M.Sc. Botany (Five-year) Programme

Regulations & Curriculum-2019

UGC-SAP and DST-FIST Assisted

Department of Botany
These Regulations are common to all the students admitted to the Five Year Integrated Master's Programmes in the Faculties of Arts, Science, Languages, Marine Sciences, and Education from the academic year 2019-2020 onwards.

1. Definitions and Nomenclature

1.1 University refers to Annamalai University.

1.2 Department means any of the academic departments and academic centres at the University.

1.3 Discipline refers to the specialization or branch of knowledge taught and researched in higher education. For example, Botany is a discipline in the Natural Sciences, while Economics is a discipline in Social Sciences.

1.4 Programme encompasses the combination of courses and/or requirements leading to a Degree. For example, M.A., M.Sc.

1.5 Course is an individual subject in a programme. Each course may consist of Lectures/Tutorials/Laboratory work/Seminar/Project work/Experiential learning/ Report writing/viva-voce etc. Each course has a course title and is identified by a course code.

1.6 Curriculum encompasses the totality of student experiences that occur during the educational process.

1.7 Syllabus is an academic document that contains complete information about an academic programme and defines responsibilities and outcomes. This includes course information, course objectives, policies, evaluation, grading, learning resources and course calendar.

1.8 Academic Year refers to the annual period of sessions of the University that comprises two consecutive semesters.

1.9 Semester is a half-year term that lasts for a minimum of 90 working days. Each academic year is divided into two semesters.

1.10 Choice Based Credit System A mode of learning in higher education that enables a student to have the freedom to select his/her own choice of elective courses across various disciplines for completing the Degree programme.

1.11 Core Course is mandatory and an essential requirement to qualify for the Degree.

1.12 Elective Course is a course that a student can choose from a range of alternatives.

1.13 Value Added Courses are optional courses that complement the students’ knowledge and skills and enhance their employability.
1.14 **Experiential Learning** is a process of learning through experience. It is specifically defined as “learning through reflection on doing”.

1.15 **Extension activities** are the activities that provide a link between the University and the community such as lab-to-land, literacy, population education, and health awareness programmes. These are integrated within the curricula with a view to sensitise the students about Institutional Social Responsibility (ISR).

1.16 **Credit** refers to the quantum of course work in terms of the number of class hours in a semester required for a programme. The credit value reflects the content and duration of a particular course in the curriculum.

1.17 **Credit Hour** refers to the number of class hours per week required for a course in a semester. It is used to calculate the credit value of a particular course.

1.18 **Programme Outcomes (POs)** are statements that describe crucial and essential knowledge, skills, and attitudes that students are expected to achieve and can reliably manifest at the end of a programme.

1.19 **Programme Specific Outcomes (PSOs)** are statements that list what the graduate of a specific programme should be able to do at the end of the programme.

1.20 **Learning Objectives (also known as Course Objectives)** are statements that define the expected goal of a course in terms of demonstrable skills or knowledge that will be acquired by a student as a result of instruction.

1.21 **Course Outcomes (COs)** are statements that describe what students should be able to achieve/demonstrate at the end of a course. They allow follow-up and measurement of learning objectives.

1.22 **Grade Point Average (GPA)** is the average of the grades acquired in various courses that a student has taken in a semester. The formula for computing GPA is given in Section 11.3.

1.23 **Cumulative Grade Point Average (CGPA)** is a measure of the overall cumulative performance of a student in all the semesters. The CGPA is the ratio of total credit points secured by a student in various courses in all semesters.

1.24 **Letter Grade** is an index of the performance of a student in a particular course. Grades are denoted by the letters S, A, B, C, D, E, and RA.

2. **Programmes Offered and Eligibility Criteria**

   The Integrated Programmes offered by the University and the eligibility criteria are detailed below.

<table>
<thead>
<tr>
<th>Faculty of Science</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>M.Sc. Botany</strong></td>
</tr>
<tr>
<td>A pass in H.S.E. (10+2 level) regular or vocational with Botany/Biology or Vocational course with Agriculture/Plant Protection as one of the courses.</td>
</tr>
</tbody>
</table>

2.1 **In the case of SC/ST and Differently-abled candidates, a pass is the minimum qualification for all the above Programmes.**
3. **Reservation Policy**
   Admission to the various programmes will be strictly based on the reservation policy of the Government of Tamil Nadu.

