. U.S.A.
3. Kumar,H.D. 1990. Modern concepts of Ecology, Vikas Publishing House Pvt. Ltd.,
4. Smith,W.H. 1981. Air pollution and forest : Interactions between air contaminants and forest ecosystems.
5. Vickery, M.L. 1984. Ecology of Tropical plants, John Wiley and Sons.
6. Melchias, G., 2001. Biodiversity and Conservation, Science Publishers Inc. USA.
7. Asthana, D.K and Meera Asthana. 2006. A text book of Environmental studies. S.Chand and Company Ltd. New Delhi.
8. Brian Groombridge. 1992. Global Biodiversity, Chapman and Hall, UK.

9. IUCN. 1985. The World Conservation Strategy, IUCN, Switzerland.
10. Ambasht, R.S. 2017. A textbook of plant ecology 15ed (pb 2019). CBS Publishers Distributors.

**Web Resources:**

1. https://www.kobo.com/us/en/ebook/plant-ecology-3.
2. https://www.worldcat.org/title/plant-ecology/oclc/613206385
3. https://books.google.co.in/books/about/Plant_Ecology.html?
4. https://www.kopykitab.com/Plant-Ecology-by-Agrawal-AK-And-Deo-PP
5. http://www.freebookcentre.net/Biology/Ecology-Books.html
6. https://www.amazon.in/Plant-Ecology-Ernst-Detlef-Schulze/dp/354020833X
7. https://www.tandfonline.com/toc/tped20/current (Plant Ecology and Diversity)
8. https://link.springer.com/journal/11258 (Plant Ecology)

## Course Outcomes (COs)

On successful completion of the course, the students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Relate to the significance of the biotic and abiotic components of the ecosystems and energy flow. | K1 |
| CO2 | Summarize the phytogeographical division of India. | K2 |
| CO3 | Explain the implication of pollution on the environment | K3 |
| CO4 | Analyze the implications of functional and behavioral ecology in natural and man-made areas, biodiversity and conservation. | K4 |
| CO5 | Develop mitigations for the effective conservation of biodiversity and disaster management | K5 |

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

## Mapping of COs with POs

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 1 | 3 | 2 | 1 | 2 | 2 | 2 | 1 |
| **CO 2** | 3 | 3 | 2 | 2 | 3 | 3 | 1 | 3 | 3 | 3 |
| **CO 3** | 2 | 2 | 3 | 3 | 1 | 2 | 1 | 3 | 1 | 2 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 | 1 | 3 | 3 | 3 | 1 |
| **CO 5** | 3 | 3 | 2 | 3 | 1 | 2 | 3 | 1 | 1 | 2 |

**S-Strong (3)  M-Medium (2)  L-Low(1)**

| Program: B.Sc. Botany | | | | |
|---|---|---|---|---|
| **Core – XV** | **Course Code:** 23UBO6C09 | | **Course Title:** PLANT BIOTECHNOLOGY AND MOLECULAR BIOLOGY | |
| **Semester** | **Hours/Week** | **Total Hours** | **Credits** | **Total Marks** |
| VI | 5 | 75 | 4 | 100 |

## Course Objectives

1. To know various aspects of biotechnology
2. To know the concept and techniques of plant tissue culture.
3. To familiarize with the gene transfer techniques.
4. To know about DNA replication and repair.
5. To familiarize with gene regulation.

## SYLLABUS

### UNIT - I

Biotechnology – history and scope. Application of plant biotechnology in various fields. Agriculture - Biofertilizers, Biopesticides. Medicine – Antibiotics (Penicillin) Recombinant vaccines, insulin and interferons. Environment – Bioremediation and Biofuel. Industry – ethanol production (yeast), citric acid production (*Aspergillus niger*) and Proteases production (*Bacillus sps*).

### UNIT - II

Plant tissue culture - introduction, scope and importance, concept of totipotency, aseptic techniques in plant tissue culture. Composition and types of media, sterilization, explant preparation and inoculation. Callus induction and micropropogation. Application of plant tissue culture in agriculture, horticulture and forestry. Synthetic seed technology.

### UNIT - III

Vectors; plasmid, bacteriophage, viral vectors, cosmids. Restriction enzymes. Recombinant DNA technology, gene transfer – indirect method - *Agrobacterium* mediated gene transfer. Direct method – Biolistic method. Development of transgenic plants with reference to insect resistance, Pros and cons of GM food.

**UNIT - IV**

Nature and function of genetic materials, Nucleic acid – base paring – Chargaff's rule, DNA – structure. Types, denaturation - renaturation. Replication of DNA in prokaryotes. RNA structure and types. DNA repair mechanism.

**UNIT - V**

Transcription – Enzymology – RNA polymerase – classes of RNA molecules – transcription in prokaryotes. Protein synthesis – Genetic code – characters – codons and anticodons. Gene regulation in Prokaryotes – *lac* operon and *trp* operon

**Recommended Texts:**

1. Bhajwani, S and Razdan, 1984. Plant tissue culture. Theory and practice.

2. *Verma P.S and Agarwal V.K. 2010. Molecular Biology. S Chand Publishers.*

3. Ignacimuthu, S.J. 2003. Plant Biotechnology. Oxford & IBH Publishing, New Delhi.

4. Bhojwani, S.S and Razdan, M.K. 2004. Plant Tissue Culture, Read Elsevier India Pvt. Ltd.

5. Purohit, S.S. 2010. Plant tissue culture, Student edition, Jodhpur.

6. Bajaj, Y.P.S. 1987. Biotechnology in agriculture and forestry. Springer – Verlag

**References Books:**

1. Bernard R Glick and Jack J Pasternak. 2001. Molecular biotechnology-principles and applications of recombinant DNA, (2nd Edition), ASM Press, Washington, D.C.

2. Jogdand, SN. 1997. Gene biotechnology, Himalaya Publishing House, New Delhi.

3. Ernst L. Winnaccker. 2002. From Genes to Clones-introduction to gene technology, VCR Pub., Weintein.

4. James, D Watson et al., 1992. Recombinant DNA (2nd Edition), WH Freeman and Co., New York.

5. Maniatis and Sambrook. 2003. Molecular Cloning- A lab manual Vol.I, II & III, Coldspring Harbor Laboratory Press, New York.

6. Old, RW and Primrose, SB. 2001. Principles of Gene Manipulation-an introduction to genetic engineering, Black Well Science Ltd., New York.

7. Halder, T and Gadgil, V.N.1981. Plant cell culture in crop improvement. Plenum, New York.

8. Neuman, K.H., Barz, W and E. Reinhard. 1985. Primary and secondary metabolism of plant cell cultures – Springer – Verlag, Berlin.

9. Barz, W., Reinhard, E and Zenk, M.H. 1977. Plant tissue culture and its biotechnology application – Springer – Verlag, Berlin.

10. Hu, C.Y and P.J.Wang. 1984. Handbook of plant cell culture Vol.1. Mac million, New York.
11. Hammond, J.C. McGarvey and V. Yusibov. 2009. Plant Biotechnology, Springer Verlag. New York.

**Web Resources:**

1. **http://www.freebookcentre.net/Biology/BioTechnology-Books.html**
2. **https://books.google.co.in/books/about/Introduction_to_Plant_Biotechnology.html?id=RgQLISN8zT8C**
3. https://www.kobo.com/us/en/ebook/plant-biotechnology-1
4. **https://www.kobo.com/us/en/ebook/plant-biotechnology-1**
5. **https://www.worldcat.org/title/molecular-biology/oclc/**1062496183
6. http://www.freebookcentre.net/Biology/Molecular-Biology-Books.html
7. https://www.amazon.in/Molecular-Biology-Multicolour-Verma-Agarwal-ebook/dp/B06XKVVWT3

## Course Outcomes (COs)

On successful completion of the course, the students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Recognize the fundamentals concepts of plant biotechnology and genetic engineering.. | K1 |
| CO2 | Explain various steps in transcription, protein synthesis and protein modification. | K2 |
| CO3 | Elucidate gene cloning and evaluate different methods of gene transfer | K3 |
| CO4 | Analyze the major concerns and applications of transgenic technology. | K4 |
| CO5 | Develop their competency on different types of plant tissue culture. | K5 |

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

## Mapping of COs with POs

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 1 | 3 | 2 | 1 | 2 | 2 | 1 | 3 |
| **CO 2** | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 2 | 2 |
| **CO 3** | 3 | 2 | 3 | 3 | 2 | 1 | 2 | 1 | 3 | 3 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 3 |
| **CO 5** | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 2 | 3 |

**S-Strong (3)  M-Medium (2)  L-Low (1)**

| Program: B.Sc. Botany | | | | |
|---|---|---|---|---|
| **Core – XVI** | **Course Code:** 23UBO6C10 | | **Course Title:** PLANT PHYSIOLOGY AND PLANT BIOCHEMISTRY | |
| **Semester** | **Hours/Week** | **Total Hours** | **Credits** | **Total Marks** |
| VI | 5 | 75 | 4 | 100 |

## Course Objectives

1. To relate to water relation of plants with respect to various physiological phenomenon.
2. To know the pathways of photosynthesis.
3. To familiarize with respiration and nitrogen metabolism.
4. To know about plant growth regulators.
5. To familiarize with plant biochemistry.

## SYLLABUS

**UNIT - I**

**WATER RELATIONS:**

Properties of water—imbibition, diffusion, osmosis and plasmolysis- ascent of sap, mechanism of water absorption – active and passive, apoplast and symplast pathway. Transpiration – types and factors affecting transpiration and significance. Opening and closing of stomata- mechanisms and theories of transpiration.

**UNIT - II**

**PHOTOSYNTHESIS:**

Radiant energy, Photosynthetic unit, photosynthetic pigments and their role, photo systems, path of carbon in photosynthesis - Light reaction, electron transport system in the chloroplast (Z-Scheme). Dark reaction - C3 cycle, C4 cycle, CAM pathway, Photorespiration

**UNIT - III**

**RESPIRATION**

Aerobic, Glycolysis, Krebs Cycle, Electron Transport System, oxidative phosphorylation, respiratory quotient, Anaerobic- fermentation - Respiratory quotient. Nitrogen metabolism - Biological nitrogen fixation, nitrogen cycle.

**UNIT - IV**

**GROWTH:**

Growth – plant growth regulators (auxins, gibberellins, cytokinins, ethylene and abscisic acid) - Practical applications - Photo morphogenesis – photoperiodism – vernalization – dormancy-phytochromes. Stress Physiology - Concepts of plant responses to stresses (water, salt, temperature).

**UNIT - V**

**PLANT BIOCHEMISTRY:**

Classification, properties and biological role of carbohydrates, proteins, lipids and nucleic acids. Enzyme – properties – classification – nomenclature of enzymes – mode of enzyme action – factors influencing enzyme action.

**Recommended Texts:**

1. Noggle and Fritz. 1976. Introductory Plant Physiology, Prentice Hall, New Delhi.
2. Pandey, SN and Sinha, BK. 1989. Plant Physiology, Vikas Publishing House Ltd., New Delhi.
3. Robert M. Devlin. 1970. Plant Physiology, East West Press, New Delhi.
4. Westhoff, P. 1998. Molecular Plant Development from Gene to Plant. Oxford University Press, Oxford, UK. Jain, JL. 1979. Fundamentals of Biochemistry, Chand & Co. Ltd., New Delhi.
5. Jain, V.K. 2006. Fundamentals of Plant Physiology, S.Chand and Company Ltd., New Delhi.
6. Conn, E and Stumpf, PK. 1979. Outline of Biochemistry Niley Easdtern Ltd., New Delhi.
7. Metz, E.T. 1960. Elements of Biochemistry. V.F & S (P) Ltd., Bombay.
8. Verma,V. 2008. Textbook of plant Physiology, Ane's student edition, New Delhi.

**References Books:**

1. Buchanan, B.B., Gruissem, W and Jones, R.L. 2000. Biochemistry and Molecular Biology of Plants, American Society of Plant Physiologists, Maryland, USA.
2. Dennis, D.T., Turpin, D.H., Lefebvre, D.D and Layzell, D.B. (Eds) 1997. Plant Metabolism (second edition). Longman Essex, England.
3. Galston, A.W. 1989. Life Processes in Plants. Scientific American Library, Springer-Verlag, New York, USA.

4. Hooykaas, P.J.J., Hall M.A and Libbenga, K.R. (eds). 1999. Biochemistry and Molecular Biology of Plant Hormones, Elsevier, Amsterdam, The Netherlands.
5. Hopkins, W.G. 1995. Introduction to Plant Physiology. John Wiley & Sons, Inc., New York, USA.
6. Moore, T.C. 1989. Biochemistry and Physiology of Plant Hormones (second edition). Springer-Verlag, NewYork, USA.
7. Nobel, P.S. 1999. Physiochemical and Environmental Plant Physiology (second edition), Academic Press, San Diego, USA.
8. Salisbury, F.B and Ross, C.W. 1992. Plant Physiology (4th edition). Wadsworth Publishing Co., California, USA.
9. Singhal, G.S., Renger, G., Sopory, S.K., Irrgang, K.D and Govindjee. 1999. Concepts in Photobiology: Photosynthesis and Photo morphogenesis. Narosa Publishing House, New Delhi.
10. Taiz, L and Zeiger, E. 1998. Plant Physiology (2nd edition). Sinauer Associates, Inc., Publishers, Massachusetts, USA.
12. Thomas, B and Vince-Prue, D. 1997. Photoperiodism in Plants (second edition). Academic Press, San Diego. USA.

**Web Resources:**

1. https://www.kobo.com/us/en/ebook/biochemistry-and-molecular-biology-of-plants
2. https://www.amazon.in/Plant-Biochemistry-Hans-Walter-Heldt-ebook/dp/B004FV4RS6
3. https://www.kobo.com/us/en/ebook/plant-biochemistry
4. https://www.kobo.com/us/en/ebook/a-textbook-of-plant-physiology-1
5. https://www.amazon.in/Advances-Plant-Physiology-P-Trivedi-ebook/dp/B01JP5L0YA
6. https://www.crcpress.com/Plant-Physiology/Stewart-Globig/p/book/9781926692692
7. https://www.amazon.com/Introduction-Plant-Physiology-William-Hopkins-ebook/dp/B006R6I850

## Course Outcomes (COs)

On successful completion of the course, the students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Relate to water relation of plants with respect to various | K1 |

| | | |
|---|---|---|
| | physiological phenomenon.. | |
| CO2 | Explain the process and significance of photosynthesis and respiration. | K2 |
| CO3 | Elucidate properties of nutrients and their deficiency symptoms in plants. | K3 |
| CO4 | Analyze the biological role of plant growth regulators, carbohydrates, proteins, lipids, nucleic acids and enzymes. | K4 |
| CO5 | Decipher the phenomenon of seed dormancy and germination in plants. | K5 |

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

**Mapping of COs with POs**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 1 | 3 | 2 | 1 | 2 | 2 | 2 | 2 |
| **CO 2** | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 2 | 3 |
| **CO 3** | 2 | 2 | 3 | 3 | 1 | 2 | 1 | 3 | 1 | 3 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| **CO 5** | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |

**S-Strong (3)  M-Medium (2)  L-Low (1)**

| Program: B.Sc. Botany | | | | |
|---|---|---|---|---|
| **Core XVII**<br>**Practical – VII** | **Course Code:** 23UBO6C07 | | **Course Title: PRACTICAL COVERING CORE XIV, XV AND XVI - PRACTICAL-VII** | |
| **Semester** | **Hours/Week** | **Total Hours** | **Credits** | **Total Marks** |
| V | 5 | 45 | 3 | 100 |

## COURSE OBJECTIVES

1. To study morphological and anatomical adaptations of plants of various habitats.
2. To demonstrate techniques of plant tissue culture.
3. To familiarize with the structure of DNA, RNA.
4. To carryout experiments related with plant physiology.
5. To perform biochemistry experiments.

**EXPERIMENTS**

**Plant Ecology and Phytogeography**

1. Study of morphological and anatomical adaptations of locally available hydrophytes, xerophytes, mesophytes and halophytes and correlate to their particular habitats.

   Hydrophytes : *Nymphaea, Hydrilla*

   Xerophytes : *Nerium, Casuarina*

   Mesophytes : *Tridax, Vernonia*

   Halophytes : *Avicennia, Rhizophora*

   Epiphytes : *Vanda*

2. Map of the phytogeographical regions of India.
3. Quadrate study and line transect.
4. Plan for a green building.

Field trip to any one scrub jungle or wetland (Guindy National park/Nanmangalam Scrub jungle/Pallikaranai Marsh/Siruthavur Scrub/Vedanthangal Bird Sanctuary/Kelampakkam Marsh/Adyar Poonga).

**Plant Biotechnology - Demonstration**

1. Sterilization techniques in plant tissue culture.
2. MS - Media preparation.

Explant sterilization, Callus induction, Plantlet, hardening.

**Molecular Biology – Photographs**

1. DNA Structure
2. tRNA
3. DNA – Replication
4. DNA – Repair
5. Genetic code

**Plant Physiology and Plant Biochemistry**

1. Determination of water potential by plasmolytic method.
2. Effect of chemicals on membrane permeability.
3. Effect of environmental factors on rate of transpiration by gravimetric method.
4. Separation of plant pigments by paper chromatography.
5. Study the rate of photosynthesis under different light intensities by using Willmott's bubble counter.
6. Study of rate of photosynthesis under different wavelengths (red & blue) of light.
7. Comparison of rate of respiration of different respiratory substrates.
8. Measurement of pH of expressed cell sap and different soils using pH meter.
9. Enzyme activity – catalase.
10. Biochemical test for carbohydrates, proteins and lipids

***Demonstration – Experiments***

1. Study the rate of transpiration by using Ganong's photometer
2. Demonstration of stomatal movement.
3. Induction of roots in leaves by auxins.

**Recommended Texts:**

1. Sharma, P.D. 2017. Ecology and Environment- Rastogi Publication, Meerut.
2. Bhojwani, S.S and Razdan, M.K. 1996. Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
3. Jackson, S.A., Kianian, S.F., Hossain, K.G and Walling, J.G. 2012. Practical laboratory

exercises for plant molecular cytogenetics. In Plant Cytogenetics (pp. 323-333). Springer, New York.

4 Plummer, D. 1988. An introduction to Practical Biochemistry, Tata McGraw–Hill Publishing Company Ltd., New Delhi.

5 Palanivelu, P. 2004. Laboratory Manual for analytical biochemistry and separation techniques, School of Biotechnology, Madurai Kamaraj University, Madurai.

6. Jayaraman.J.1981. Laboratory Manual in Biochemistry. Whiley Eastern Limited,New Delhi.

7. Bendre, A.M. and Ashok Kumar, 2009. A text book of practical Botany. Vol. I & II.Rastogi Publication. Meerut. 9th Edition.

**Reference Books:**

1. Mick Crawley. 1996. Plant Ecology, 2nd Edition Wiley-Blackwell.
2. Gamborg, O.L and G.C. Phillips (eds). 1995. Plant cell, tissue and organ culture. Springer Lab Manual.
3. Glick, B.R and J.E. Thompson. 1993. Methods in Plant Molecular Biology and Biotechnology. CRC Press, Boca Raton, Florida.
4. Bala, M., Gupta, S., Gupta, N.K and Sangha, M.K. 2013. Practicals in plant physiology and biochemistry. Scientific Publishers (India).
5. Wilson, K and J. Walker (Eds). 1994. Principles and Techniques of PracticalBiochemistry (4th Edition) Cambridge University Press, Cambridge.
6. Bendre, A.M and Ashok Kumar. 2009. A text book of practical Botany. Vol. I & II.Rastogi Publication. Meerut. 9th Edition.
7. Manju Bala, Sunita Gupta, Gupta, N.K. 2012. Practicals in Plant Physiology and Biochemistry. Scientific Publisher.

**Web resources:**

1. https://www.amazon.com/Practical-plant-ecology-beginners-communities/dp/B00088FDQK
2. https://www.amazon.in/Practical-Biotechnology-Plant-Tissue-Culture/dp/8121932009
3. https://www.elsevier.com/books/molecular-biology-techniques/carson/978-0-12-815774-9
4. https://www.amazon.in/Practical-Physiology-Biochemistry-Sunita-Sangha/dp/9386102633
5. https://www.amazon.in/Practical-Biochemistry-Muriel-Wheldale-Onslow/dp/1107634318

***Bonafide record of practical work done should be submitted for the practical examination.**

## Course Outcomes (COs)

On successful completion of the course, the students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Relate to the distribution and adaptions of plants pertaining to their habitat | K1 |
| CO2 | Demonstrate skills in green planning and callus culture. | K2 |
| CO3 | Elucidate the basic principles involved in the plant physiology and biochemistry experiments. | K3 |
| CO4 | Appreciate the structure and functions of DNA and RNA. | K4 |
| CO5 | Estimate the biochemical components and determine the factors controlling photosynthesis and transpiration of plants. | K5 |

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

## Mapping of COs with POs

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 1 | 3 | 2 | 1 | 2 | 2 | 3 | 1 |
| **CO 2** | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 3 | 2 |
| **CO 3** | 2 | 2 | 3 | 3 | 1 | 2 | 1 | 2 | 2 | 3 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| **CO 5** | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 2 |

**S-Strong (3)** **M-Medium (2)** **L-Low(1)**

**Program: B.Sc. Botany**

| Elective-II | Course Code: 23UBO6E04 | | Course Title: HORTICULTURE | |
|---|---|---|---|---|
| **Semester** | **Hours/Week** | **Total Hours** | **Credits** | **Total Marks** |
| VI | 4 | 30 | 3 | 100 |

## COURSE OBJECTIVES

1. To gain an understanding of the fundamentals of horticulture and techniques needed to grow and maintain plants.
2. To develop skills in students to work as gardeners, therapists, designers, growers and technical advisors in the food and non-food sectors of horticulture.
3. To know about hydroponic culture.
4. To develop the various horticultural crop protection.
5. To impart the knowledge on market preparation.

**UNIT – I**

Importance and scope of horticulture. Classification of horticultural crops –fruits and vegetables. Essentials of nursery Management - Soil management: Garden soil, Physical and chemical properties of soil, Organic matter, Compost, Cultural practices; Water management: Water quality, Irrigation, Mulching. Nursery structures**:** Protected cultivation (greenhouses), environment controls.

**UNIT – II**

Hydroponic culture-types of container. Use of manures and fertilizers in Horticultural crop production. Principles of organic farming. Environmental factors influencing vegetable and fruit production.

**UNIT III**

Horticultural crop protection; physical control - pruning. Chemical control- pesticides, fungicides. Plant propagation - cutting, layering, budding, grafting. Types of gardens: formal, informal, kitchen and Terrace. Indoor gardening-bottle garden. Floriculture, ornamental gardening.

**UNIT IV**

A brief account of annual, biennials and perennials with reference to ornamental gardens. Green house, terrarium, water garden, rockery plants, bonsai techniques. Landscaping, principles and basic components.

**UNIT V**

Technology of horticultural crops - market preparation: harvesting and handling, packaging and transport, storage; chemical treatment. Economics of cultivation Crops: Cardamom, pepper, clove. Food processing - freezing, bottling and canning, drying and chemical preservation.

**Text Books**

1. Hartmann, H.T and D.E. Kester. 1989. Plant propagation – principles and practices. Half of India. New Delhi.
2. Bose, T.K and Mitra and Sadhu. 1991. Propagation of tropical and subtropical horticultural crops. Naya Prakash.
3. Singh, S.P. 1989. Mist propagation Metropolitan book Co., New Delhi.
4. Chadha, K.L. 1986. Ornamental horticulture in India ICAR, Krishi Bhavan, New Delhi.
5. Bose, T.K and Mukharjee, D. 1977. Gardening in India. Oxford & IBH Pub., Co., Calcutta.
6. Gopalswamy Iyyangar. 1970. Complete gardening in India, Kalyan Printers, Bangalore.
7. Rangaswami, G and Mahadevan, A. 1999. Diseases of Crop Plants in India (4th edition). Prentice Hall of India Pvt. Ltd., New Delhi

**Reference Books**

1.Arditti, A. 1977. Orchid biology, Gornell Univ., Press. Ithaca.

2. Bailey, S. 1971. Perpectual flowering carnation, Fabner and Fabner, London.

3. Laurie, A., Kiplingr, D.D and Nelson, K.S. 1968. Commercial flower forcing. Mc Graw-Hill Book, London.

4. Cumming, R.W. 1964. The chrysanthemum Book. D.Van., Nostrand Inc.

5. Biswas, T.D. 1984. Rose growing – Principles and Practices – Assoc., Pub., Co., New Delhi.

8. Hartman, H.T and Kester, D.E. 1989. Plant propagation. Printice Hall Ltd., New Delhi.
9. Abraham, A and Vatsala, P. 1981. Introduction to Orchids. Trop. Bot. Garden, Trivandrum.

10. Bose, T.K and Yadav, L.P. 1989. Commercial flowers. Naya Prakash, Calcutta.

11. Mc Daniel, G.L. 1982. Ornamental horticulture. Reston Publ., London.

12. Helleyer, A. 1976. The Collingridge Encyclopedia of gardening Chartwell Book, Inc., New Jercy.

**Web Resources**

1.https://www.kopykitab.com/Precision-Horticulture-by-Archarya-SK

2. https://www.ebooks.com/en-us/subjects/science-horticulture-ebooks/423/

3. http://www.agrimoon.com/horticulture-icar-ecourse-pdf-books/

4. https://www.worldcat.org/title/handbook-of-horticulture/oclc/688653648

5. https://cbseportal.com/ebook/vocational-books-horticulture

6. http://www.digitalbookindex.org/_search/search010agriculhortigardena.asp

## Course Outcomes (COs)

On successful completion of the course, the students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Enumerate the concepts in horticulture and nursery management. | K1 |
| CO2 | Demonstrate a working knowledge on biology of soil, compost making, designing and planning of garden, pest, diseases and nutrient management practices. | K2 |
| CO3 | Appraise the importance of floriculture and evaluate the contribution of spices and condiments on economy. | K3 |
| CO4 | Analyze different methods of weed control in horticultural crops. | K4 |
| CO5 | Develop their competency on pre and post-harvest technology in horticultural crops. | K5 & K6 |

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

## Mapping of COs with POs

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 1 | 1 | 2 | 1 | 2 | 2 | 2 | 1 |
| **CO 2** | 3 | 3 | 2 | 1 | 1 | 3 | 1 | 3 | 1 | 3 |
| **CO 3** | 2 | 2 | 3 | 3 | 1 | 2 | 2 | 3 | 1 | 2 |
| **CO 4** | 3 | 3 | 2 | 2 | 3 | 2 | 3 | 1 | 3 | 2 |
| **CO 5** | 3 | 3 | 2 | 3 | 1 | 3 | 2 | 3 | 1 | 3 |

**S-Strong (3)  M-Medium (2)  L-Low( 1)**

| Program: B.Sc. Botany | | | | |
|---|---|---|---|---|
| **Elective-II** | **Course Code: 23UBO6E04** | | **Course Title: NATURAL RESOURCE MANAGEMENT** | |
| **Semester** | **Hours/Week** | **Total Hours** | **Credits** | **Total Marks** |
| VI | 4 | 30 | 3 | 100 |

## COURSE OBJECTIVES

1. To develop an appreciation for the natural resources and their ecological and economic impact.
2. To gain an understanding of various strategies of natural resource management.
3. To understand the concept of different natural resources and their utilization.
4. To create the models of natural resource conservation and maintenance.
5. To study the significance of natural resources pertaining to economy and environment.

**UNIT – I**

Introduction to Natural Resource Bases: Concept of resource, classification of natural resources. Factors influencing resource availability, distribution and uses. Interrelationships among different types of natural resources. Concern on Productivity issues. Ecological, social and economic dimension of resource management.

**UNIT – II**

Forest resources: forest vegetation, status and distribution, major forest types and their characteristics. Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people, forest management. Developing and developed world strategies for forestry. Land resources: Land as a resource. Dry land, land use classification, land degradation, man induced landslides, soil erosion and desertification.

**UNIT III**

Landscape impact analysis, wetland ecology & management. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Water ecology and management. Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies Food resources: World food problems, changes caused by agriculture and over-grazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case-studies. Fish and other

marine resources: Production, status, dependence on fish resource, unsustainable harvesting, issues and challenges for resource supply, new prospects.

**UNIT IV**

Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. Resource Management Paradigms: Resource management the evolution and history of resource management paradigms. Resource conflicts: Resource extraction, access and control system. Approaches in Resource Management: Ecological approach; economic approach; ethnological approach; implications of the approaches; integrated resource management strategies. Poverty and implications in Resource Management in developing countries – Poverty in developing countries, causes and link with resources scarcity and poverty.

**UNIT V**

Management of Common International Resources: Ocean, climate, International fisheries and management commissions; Antarctica: the evolution of an international resource management regime. Case Studies: 1. Resource management in mountain ecosystem 2. Dry-land ecosystem 3. The management of marine and coastal resources 4. Case study of shifting Cultivation 5. Mangrove ecosystem and their management.

**Text Books**

1. Vasudevan, N. 2006. Essentials of Environmental Science. Narosa Publishing House, New Delhi.

2. Singh, J. S., Singh, S.P. and Gupta, S. 2006. Ecology, Environment and Resource Conservation. Anamaya Publications, New Delhi.

3. Rogers, P.P., Jalal, K.F. and Boyd, J.A. 2008. An Introduction to Sustainable Development. Prentice Hall of India Private Limited, New Delhi.

4. United States Government Accountability Office.2008. Natural Resource Management. Nova Science Publishers Inc, 10th Edition

5. Stacy Keach. 2016. Natural Resources Management. Syrawood Publishing House

6. Rathor, V.S. and Rathor B. S. 2013. Management of Natural Resource for Sustainable Development. Daya Publishing House, New Delhi.

**Reference Books**

1. Coastal Ecology & Management, Mann, K.H. 2000. Ecology of Coastal Waters with Implications for Management (2nd Edition).Chap. 2-5, pp.18-78 & Chap. 16, pp.280-303.

2. Global Change and Natural Resource Management, Vitousek, P.M. 1994. Beyond global warming: Ecology and global change. Ecology 75, 1861-1876.

3. Agarwal, K.C., 2001. Environmental Biology, Nidhi Publication Ltd. Bikaner.

4. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publishing House.

5. Heywood, V.H. & Watson, R.T. 1995. Global Biodiversity Assessment. Cambridge Univ. Press.

6. Miller T.G. Jr. Environmental Science, Wadsworth Publishing Co. (TB).

7. Townsend C., Harper J, and Michael Begon. Essentials of Ecology, Blackwell Science.

8. Francois Ramade 1984. Ecology of Natural Resources. John Wiley & Sons Ltd.

9. Odum, E.P. 1971. Fundamentals of Ecology. W.B. Saunders Co. USA, 574p.

**Web resources**

1. https://books.google.co.in/books/about/Natural_Resource_Management.html?id=Tz9iDM https://books.google.co.in/books/about/Natural_Resource_Management.html?id=Tz9iDM 6crLIC&redir_esc=y
2. https://books.google.co.in/books/about/Natural_Resource_Conservation_and_Enviro.html ?id=T2SRuhxpUW8C&redir_esc=y
3. https://www.amazon.in/MANAGING-NATURAL-RESOURCES-FOCUS-WATER-ebook/dp/B00OPTWHOE
4. https://www.kobo.com/us/en/ebooks/natural-resources
5. https://www.igi-global.com/chapter/natural-resources-management/195183 6crLIC&redir_esc=y
6. https://books.google.co.in/books/about/Natural_Resource_Conservation_and_Enviro.html ?id=T2SRuhxpUW8C&redir_esc=y
7. https://www.amazon.in/MANAGING-NATURAL-RESOURCES-FOCUS-WATER-ebook/dp/B00OPTWHOE
8. https://www.kobo.com/us/en/ebooks/natural-resources
9. https://www.igi-global.com/chapter/natural-resources-management/195183

## Course Outcomes (COs)

On successful completion of the course, the students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Relate to significance of natural resources pertaining to economy and environment | K1 |
| CO2 | Understand the concept of different natural resources and their utilization. | K2 |
| CO3 | Evaluate the management strategies of different natural resources. | K3 |
| CO4 | Critically analyze the sustainable utilization land, water, forest and energy resources. | K4 |
| CO5 | Design new models of natural resource conservation and maintenance. | K5 & K6 |

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

## Mapping of COs with POs

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 1 | 2 | 1 | 2 | 1 | 2 | 2 | 2 | 1 |
| **CO 2** | 3 | 1 | 2 | 1 | 3 | 3 | 2 | 3 | 3 | 3 |
| **CO 3** | 2 | 2 | 3 | 3 | 1 | 2 | 1 | 2 | 1 | 2 |
| **CO 4** | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 1 | 3 | 2 |
| **CO 5** | 3 | 3 | 2 | 1 | 1 | 3 | 3 | 3 | 1 | 3 |

**S-Strong (3)  M-Medium (2)  L-Low (1)**

| Program: B.Sc. Botany | | | | |
|---|---|---|---|---|
| **ELECTIVE-II** | **Course Code: 23UBO6E04** | | **Course Title: FORESTRY** | |
| **Semester** | **Hours/Week** | **Total Hours** | **Credits** | **Total Marks** |
| VI | 4 | 90 | 3 | 100 |

## COURSE OBJECTIVES

1. To study the distribution pattern, composition and diversity of forest ecosystem
2. To understand the method of forest management principles and conservation.
3. To enable them to meaningfully contribute in the forest conservation.
4. To raise student awareness of the need to create a sustainable way of living and the current global issues with forestry caused by human interference.
5. To provide a platform to appreciate biodiversity and the importance.

### UNIT – I

### SILVICULTURE:

Forests - definition. Extent of forests in India and other countries. Forest types of India and Tamil Nadu - revised classification - pure and mixed stands - even and uneven aged stands. Role of forests. Factors of locality - climatic - edaphic - topographic - biotic - interaction of forest with the environment. Silviculture - objectives - scope - general principles. Regeneration - natural and artificial. Nursery techniques - containerized seedling production - techniques and methods. Vegetative and clonal propagation techniques and methods - macro and micro propagation techniques.

### UNIT – II

### FOREST MENSURATION AND MANAGEMENT:

Forest Mensuration - Definition and objectives. Measurement of diameter, girth, height, crown and volume of trees - methods and principles - tree stem form - form factor. Volume estimation of stand - age - basal area determinations Stem and Stump Analysis. Forest inventory - sampling techniques and methods - measurement of crops - sample plots. Yield calculation - CAI and MAI - volume, yield and stand tables preparation.

**UNIT III**

**FOREST UTILIZATION AND WOOD TECHNOLOGY:**

Logging - extraction of timber - felling rules and methods - conversion methods - conversion season. Implements used - cross cutting system - sawing - different types - extraction methods. Grading of timbers. Transportation of timbers - major and minor transportation methods Storage and sales of logs - sales depot - management of depots. Recent trends in logging - Ergonomics and RIL. Forest products - Timber - timber, fuel, pulp, paper, rayon and match. Wood Composites - plywood, particle board, fiber boards, MDF, hardboard, insulation boards - production technology. Non timber forest products (NTFP) - collection - processing and storage of NTFP - fibres and flosses - bamboos and canes - katha and bidi leaves - essential oils and oil seeds - gums and resins - tans and dyes - drugs - insecticides - lac and shellac - tassar silk - role of tribal co-operative societies.

**UNIT IV**

**FOREST BIOLOGY AND BOTANY:**

Forest ecology - definition - biotic and abiotic components - forest ecosystem - forest community - concepts - succession - primary productivity - nutrient cycling. Composition of forest types in India - classification of India's forests - species composition - association and diversity. Restoration ecology - global warming - green house effects - ozone layer depletion - acid rain - role of trees in environmental conservation. Biodiversity - Definition, origin, types - factors endangering biodiversity - biodiversity hotspots - endemism - Red Data Book. Biodiversity assessments - principles and methods.

**UNIT V**

**FOREST BOTANY:**

Importance of botany - taxonomic classification of plant species - identification of species - composition and association. Dendrology - principles and establishment of herbaria and arboreta. Tree Improvement - Forest Genetics and Tree Breeding - Definition and concepts - Steps in tree improvement - Variation and selection - Progeny Evaluation Test (PET) - Candidate Tree, Plus Tree, Elite trees - use of provenances and seed sources - heritability and genetic gains - hybrids in tree improvement - heterosis exploitation. Seed production Area and seed orchards - types and establishment. In situ and ex situ gene conservation. Exotics - role of exotic forest trees in India - application of biotechnological methods in forestry.

**AGRO FORESTRY AND SOCIAL FORESTRY:**

Agro forestry - definition, concept and objectives. Classification of agro forestry systems - primary systems and subsystems - inheritance effects. Tree-crop interactions - above and below ground - competition for space, water, light and nutrients. Microclimatic modifications - nutrient cycling and soil fertility improvement - Allelopathy and allelochemicals. - Ecological aspects of

agro forestry - benefits and limitations of agro forestry. Agro forestry practices for different agro-climatic zones of Tamil Nadu. Agro forestry practices for wasteland reclamation. Social forestry - objectives and scope and necessity - its components and implementation in local and national levels - social attitudes and community participation. JFM - principles, objectives and methodology - choice of species for agro forestry and social forestry. Urban Forestry - definition and scope - benefits - choice of tree species - planting techniques and management.

**Text Books**

1. Manikandan, K and S. Prabhu. 2013. Indian forestry, a breakthrough approach to forest service. Jain Bros.
2. Roger Sands. 2013. Forestry in a global context, CAB international.
3. Balakathiresan. S.1986. Essentials of Forest Management. Natraj Publishers, Dehradun.
4. Agarwala, V.P. 1990. Forests in India, Environmental and Protection Frontiers. Oxford & IBH Publishing Co. New Delhi.
5. Chundawat, B.S. and Gautham, S.K. 1996. Text book of Agro forestry. Oxford and IBH publisher, New Delhi.
6. Singhi, G.B. 1987. Forest Ecology of India, Publisher: Rawat.
7. Ramprakash. 1986. Forest management. IBD Publishers, Debra Dun.
8. Tiwari, K.M. 1983. Social forestry in India. Nataraj Publishers, Dehra Dun.
9. Mehta, T. 1981. A handbook of forest utilization. Periodical Expert Book Agency, New Delhi.
10. Nair, N.C and Henry, A.N. 1983. Flora of Tamilnadu, India. Series: 1, Analysis, Vol.1. BSI, Coimbatore, India.

**Reference Books**

1. Donald L. Grebner.Jacek P. Siry and Pete Bettinger. 2012. Introduction to forestry and Natural resources Academic press
2. West, P.W. 2015. Tree and forest measurement, Springer international publishing Switzerland.
3. Kollmann, F.F.P and Cote, W.A. 1988. Wood science and Technology. Vol. I & II Springer Verlag, New York.
4. Agarwala, V.P. 1990. Forests in India, Environmental and Protection Frontiers. Oxford IBH Publishing Co., New Delhi.
5. Belcher, B.M. 1998. A production-to-consumption systems approach: Lessons from the bamboo and rattan sectors in Asia. In: Wollenberg, E and A. Ingles (Eds.). Incomes from the forest: methods for the development and conservation of forest products for local communities. Center for International Forestry Research (CIFOR), Bogor, Indonesia.
6. Chomitz, K.M., with P. Buys, G. De Luca, T.S. Thomas, and S. WertzKanounnikoff. 2007. Incentives and constraints shape forest outcomes. In: At loggerheads? Agricultural

expansion, poverty reduction and environment in tropical forests. The World Bank, Washington, DC.

7. Rao, K.R. and Juneja, K.B.S. 1992. Field identification of 50 important timbers of India. ICFRE Publi. Dehradun 123 p.

**Web resources**

1. http://wwwwds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2006/10/19/000112742_2006 1019150049/Rendered/PDF/367890Loggerheads0Report.pdf.
2. https://www.britannica.com/science/forestry
3. https://en.wikipedia.org/wiki/Forestry.
4. https://www.biologydiscussion.com/forest/essay-forest-importance.major products-and-its-conservation/25119
5. https://academic.oop.com
6. https://www.cbd.int>development>doc.
7. https://www.sciencedirect.com/topics/agriculture-and-biological-science-forest-product.

**Course Outcomes (COs)**

On successful completion of the course, the students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Relate to the basic concepts related to forest distribution, degradation, protection, management and resource utilization. | K1 |
| CO2 | Understand complex interactions of humans and forest ecosystems in a global context. | K2 |
| CO3 | Demonstrate skills for ecological measurements and interpretation of forest ecology management. | K3 |
| CO4 | Examine and decipher the factors influencing forest vegetation, forest degradation and methods of wood preservation | K4 |
| CO5 | Develop new strategies and apply the knowledge gained for problem-solving analysis in the conservation and management of forest ecosystems. | K5 & K6 |

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

## Mapping of COs with POs

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 2 |
| **CO 2** | 3 | 3 | 3 | 3 | 2 | 3 | 1 | 1 | 3 | 1 |
| **CO 3** | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO 4** | 3 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 |
| **CO 5** | 3 | 2 | 1 | 3 | 1 | 1 | 2 | 3 | 1 | 2 |

**S-Strong (3)  M-Medium (2)  L-Low (1)**

| Program: B.Sc. Botany | | | | |
|---|---|---|---|---|
| **ELECTIVE-III** | **Course Code: 23UBO6E05** | | **Course Title: BIONANOTECHNOLOGY** | |
| **Semester** | **Hours/Week** | **Total Hours** | **Credits** | **Total Marks** |
| VI | 4 | 90 | 3 | 100 |

## COURSE OBJECTIVES

1. To provide students with comprehensive knowledge of basics in nanotechnology.
2. To enable the students understand and appreciate the various applications of nanoparticles.
3. To give perspective to researchers and students who are interested in nanoscale physical and biological systems and their applications in medicine.
4. To introduce the concepts in nanomaterials and their use with biocomponents to synthesize and interact with larger systems.
5. To impart knowledge on the most recent molecular diagnostic and therapeutic tools used to treat various diseases.

**UNIT – I**

**INTRODUCTION TO NANOTECHNOLOGY:**

History, Concepts, Prospects and Challenges. Scope of nanotechnology in Indian and global perspectives. Definition - Nanoscience, Nanotechnology. Classification based on the dimensionality- basic understanding of 1D, 2D and 3D nanostructures. Overview of nanoparticles, nanoclusters - nanotubes, nanowires and nanodots. Biotemplates – DNA to build nanocubes and hinges – smart glue, DNA as wire template.

**UNIT – II**

**SYNTHESIS OF NANOPARTICLES:**

Synthesis of nanoparticles - Top down and bottom up approach. Methods of synthesis: Physical, Chemical reduction – reducing agents, capping agents, stabilizing of nanoparticles and Biological – Novel synthetic methods using plant extracts, bacteria and fungi.

**UNIT III**

**FOREST UTILIZATION AND WOOD TECHNOLOGY:**

**PROPERTIES & CHARACTERIZATION OF NANOPARTICLES:**

Nano size effects - optical, electrical, mechanical, magnetic and catalytic activity. Characterization of nanoparticles using UV-Visible spectroscopy, SEM, TEM, Atomic force microscopy, Scanning tunnel microscopy, NMR, X-ray Crystallography and Photoluminescence.

**UNIT IV**

**NANOCARRIERS:**

Introduction. Nanocarriers for drug delivery (DDS) – Polimeric nanotubes and solid lipid nanoparticles (SLN) as carriers, controlled release, site specific targeting. Magnetic nanoparticles as drug carriers and its applications.

**UNIT V**

**APPLICATIONS OF NANOPARTICLES:**

Textiles, Food industry - nutraceutical, Medicine - antimicrobial activity, wound healing and dressing; Environment – green manufacturing. Agriculture - nanofertilizers and nanopesticides. Smart biosensors – Components and its application.

**Text Books**

1. Charles, P. Poole, Jr. & Frank J. Owens. 2003. Introduction to Nanotechnology, A

John Wiley & Sons, INC., Publication.

2. George, K. Knopf & Amarjeet S. Bassi. 2006. Smart Biosensors. CRC Press.
3. Pradeep, T. 2007. Nano: The Essentials, Understanding Nanoscience and
4. Sulabha, K. Kulkarni. 2007. Nanotechnology: Principles and Practices. Capital
5. Christof, M. Niemayer, Chad A. Mirkin. 2004. Nanobiotechnology: Concepts, applications and perspectives, Wiley VCH publishers.
6. Jain, K.K. 2001. Nanobiotechnology: Molecular Diagnosis, Taylor Francis Group.
7. Sharma P.K. 2008. Understanding Nanotechnology. Vista International Publishing House, Delhi.
8. Viswanathan B. 2009. Nano Materials. Narosa Publishing House, New Delhi.

**Reference Books**

1. Claudio Nicolini. 2009. Nanotechnology Nanosciences, Pon Stanford Pub.Pvt.Ltd,
2. Robert, A and Ferias, Jr. 1999. Nanomedicine, Volume I: Basic capabilities, Landes Bioscience.
3. Barbara Panessa-Warren. 2006 Understanding cell-nanoparticle interactions making nanoparticles more biocompatible. Brookhaven National Laboratory.

4. European Commission, SCENIHR. 2006. Potential risks associated with engineered and adventitious products of nanotechnologies, European Union.
5. Gysell Mortimer, 2011. The interaction of synthetic nanoparticles with biological systems PhD Thesis, School of Biomedical Sciences, Univ.of Queensland.
6. Murty, B.S., Shankar, P., Raj, B., Rath, B.B., Murday, J. 2013. Textbook of Nanoscience and Nanotechnology. Spirnger Publication.
7. Prashant Kesharwani. 2019. Nanotechnology-Based Targeted Drug Delivery Systems for Lung Cancer. Academic Press. An imprint of Elsevier.

**Web resources**

1. https://onlinelibrary.wiley.com/doi/book/10.1002/3527602453
2. https://www.elsevier.com/books/nanobiotechnology/ghosh/978-0-12-822878-4
3. https://www.routledge.com/Nanobiotechnology-Concepts-and-Applications-in-Health-Agriculture-and/Tomar-Jyoti-Kaushik/p/book/9781774635179
4. https://www.nanowerk.com/nanotechnology/periodicals/ebook_a.php
5. https://phys.org/news/2014-10-endless-possibilities-bio-nanotechnology.html
6. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC419715/
7. https://phys.org/news/2014-10-endless-possibilities-bio-nanotechnology.html
8. http://www.particle-works.com/applications/controlled-drug-release/Applications

## Course Outcomes (COs)

On successful completion of the course, the students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Relate to the essential features of biology and nanotechnology that are converging to create the new area of bionanotechnology | K1 |
| CO2 | Explain the synthesis of nanomaterials and their applications. | K2 |
| CO3 | Apply the knowledge gained to develop nanomaterials | K3 |
| CO4 | Compare the advantages and disadvantages of nanoparticles in health, medicine and environment. | K4 |
| CO5 | Construct various types of nanomaterial for application and evaluate the impact on environment. | K5 & K6 |

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

## Mapping of COs with POs

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO 2** | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 1 |
| **CO 3** | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 2 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO 5** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

**S-Strong (3)** **M-Medium (2)** **L-Low (1)**

| Program: B.Sc. Botany | | | | |
|---|---|---|---|---|
| Elective-III | Course Code: 23UBO6E05 | | Course Title: COMPUTER APPLICATIONS IN BOTANY | |
| **Semester** | **Hours/Week** | **Total Hours** | **Credits** | **Total Marks** |
| VI | 4 | 75 | 3 | 100 |

## COURSE OBJECTIVES

1. To familiarize the student with the fundamentals concepts of bioinformatics.
2. To equip students with computational skills for drug design.
3. To learn about the bioinformatics database, data format and data retrieval from online sources.
4. To develop interdisciplinary skills in using computers in botany to learn about the biological database.
5. Student is aware with the most recent technologies for sequencing and bioinformatics analysis and is able to apply them to the structural and functional genomics of plants.

**UNIT – I**

Introduction to computers and Bioinformatics. Introduction to Computers – classification, computer generation, low, medium and high level languages, software and hardware, operating systems personal, mini, main frame and super computers, characteristics and application, computer memory and its types, data representation and storage. Microsoft excel, data entry, graphs, aggregate functions, formulas and functions, number systems, conversion devices, secondary storage media

**UNIT – II**

Biological Research on the web: Using search engines, finding scientific articles. Fundamentals of networking, internet, intranet, search engines- yahoo, Google, etc. telnet, ftp.

**UNIT III**

Computer fundamentals - programming languages in bioinformatics, role of supercomputers in biology. Historical background. Scope of bioinformatics - Genomics, Transcriptomics, Proteomics, Metabolomics, Molecular Phylogeny, computer aided Drug Design (structure based and ligand based approaches), Systems Biology and Functional Biology. Applications and Limitations of bioinformatics.

**UNIT IV**

Introduction to databases. Biological databases- NCBI, EMBL and DDBJ. Data Generation and Data Retrieval Generation of data (Gene sequencing, Protein sequencing, Mass spectrometry, Microarray), Sequence submission tools (BankIt, Sequin, Webin); Sequence file format (flat file, FASTA, GCG, EMBL, Clustal, Phylip, Swiss-Prot); Sequence annotation; Data retrieval systems (SRS, Entrez) DNA sequencing methods. protein sequencing Phylogenetic analysis Similarity, identity and homology, Alignment – local and global alignment, pairwise and multiple sequence alignments, alignment algorithms. Methods of Alignment (Dot matrix, Dynamic Programming, BLAST and FASTA); Phylogenetic analysis: Construction of phylogenetic tree, dendrograms, methods of construction of phylogenetic trees.

**UNIT V**

**Applications:**

Application of Taxonomic Software for preparation of Dichotomous Key. Phylogenetic analysis.

Make line drawing of Plants for description. Usage of plant identification apps on android phones. Computer application in biostatistics - MS Excel and SPSS.Computer Aided Designing (CAD) for outdoor and indoor Land scaping. Exposure to CAD (Computer Aided Designing).

**Text Books**

1. P.K. Gupta. Biotechnology and Henomics. 2016-2017. Rastogi Publications, 7th Reprint (1st Edition.
2. Ghosh, Z., Mallick, B. 2008. Bioinformatics – Principles and Applications, 1st edition. New Delhi, Delhi: Oxford University Press.
3. Baxevanis, A.D. and Ouellette, B.F., John.2005. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, 3rd edition. New Jersey, U.S.: Wiley & Sons, Inc.
4. Roy, D. 2009. Bioinformatics, 1st edition. New Delhi, Delhi: Narosa Publishing House.
5. Andreas, D., Baxevanis, B.F., Francis, Ouellette. 2004. Bioinformatics: A practical guide to the analysis of genes and proteins, 3rd edition. New Jersey, U.S.: John Wiley and Sons.
6. Pevsner J. 2009. Bioinformatics and Functional Genomics, 2nd edition. New Jersey, U.S.: Wiley Blackwell.
7. Xiong J. 2006. Essential Bioinformatics, 1st edition. Cambridge, U.K.: Cambridge University Press.

**Reference Books**

1. Gibas, C and Jambeck, P. 1999. Developing Bioinformatics Skills. O'Reilly Shroff Publishers and Distributors Pvt, Ltd., New York, US.
2. David W. Mount. 2004. Bioinformatics Sequence and Genome Analysis. 2nd Edition, Cold Spring Harbor Laboratory Press, New York, US.
3. Harshitha, D. 2006. Techniques of Teaching Computer Science, International Book

Distributor, Dehradun.

4. Chwan-Hwa (John) Wu, J. David Irwin. 2016. Computer networks and cyber security. CRC Press.
5. Rui Jiang, Xuegong Zhang and Michael Q. Zhang. 2013. Basics of Bioinformatics. Springer-Verlag Berlin Heidelberg.
6. Ron Wehrens and Reza Salek. 2019. Metabolomics: Practical Guide to Design and Analysis. Chapman and Hall/CRC; 1st edition.
7. Simon, R. Miller and S.A. Garry. 1998. Internet for the Molecular Biologists. Volume III 2nd Edn. Horizontal Scientific Press, Norwich, UK.

**Web Resources**

1. http://www.agrimoon.com/introduction-to-computer-applications-pdf-book/
2. https://www.ebooks.com/en-us/subjects/computers/
3. https://it.careers360.com/download/ebooks
4. http://www.aun.edu.eg/molecular_biology/Procedure%20Bioinformatics22.23-4-2015/Xiong%20-%20Essential%20Bioinformatics%20send%20by%20Amira.pdf
5. http://www.freebookcentre.net/Biology/BioInformatics-Books.html
6. https://courses.cs.ut.ee/MTAT.03.242/2017_fall/uploads/Main/Basics_of_Bioinformatics.pdf

## Course Outcomes (COs)

On successful completion of the course, the students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Recognize advanced resources for accessing scholarly literature from the internet. | K1 |
| CO2 | Explain the concept of databases and use of different public domain for DNA and proteins sequence retrieval. | K2 |
| CO3 | Apply various software resources with advanced functions to carry out analysis of data procured through research. | K3 |
| CO4 | Decipher the effective utilization of bibliography management software while typing and downloading citations. | K4 |
| CO5 | Determine how the knowledge gained can be used for designing experiments and data interpretation. | K5 & K6 |

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

**Mapping of COs with POs**

**2.**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 3 | 1 | 3 | 3 | | |
| **CO 2** | 3 | 3 | 3 | 2 | 1 | 3 | 3 | 2 | | |
| **CO 3** | 3 | 3 | 3 | 1 | 2 | 1 | 3 | 2 | | |
| **CO 4** | 3 | 3 | 3 | 1 | 2 | 1 | 3 | 2 | | |
| **CO 5** | 3 | 3 | 3 | 1 | 2 | 1 | 3 | 2 | | |

**S-Strong (3)  M-Medium (2)  L-Low (1)**

| Program: B.Sc. Botany | | | | |
|---|---|---|---|---|
| **Elective-III** | **Course Code: 23UBO6E05** | | **Course Title: FORENSIC BOTANY** | |
| **Semester** | **Hours/Week** | **Total Hours** | **Credits** | **Total Marks** |
| VI | 4 | 30 | 3 | 100 |

## COURSE OBJECTIVES

1. The provide basic knowledge about the application of Botany to Forensic investigations and legal disputes.
2. To provide students with knowledge of palynology, dendrology, plant anatomy, pharmacognosy, molecular biology and toxic compounds from plants that could serve as leads in crime spots.
3. To learn classification of plants from forensic point of view.
4. To understand forensic importance of different parts of plants.
5. To develop and identify main morphological and anatomical features of plants, which could be useful for forensic investigations.

**UNIT – I**

General plant classification schemes, Sub specialization of forensic botany- plant morphology, plant anatomy, plant systematic, palynology, plant ecology, limnology, 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.

**UNIT – II**

Various types of woods, timbers, seeds and leaves and their forensic importance, Identification and matching of various types of wood, timber varieties, seeds and leaves. Types of fibers – forensic aspects of fiber examinations, Identification and comparison of man–made and natural fibres. Various types of planktons and diatoms and their forensic importance. Study and identification of pollen grains, Identification of starch grains, powder and stains of spices etc. Paper and Paper Pulp identification.

**UNIT III**

Various types of poisonous plants: *Abrus precatorius*, *Aconitum napellus*, *Anacardium occidentale*, *Argemone mexicana*, *Cannabis sativa*, *Claviceps purpuria*, *Croton tiglium*, *Atropa*

*belladonna*, *Gloriosa superba*, *Jatropha curcas*, *Lathyrus sativus*, *Nerium indicum*, *Nicotiana tabacum*, *Strychnos nux vomica*, *Thevetia nerifolia*. Types of plants yielding drugs of abuse – opium, cannabis, coco, tobacco, datura, *Psilocybin* mushrooms.

**UNIT IV**

Collection and preservation of botanical evidences: Botanical samples, outdoor crime scene consideration.

**UNIT V**

Analysis of samples, DNA analysis, plant DNA typing, Classic forensic botany cases: Case histories by using Plant anatomy and systematic, Palynology, Plant ecology, Limnology, Plant Molecular Biology and DNA, Drug enforcement and DNA.

**Text Books**

1. Coyle, H.M. 2005. Forensic Botany: Principles and Applications to Criminal Casework. CRC Press.
2. James, S.H., Nordby J.J., Bell, S. 2015. Forensic Science: An Introduction to Scientific and Investigative Techniques. CRC Press; 4 edition.
3. David W. Hall, Dr. Jason H. Byrd. 2012. Forensic Botany. Wiley-Blackwell; United Kingdom.
4. Jane H Bock, David Norris.2015. Forensic Plant Science. Elesvier.
5. Patricia E. J. Wiltshire.2012. Forensic Ecology, Botany, and Palynology: Some Aspects of Their Role in Criminal Investigation.
6. Criminal and Environmental Soil Forensics pp 129–149

**Reference Books**

1. Hall, D.W and Byrd, J. 2012. Forensic Botany: a practical guide. Wiley-Blackwell, 1edition.
2. Bock, J.H and Norris, D.O. 2016. Forensic Plant Science, Academic Press.
3. Nicholas Marquez Grant, John Wiley. 2012. Forensic Ecology Handbook. Wiley Backwell.
4. David W. Hall, Jason Byrd. 2012. Forensic Botany: A Practical Guide. Wiley-Blackwell.
5. Heather Miller Coyle.2007.Forensic Botany: Principles and Applications to Criminal Casework is packed with details — David M. Jarzen, Florida Museum of Natural History, University of Florida, in AASP Newsletter, Vol. 40, No. 2.

**Web Resources**

1. https://www.kobo.com/us/en/ebook/forensic-botany
2. https://www.worldcat.org/title/forensic-botany-a-practical-guide/oclc/796086574
3. https://www.buecher.de/shop/pflanzenoekologie/forensic-botany-ebook-pdf/hall-david-w--byrd-jason/products_products/detail/prod_id/37354547/

4. https://www.crcpress.com/Forensic-Botany-Principles-and-Applications-to-Criminal-Casework/Miller-Coyle/p/book/9780849315299
5. http://docshare02.docshare.tips/files/25818/258183613.pdf

## Course Outcomes (COs)

On successful completion of the course, the students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Recognize morphological and anatomical features of plants, which could be useful for forensic investigations. | K1 |
| CO2 | Summarize the forensic importance of different parts of plants. | K2 |
| CO3 | Apply techniques for the collection and preserve of botanical evidences of crime. | K3 |
| CO4 | Analyze and decipher the significance of classic and DNA based forensic botany cases. | K4 |
| CO5 | Interpret and deduce new methods for the detection of plant poisons used in crime. | K5 & K6 |

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

## Mapping of COs with POs

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 1 | 3 | 2 | 1 | 2 | 2 | 2 | 1 |
| **CO 2** | 3 | 3 | 2 | 1 | 1 | 3 | 2 | 3 | 1 | 3 |
| **CO 3** | 2 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 1 | 2 |
| **CO 4** | 3 | 3 | 3 | 3 | 2 | 1 | 3 | 3 | 2 | 1 |
| **CO 5** | 3 | 3 | 2 | 3 | 2 | 3 | 1 | 2 | 2 | 3 |

**S-Strong (3)  M-Medium (2)  L-Low (1)**

| Program: B.Sc. Botany | | | | |
|---|---|---|---|---|
| Skill Enhancement | Course Code: 23UBO6S08 | | Course Title: BOTANY FOR COMPETITIVE EXAMINATIONS | |
| **Semester** | **Hours/Week** | **Total Hours** | **Credits** | **Total Marks** |
| VI | 2 | 30 | 2 | 100 |

## COURSE OBJECTIVES

1. To develop the student for competitive examination.
2. To select the important topics as far as possible, with reference to the examination point of view. It gives a comprehensive account of botany.
3. To understand not only the basics of botany and also gives the broader perspective to prepare for the competitive examinations.
4. The essays give a detailed account of each aspect of botany to help students preparing for IAS, IFS and state civil services.
5. General understanding of plants around us, the different biophysical and biochemical processes that occur within them and their importance to human life.

**UNIT – I**

**PLANT WORLD:**

Plant science and its branches . Five kingdom classification. Outline of Kingdom plantae General characters and Economic importance of Algae, Fungi and Lichens.

**UNIT – II**

**GENERAL CHARACTERS OF PLANT GROUPS:**

General characters and Economic importance of Bryophytes, Pteridophytes and Gymnosperms .Palaeobotany- Types of fossils, Geological time scale ,Fossil beds of Tamil Nadu.

**UNIT III**

**PLANT MORPHOLOGY AND TAXONOMY:**

Root system and shoot system. Modifications (Pneumatophore, Stilt root, Epiphytic root, Cladode, Phylloclade ,Pitcher and Phyllode) Parts of a flower - Fruits types(Outline) Parthenocarpy-Pollination – types, Seed dispersal – types, Seed Germination types. Taxonomy –definition. Types of classification- Taxonomic hierarchy, ICN, Binomial nomenclature and BSI. Herbarium and Major Herbaria of the world.

**UNIT IV**

**CYTOLOGY AND GENETICS:**

Cell –Prokaryotic and Eukaryotic – Cell organelles with functions . DNA and RNA (Basic concepts) -Cell division and its significance -Mitosis and Meiosis (outline) Mendelism – Monohybrid and Dihybrid cross, Sex linked inheritance

**UNIT V**

**ECOLOGY AND BIODIVERSITY:**

Ecosystem – abiotic and biotic components. Energy flow in an ecosystem, Aforestation, Deforestation- Chipko movement –-Forest Conservation act- Pollution types and effects- Eutrophication, Global warming ,Ozone depletion, Climate change.

Biodiversity and types- Hot spots, Mega diversity countries, Conservation – *ex situ* and *in situ* methods. Endangered plants and Red data Book. Rio -Earth summit. Biodiversity Management Policies - IUCN, UNEP, WWF, ICSU, WCMC.

**Text Books**

1. Pullaiah, T & D, Varalakshmi Narayana, P, Suresh. 2021. Botany for Competitive Examinations: (Useful for UPSC-Indian Forest Service, Civil Services, PCS, ASRB CSIR - NET, ICAR-NET and Other Competitive Exams.) Astral Cracker.
2. Mitra, S. 2016. Botany for competitive examinations, Academic Publishers.
3. Mohd Akil Shahezad. 2018. M.C.Qs. in Botany, Library Book House.
4. 4.Sharma, P.C. 2017. Text Book of Plant Anatomy. Arjun Publishing House, New Delhi.
5. Sharma, O.P. 2017. Plant Taxonomy. (II Edition).The McGraw Hill Companies Taxonomy: Nair Datta
6. Thieman. 2014. Introduction to Biotechnology 3rd Edition. Pearson Education India.

**Reference Books**

1. De Robertis and De Robertis. 1990. Cell and Molecular Biology, Saunders College, Philadelphia, USA.
2. Gardner, E.J., Simmons, M.J and Snustad, D. 1991. Principles of Genetics, John Wiley Sons Inc., 8th Edn., New York.
3. Salisbury, F. B.C.W. Ross.1991. Plant Physiology. Wassworth Pub. Co. Belmont.
4. Sharma, P.D. 2017. Ecology and Environment- Rastogi Publication, Meerut.
5. Vardhana, R. 2009. Economic Botany. 1st ed. Sarup Book Publishers Pvt Ltd. New Delhi.
6. Power, C.B and Daginawa, H.F. 2010. General Microbiology : Himalaya Publishing House Pvt Ltd,
7. Rangasamy, G. 2006. Disease of crop plants in India (4th edition). Tata Mc Graw Hill New Delhi.
8. Singh, V., Pande, P.C and Jain, D.K. 2021. A Text Book of Botany. Rastogi Publications,Meerut.

9. Bhojwani, S.S. Bhatnagar, S.P and Dantu, P.K. 2015. The Embryology of Angiosperms (6th revised and enlarged edition). Vikas Publishing House, New Delhi.

**Web resources**

1. https://www.amazon.in/BOTANY-COMPETITIVE-EXAMINATIONS-SUNIT-MITRA/dp/9383420898
2. https://www.amazon.in/Botany-Competitive-Examinations-UPSC-Indian-Competive/dp/B08VWB64BC
3. https://www.ssclatestnews.com/botany-book-pdf-free-download-for-competitive-exams/
4. https://sscstudy.com/botany-for-competitive-exams-pdf/
5. https://www.amazon.in/Botany-Entrance-Examination-Anupam-Rajak-ebook/dp/B089S1GLMP

## Course Outcomes (COs)

On successful completion of the course, the students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Identify and define different groups of plants with their taxonomic position Compare the different groups of plants and evaluate their economic importance | K1, K2 & K5 |
| CO2 | List down the general characters of Bryophytes, Pteridophytes and Gymnosperms<br>Classify the types of fossils and recognize the fossil beds of Tamil Nadu Analyse and trace the origin of different plant groups using Geological Time scale | K1, K3 & K5 |
| CO3 | Appreciates the morphology of plant and analyse different modifications of plant organs. Explore the major Herbaria of the world and recognize the importance. | K3 & K5 |
| CO4 | Differentiate Prokaryotic and Eukaryotic cell. Evaluate the significance of cell division. Justify the cause for the sex linked inheritance. Tabulate the different cell organelles with their functions. | K2, K3 & K5 |
| CO5 | Define and appreciates biodiversity. | K1, K5 & K6 |

| | | |
|---|---|---|
| | Identify the cause and solve environmental related issues .<br>Design eco friendly approaches to protect earth and generate new conservation strategies. | |

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

**Mapping of COs with POs**

| Cos | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 1 | 3 | 2 | 1 | 1 | 2 | 3 | 1 |
| **CO 2** | 3 | 2 | 1 | 2 | 3 | 3 | 2 | 3 | 2 | 1 |
| **CO 3** | 2 | 2 | 3 | 3 | 1 | 2 | 1 | 3 | 2 | 3 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| **CO 5** | 3 | 3 | 2 | 3 | 2 | 1 | 3 | 3 | 3 | 2 |

**S-Strong (3) M-Medium (2) L-Low(1)**

| Program: B.Sc. Botany | | | | |
|---|---|---|---|---|
| Skill Enhancement | **Course Code: 23UBO6S08** | | **Course Title: BOTANY FOR ADVANCED STUDIES** | |
| **Semester** | **Hours/Week** | **Total Hours** | **Credits** | **Total Marks** |
| VI | 4 | 30 | 2 | 100 |

## COURSE OBJECTIVES

1. To be familiar with the basic concepts and principles of plant systematics.
2. Learn the importance of plant anatomy in plant production systems.
3. To expose the students a fundamental of the various techniques used in molecular studies.
4. To learn about the physiological processes that underlie plant metabolism.
5. To know the energy production and its utilization in plants.

**UNIT – I**

**MOLECULAR GENETICS**

Molecular Biology of gene expression: Brief overview of the Central Dogma and Teminism. Transcription in prokaryotes and eukaryotes. Types and structure of RNA polymerase, Different types of RNA, Regulatory sequences and transcription factors involved. Mechanism: Initiation, elongation and termination. Split genes and RNA splicing in eukaryotes. Translation in prokaryotes and eukaryotes. Salient features, exceptions, tRNA-suppressor mutations. Mechanism of translation: Chain initiation, elongation and termination, proteins involved, factors affecting translation accuracy. Molecular mechanism of mutation, cancer biology, human cytogentics. Molecular mechanism of Gene Regulation: Regulation in prokaryotes, Regulation in Eukaryotes, Epigenetic mechanisms: methylation and transcriptional inactivation, cosuppression through transcriptional silencing, genome imprinting. RNA processing->alternative splicing, RNA stability, RNA interference. Translational regulation: Gene amplification, mating type interconversion. Genomics: Structural genomics, Genetic and physical mapping ( RFLP), microsatellite maps, cyotogenetic maps, physical maps, positional cloning, chromosome walks and jumps, Genome sequencing, genome databases, human genome sequencing project. Functional genomics. transcriptome, proteome and metabolome, Microarrays and gene-chips. Comparative genomics. Functional and evolutionary relationships prokaryotes, organelles and eukaryotes, orthologues and paralogues. Metabolomics: Identification and quantification of cellular metabolites in biological samples. Pharmacogenomics and drug designing.

**UNIT – II**

**ADVANCED TRENDS IN SYSTEMATICS**

**Basic concepts of:**

a. Morphology - History, general morphology, types of data, methods of gathering data,

b. Anatomy - History, general anatomy, types of data, methods of gathering data,

c. Embryology – History, types of data, methods of gathering data;

d. Palynology: History, general palynological characters, types of data, methods of gathering data;

e. Cytology and Cytogenetics: History, general cytological and cytogenetic characters, types of data, methods of gathering data;

f. Ecology, History, general ecology, types of data, methods of gathering data

(At least two examples from each section should be studied to substantiate the taxonomic significance)

**CHEMOTAXONOMY:**

a. History, general chemical and chemotaxonomic characters, types of data, methods of gathering data.
b. Identification of the major classes of the pharmaceutically important secondary metabolites from natural sources 8 (phenolics, steroids, terpenoids glycosides and alkaloids).
c. Applications: Phytochemicals in cosmetics, aromatherapy, disease prevention, biotechnology in the production of phytochemicals. Phytochemical databases (iii) Molecular trends in Biosystematics
d. Molecules and genomes in plant systematics, techniques used in molecular taxonomy, molecular systematics in crop evolution
e. Serology in relation to plant taxonomy- Methods, role of serology in taxonomy.
f. Cladistics and Phenetics (iv) Molecular trends in Reproductive Biology: (i) Apomixis – Types, cytogenetic basis and induction of apomixes, applications.

**UNIT III**

**PLANT PHYSIOLOGY**

Modern concepts Photosynthesis – Environmental and agricultural relevance; Respiration – Biochemical control of respiration Photomorphogenesis Phytochrome genes and their expression, control of photo-morphogenic responses. Dose-response relations in photomorphogenesis, light induced chloroplast differentiation, effect of photoreceptors. Biological clock: Circadian rhythms, rhythm responses to environment, clock mechanism. Photoperiodism General principles , florigen concept Plant growth and development Patterns of growth and differentiation; Gene expression and mutations regulating meristem function, embryogenesis, seedling, root, leaf and flower development. Homeotic genes, ABCD model in Arabidopsis flower, hormonal control of plant tissue development, effect of auxins on root and root formation, gibberellin promoted growth of

plants, ethylene and triple response mutants, brassinosteroids and photomorphogenesis.

**UNIT IV**

**PLANT PHYSIOLOGY**

Enzymes: General account: Importance and properties of enzymes in biological sciences, the classification and nomenclature of enzymes with examples, Mechanism of enzyme action role of enzyme in chemical action, various factors affecting the enzyme activity.Molecular genetics in plant physiology, Environmental plant physiology, Stress physiology .

**UNIT V**

**ECONOMC BOTANY**

Economic importance of Cereals, Tuber Crops, Fibre yielding plants, Plantation Crops, Sugar yielding plants, Narcotics, Vegetables, Oil yielding plants, Pulses and Beverages

**Text Books**

1. Sharma, O.P. 2017. Plant Taxonomy. (II Edition).The McGraw Hill Companies.
2. Maheshwari, P. 1963. Recent Advances in Embryology of Angiosperm s. Intl. Soc. Plant Morphologists, New Delhi.
3. Sharma, P.C. 2017. Text Book of Plant Anatomy. Arjun Publishing House, New Delhi.
4. Jain, V.K. 2017. Plant Physiology, S.Chand & Company Ltd. New Delhi.
5. Lincoln, T, Eduardo, Z, Ian Max, M, and Angus, M. 2018. Fundamentals of Plant Physiology. Sinauer Associates Inc., US.
6. Becker, W.M., Kleinsmith L.J. & Hardin J. 2005. The World of the Cell (6th edition). Benjamin/Cummings Pub. Co. New York.
7. Brooker, R. J. 1999. Genetics Analysis and Principles. Addison Wesley Longman Inc., New York.
8. Bruce, A. et. al. 2002. Molecular Biology of the Cell. Garland Publishing. New York.

**Reference Books**

1. Mabberley, J.D. 2014. Mebberley's Plant-Book: A portable dictionary of plants, their classification and uses, 3rd ed. Cambridge University Press, Cambridge, U.K. 1021pp.
2. Pandey.B.P. 1999. Economic Botany. S. Chand Limited, New Delhi.
3. Bhojwani, S.S. and Soh, W.Y. 2013. Current trends in the embryology of angiosperms. Springer Science & Business Media, Germany.
4. Cutler, D. F., Botha, T and Stevenson, D.W. 2008. Plant Anatomy: An Applied Approach. Blackwell Publishing, Malden, USA.

5. Steward, F.C. 2012. Plant Physiology Academic Press, US.
6. Hopkins, W.G and Huner, N.P. 2009. Introduction to Plant Physiology (4th ed.). John Wiley & Sons. U.S.A.
7. Noggle G.R and G.J. Fritz. 2002. Introductory Plant Physiology. Prentice Hall of India, New Delhi.
8. Anthony J . F. G .2000. An Introduction to Genetic Analysis. W. H. Freeman &Co. New York.
9. Hartl, .D.L & Jones E. W. 2000. Genetic analysis of Genes and Genomes Jones and Bartlett Pub, Boston.
10. Klug .S.W. & Cummings, M.R. 2003. Concepts of Genetics . Pearson Education Pvt. Ltd., Singapore. Kreezer et al . 2001. Recombinant DNA and Biotechnology. American Society for Cell Biology, New York.
11. Lodish Harvey. 1999. Molecular Cell Biology. W.H. Freeman &Co. New York.
12. Russell, P.J. 2005. Genetics: A Molecular Approach (2nd edition). Pearson/Benjamin Cumming, San Francisco.
13. Snustad, D. P. & Simmons M.J. 2003.Principles of Genetics. John Hailey & Sons Inc. U.S.A.
14. Mabberley, J.D. 2014. Mebberley's Plant-Book: A portable dictionary of plants, their classification and uses, 3rd ed. Cambridge University Press, Cambridge, U.K. 1021pp.
15. Pandey.B.P. 1999. Economic Botany. S. Chand Limited, New Delhi.
16. Bhojwani, S.S. and Soh, W.Y. 2013. Current trends in the embryology of angiosperms. Springer Science & Business Media, Germany.
17. Cutler, D. F., Botha, T and Stevenson, D.W. 2008. Plant Anatomy: An Applied Approach. Blackwell Publishing, Malden, USA.
18. Steward, F.C. 2012. Plant Physiology Academic Press, US.
19. Hopkins, W.G and Huner, N.P. 2009. Introduction to Plant Physiology (4th ed.). John Wiley & Sons. U.S.A.
20. Noggle G.R and G.J. Fritz. 2002. Introductory Plant Physiology. Prentice Hall of India, New Delhi.
21. Anthony J . F. G .2000. An Introduction to Genetic Analysis. W. H. Freeman &Co. New York.
22. Hartl, .D.L & Jones E. W. 2000. Genetic analysis of Genes and Genomes Jones and Bartlett Pub, Boston.
23. Klug .S.W. & Cummings, M.R. 2003. Concepts of Genetics . Pearson Education Pvt. Ltd., Singapore. Kreezer et al . 2001. Recombinant DNA and Biotechnology. American Society for Cell Biology, New York.
24. Lodish Harvey. 1999. Molecular Cell Biology. W.H. Freeman &Co. New York.
25. Russell, P.J. 2005. Genetics: A Molecular Approach (2nd edition). Pearson/Benjamin

Cumming, San Francisco.

26. Snustad, D. P. & Simmons M.J. 2003.Principles of Genetics. John Hailey & Sons Inc. U.S.A.

**Web resources**

1. http:// www.ornl.gov.
2. http:// ash. gene. ncl. ac .nk..
3. http://tor. cshl. org. http:www. gdb. org.
4. http: //www. neg r. org.
5. http: // www. genetics. wustl. edu.
6. http: // genome. imb- jena. dc.

## Course Outcomes (COs)

On successful completion of the course, the students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Understand of the basic principles of systematics, including identification, nomenclature, classification, and the inference of evolutionary patterns from data | K1, K2 & K5 |
| CO2 | Learn the structures, functions and roles of apical *vs* lateral meristems in monocot and dicot plant growth. | K1,K3 & K5 |
| CO3 | Understand the organization of nuclear genome. | K3 & K5 |
| CO4 | Understand the various steps involved in the basic functioning of plant growth and the nutritive value of food. | K2, K3 & K5 |
| CO5 | Gain awareness about the various processes involved in the energy production in plants and metabolic pathways. | K1, K5 & K6 |

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

## Mapping of COs with POs

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 1 | 3 | 2 | 1 | 2 | 2 | 1 | 2 |
| **CO 2** | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 3 | 2 |
| **CO 3** | 2 | 2 | 3 | 2 | 1 | 2 | 1 | 3 | 2 | 1 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 3 |
| **CO 5** | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 2 |

**S-Strong (3)** **M-Medium (2)** **L-Low (1)**

## ELECTIVE ALLIED BOTANY-I

| Program: B.Sc. Botany | | | | |
|---|---|---|---|---|
| Core-Allied-I | Course Code: 23UBO3AB01 | | Course Title: ALLIED BOTANY-I | |
| **Semester** | **Hours/Week** | **Total Hours** | **Credits** | **Total Marks** |
| 1 | 4 | 30 | 2 | 100 |

### COURSE OBJECTIVES

1. To study morphological and anatomical adaptations of plants of various habitats.
2. To demonstrate techniques of plant tissue culture.
3. To familiarize with the structure of DNA, RNA.
4. To carryout experiments related with plant physiology.
5. To perform biochemistry experiments.

**UNIT – I**

**Algae:**

General characters of algae - Structure, reproduction and life cycle of the following genera - *Anabaena* and *Sargassum* and economic importance of algae.

**UNIT – II**

**Fungi, Bacteria and Virus:**

General characters of fungi, structure, reproduction and life cycle of the following genera - *Penicillium* and *Agaricus* and economic importance of fungi. Bacteria - general characters, structure and reproduction of *Escherichia coli* and economic importance of bacteria. Virus - general characters, structure of TMV, structure of bacteriophage.

**UNIT III**

**Bryophytes, Pteridophytes and Gymnosperms:**

General characters of Bryophytes, Structure and life cycle of *Funaria*. General characters of Pteridophytes, Structure and life cycle of *Lycopodium*. General characters of Gymnosperms, Structure and life cycle of *Cycas*.

**UNIT IV**

**Cell Biology:**

Prokaryotic and Eukaryotic cell- structure /organization. Cell organelles - ultra structure and function of chloroplast, mitochondria and nucleus. Cell division - mitosis and meiosis.

**UNIT V**

**Genetics and Plant Biotechnology:**

Mendelism - Law of dominance, Law of segregation, Incomplete dominance. Law of independent assortment. Monohybrid and dihybrid cross - Test cross - Back cross. Plant tissue culture - *In vitro* culture methods. Plant tissue culture and its application in biotechnology.

**Text Books**

1. Singh, V., Pande, P.C and Jain, D.K. 2021. A Text Book of Botany. Rastogi Publications,Meerut.
2. Bhatnagar, S.P and Alok Moitra. 2020. Gymnosperms, New Age International (P) Ltd., Publishers, Bengaluru.
3. Sharma, O.P. 2017. Bryophyta, MacMillan India Ltd. Delhi.
4. Lee, R.E. 2008. Phycology, IV Edition, Cambridge University Press, New Delhi.
5. Rao, K., Krishnamurthy, K.V and Rao, G.S. 1979. Ancillary Botany,S. Viswanathan Pvt. Ltd., Madras.

**Reference Books**

1. Parihar, N.S. 2012. An introduction to Embryophyta –Pteridophytes - Surjeet Publications, Delhi.
2. Alexopoulos, C.J. 2013. Introduction to Mycology. Willey Eastern Pvt. Ltd.
3. Vashishta, P.C. 2014. Botany for Degree Students Gymnosperms. Chand & Company Ltd, Delhi.
4. Coulter, M. Jhon, 2014. Morphology of Gymnosperms. Surjeet Publications, Delhi.
5. Vashishta, P.C. 2014. Botany for Degree Students Algae. 2014. Chand & Company Ltd, Delhi.
6. Parihar, N.S. 2013. An introduction to Embryophyta –Bryophytes -, Surjeet Publications, Delhi.
7. Pandey B.P. 1986, Text Book of Botany (College Botany) Vol I &II, S.Chand and Co.New Delhi.

**Web resources**

1. https://www.kobo.com/us/en/ebook/the-algae-world
2. http://www.freebookcentre.net/biology-books-download/Fungi-(PDF-15P).html
3. http://scitec.uwichill.edu.bb/bcs/bl14apl/bryo1.htm
4. https://www.toppr.com/guides/biology/plant-kingdom/pteridophytes/
5. https://arboretum.harvard.edu/wp-content/uploads/2013-70-4-beyond-pine-cones-an-introduction-to-gymnosperms.pdf
6. https://www.us.elsevierhealth.com/medicine/cell-biology
7. https://www.us.elsevierhealth.com/medicine/genetics
8. https://www.kobo.com/us/en/ebook/plant-biotechnology-1

## Course Outcomes (COs)

On successful completion of the course, the students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Increase the awareness and appreciation of human friendly algae and their economic importance. | K1 |
| CO2 | Develop an understanding of microbes and fungi and appreciate their adaptive strategies | K2 |
| CO3 | Develop critical understanding on morphology, anatomy and reproduction of Bryophytes, Pteridophytes and Gymnosperms. | K3 |
| CO4 | Compare the structure and function of cells and explain the development of cells. | K3 |
| CO5 | Understand the core concepts and fundamentals of plant biotechnology and genetic engineering. | K5 |

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

## Mapping of COs with POs

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO 2** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO 3** | 2 | 3 | 3 | 3 | 3 | 1 | 3 | 3 | 3 | 3 |
| **CO 4** | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 2 | 3 |
| **CO 5** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 1 |

**S-Strong (3)  M-Medium (2)  L-Low (1)**

## ELECTIVE ALLIED BOTANY-II

| Program: B.Sc. Botany | | | | |
|---|---|---|---|---|
| Core-Allied-II | Course Code: 23UBO4AB02 | | Course Title: ALLIED BOTANY-II | |
| **Semester** | **Hours/Week** | **Total Hours** | **Credits** | **Total Marks** |
| II | 4 | 30 | 2 | 100 |

### COURSE OBJECTIVES

1. To be familiar with the basic concepts and principles of plant systematics.
2. Learn the importance of plant anatomy in plant production systems.
3. Understand the mechanism underling the shift from vegetative to reproductive phase.
4. To learn about the physiological processes that underlie plant metabolism.
5. To know the energy production and its utilization in plants.

**UNIT – I**

**MORPHOLOGY OF FLOWERING PLANTS:**

Plant and its parts. Structure and function of root and stem. Leaf and its parts. Leaf types- simple and compound. Phyllotaxy and types. Inflorescence - Racemose, Cymose and Special types. Terminology with reference to flower description.

**UNIT – II**

**TAXONOMY:**

Study of the range of characters and plants of economic importance in the following families: Rutaceae, Caesalpiniaceae, Asclepiadaceae, Euphorbiaceae and Cannaceae.

**UNIT III**

**ANATOMY**

Tissue and tissue systems: Simple and complex tissues. Anatomy of monocot and dicot roots - anatomy of monocot and dicot stems - anatomy of dicot and monocot leaves.

**UNIT IV**

**EMBRYOLOGY**

Structure of mature anther and ovule - Types of ovules, structure of embryo sac, pollination - double fertilization, structure of dicotyledonous and monocotyledonous seeds.

**UNIT V**

**PLANT PHYSIOLOGY**

Absorption of water, photosynthesis - light reaction - Calvin cycle; respiration - Glycolysis - Krebs cycle - electron transport system. Growth hormones - auxins and cytokinins and their applications.

**Text Books**

1. Sharma, O.P. 2017. Plant Taxonomy. (II Edition).The McGraw Hill Companies.
2. Bhojwani, S.S. Bhatnagar, S.P and Dantu, P.K. 2015. The Embryology of Angiosperms (6th revised and enlarged edition). Vikas Publishing House, New Delhi.
3. Maheshwari, P. 1963. Recent Advances in Embryology of Angiosperms. Intl. Soc. Plant Morphologists, New Delhi.
4. Salisbury, F. B.C.W. Ross.1991. Plant Physiology. Wassworth Pub. Co. Belmont.
5. Ting, I.P. 1982. Plant Physiology. Addison Wesley Pb. Philippines.

**Reference Books**

1. Lawrence.G.H.M. 1985. An Introduction to Plant Taxonomy, Central Book Depot, Allahabad.
2. Bhojwani, S.S and Bhatnagar, S.P. 2000. The Embryology of Angiosperms (4th revised and enlarged edition). Vikas Publishing House, New Delhi.
3. Pandey, B.P. 2012. Plant Anatomy. S Chand Publishing.
4. Jain, VK. 2006. Fundamentals of Plant Physiology, S. Chand and Company Ltd.
5. Rajni Gupta. 2012. Plant Taxonomy: Past, Present and Future. Vedams (P) Ltd. New Delhi.
6. Jain, V.K. 2006. Fundamentals of Plant Physiology, S.Chand and Company Ltd., New Delhi.
7. Verma, S.K. 2006. A Textbook of Plant Physiology, S.K.Chand & Co., New Delhi.

**Web resources**

1. https://books.google.co.in/books/about/Plant_Taxonomy.html?id=0bYs8F0Mb9gC&redir_esc=y
2. https://books.google.co.in/books/about/PLANT_TAXONOMY_2E.html?id=Roi0lwSXFnUC&redir_esc=y
3. **https://archive.org/EXPERIMENTS/plantanatomy031773mbp**
4. https://www.amazon.in/Embryology-Angiosperms-6th-S-P-Bhatnagar-ebook/dp/B00UN5KPQG
5. https://www.crcpress.com/Plant-Physiology/Stewart-Globig/p/book/9781926692692

## Course Outcomes (COs)

On successful completion of the course, the students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Understand the fundamental concepts of plant anatomy and embryology. | K1 |
| CO2 | Analyze and recognize the different organs of plants and secondary growth. | K2 |
| CO3 | Understand water relation of plants with respect to various physiological processes. | K3 |
| CO4 | Classify aerobic and anaerobic respiration. | K3 |
| CO5 | Classify plant systematics and recognize the importance of herbarium and virtual herbarium. | K5 |

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

## Mapping of COs with POs

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO 2** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO 3** | 2 | 3 | 3 | 3 | 3 | 1 | 3 | 3 | 3 | 3 |
| **CO 4** | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 2 |
| **CO 5** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 |

**S-Strong (3)  M-Medium (2)  L-Low (1)**

## ELECTIVE ALLIED BOTANY PRACTICALS

| Program: B.Sc. Botany | | | | |
|---|---|---|---|---|
| **Core-Allied Practicals-I** | **Course Code: 23UBO2AP01** | | **Course Title : ALLIED BOTANY PRACTICALS** | |
| **Semester** | **Hours/Week** | **Total Hours** | **Credits** | **Total Marks** |
| II | 4 | 45 | 2 | 100 |

## COURSE OBJECTIVES

1. To enhance information on the identification of each taxonomical group by developing the skill-based detection of the morphology and microstructure of microorganisms, algae, and fungi.
2. To comprehend the fundamental concepts and methods used to identify Bryophytes, Pteridophytes and Gymnosperms through morphological changes and evolution, anatomy and reproduction.
3. To be familiar with the basic concepts and principles of plant systematic
4. Understanding of laws of inheritance, genetic basis of loci and alleles.
5. To learn about the physiological processes that underlie plant metabolism.

## EXPERIMENTS

1. Make suitable micro preparation of the types prescribed in Algae, Fungi, Bryophytes, Pteridophytes and Gymnosperms.
2. Micro photographs of the cell organelles ultra structure.
3. Simple genetic problems.
4. To describe in technical terms, plants belonging to any of the family prescribes and to identify the family.
5. To dissect a flower, construct floral diagram and write floral formula.
6. Demonstration experiments
    1. Ganong's Light screen
    2. Ganong's respiroscope
7. To make suitable micro preparations of anatomy materials prescribed in the syllabus.

8. Spotters - Algae, Fungi, Bryophytes, Pteridophytes, Gymnosperms and Angiosperm anatomy, Embryology, Cell biology and Biotechnology.

**Recommended Texts:**

1. Sharma, O.P. 2017. Bryophyta, MacMillan India Ltd, New Delhi.
2. Sharma, O.P. 2012. Pteridophyta, Tata McGraw-Hills Ltd, New Delhi.
3. Subramaniam, N.S. 1996. Laboratory Manual of Plant Taxonomy. Vikas Publishing House Pvt. Ltd., New Delhi.
4. Benjamin, A. Pierce. 2012. Genetics- A conceptual Approach. W.H. Freeman and Company, New York, England.
5. Noggle G.R and G.J. Fritz. 2002. Introductory Plant Physiology. Prentice Hall of India, New Delhi.

**Reference Books:**

1. Strickberger, M.W. 2005. Genetics (III Ed). Prentice Hall, New Delhi, India.
2. Nancy Serediak and M. Huynh. 2011. Algae identification lab Guide. Accompanying manual to algae identification field guide, Ottawa Agriculture and Agri food Canada publisher.
3. Mohammed Gufran Khan, Shite Gatew and Bedilu Bekele. 2012. Practical manual for Bryophytes and Pteridophytes. Lambert Academic Publishing.
4. Aler Gingauz. 2001. Medicinal Chemistry. Oxford University Press & WileyPublications.
5. Steward, F.C. 2012. Plant Physiology Academic Press, US

**Web resources:**

1. https://www.amazon.in/Practical-Manual-Pteridophyta-Rajan-Sundara/dp/8126106883
2. https://www.google.co.in/books/edition/Gymnosperms/3YrT5E3Erm8C?hl=en&gbpv=1&dq=gy mnosperms&printsec=frontcover
3. https://www.amazon.in/Computational-Phytochemistry-Satyajit-Dey-Sarker-ebook/dp/B07CV96NZJ
4. https://medlineplus.gov/genetocs/understanding/basics/cell/
5. https://apan.net/meetings/apan45/files/17/17-01-01-01.pdf
6. http://www.cuteri.eu/microbiologia/manuale_microbiologia_pratica.pdf
7. https://www.amazon.in/Manual-Practical-Bryophyta-Suresh-Kumar/dp/B0072GNFX4

***Bonafide record of practical work done should be submitted for the practical examination.**

## Course Outcomes (COs)

On successful completion of the course, the students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | To study the internal organization of algae and fungi. | K1 |
| CO2 | Develop critical understanding on morphology, anatomy and reproduction of Bryophytes, Pteridophytes and Gymnosperms.. | K2 |
| CO3 | To study the classical taxonomy with reference to different parameters. | K3 |
| CO4 | Understand the fundamental concepts of plant anatomy and embryology | K4 |
| CO5 | To study the effect of various physical factors on photosynthesis. | K5 |

**K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create**

## Mapping of COs with POs

**1.**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO 2** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO 3** | 2 | 3 | 3 | 3 | 3 | 1 | 3 | 3 | 1 | 3 |
| **CO 4** | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 3 |
| **CO 5** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 |

**S-Strong (3)** **M-Medium (2)** **L-Low (1)**