4. **Programme Duration**
4.1 The Five Year Master’s Programmes consist of five academic years and ten semesters.
4.2 Each academic year is divided into two semesters, the first being from July to November and the second from December to April.
4.3 Each semester will have 90 working days (18 weeks).

5. **Programme Structure**
5.1 The Five Year Integrated Programme consists of Language Courses, Core Courses, Allied Courses, Elective Courses, Soft Skills, Experiential Learning and Project. Students shall also participate in Extension Activities as part of their curriculum.

5.2 **Language Courses**
5.2.1 Each student shall take two languages of four courses each, one in each semester for the first two years of the programme.
5.2.2 Language-I shall be Tamil or another language such as Hindi or French.
5.2.3 Language-II shall be English.

5.3 **Core courses**
5.3.1 These are a set of compulsory courses essential for each programme.
5.3.2 The core courses include both Theory (Core Theory) and Practical (Core Practical) courses.

5.4 **Allied Courses**
5.4.1 Each student shall take courses in two disciplines allied to the main subject (Allied-I and Allied-II) of the programme in the first four semesters.
5.4.2 In Arts, Languages, and Education, there will be three Theory Courses each for Allied-I and Allied-II.
5.4.3 In Science and Marine Sciences, there will be two Theory courses and one Practical course each for Allied-I and Allied-II.

5.5 **Elective Courses**
5.5.1 **Departmental Electives (DEs)** are the electives that students can choose from a range of Electives offered within the Parent Department offering the Programme.
5.5.2 **Interdepartmental Electives (IDEs)** are electives that students can choose from amongst the courses offered by other departments of the same faculty as well as by the departments of other faculties.
5.5.3 Students shall take a combination of both DEs and IDEs.

5.6 **Soft Skills**
5.6.1 Soft skills are intended to enable students to acquire attributes that enhance their performance and achieve their goals with complementing hard skills.
5.6.2 Soft skills include communication skills, computer skills, social skills, leadership traits, team work, development of emotional intelligence quotients, among others.

5.6.3 Each student shall choose four courses on soft skills from a range of courses offered from the First to the Sixth Semester.

5.7 **Value Education**
All students shall take a course on Value Education that includes human values, sustainable development, gender equity, ethics and human rights.

5.8 **Experiential Learning**
5.8.1 Experiential learning provides opportunities to students to connect principles of the discipline with real-life situations.

5.8.2 In-plant training/field trips/internships/industrial visits (as applicable) fall under this category.

5.9 **Extension Activities**
5.9.1 It is mandatory for every student to participate in extension activities.

5.9.2 All the students shall enrol under NSS/NCC/YRC/RRC or any other Service Organisation in the University.

5.9.3 Students shall put in a minimum attendance of 40 hours in a year duly certified by the Programme Co-ordinator.

5.9.4 Extension activities shall be conducted outside the class hours.

5.10 **Project**
5.10.1 Each student shall undertake a Project in the final semester.

5.10.2 The Head of the Department shall assign a Project Supervisor to the student.

5.10.3 The Project Supervisor shall assign a topic for the project and monitor the progress of the student periodically.

5.10.4 Students who wish to undertake project work in recognised institutions/industry shall obtain prior permission from the University. The Project Supervisor will be from the host institute, while the Co-Supervisor shall be a faculty in the parent department.

5.11 **Value Added Courses (VACs)**
5.11.1 Students may also opt to take Value Added Courses beyond the minimum credits required for the award of the Degree. VACs are outside the normal credit paradigm.

5.11.2 VACs enhance the students’ employability and life skills. VACs are listed on the University website and in the Handbook on Interdepartmental Electives and VACs.

5.11.3 Each VAC carries 2 credits with 30 hours of instruction, of which 60% (18 hours) shall be Theory and 40% (12 hours) Practical.
5.11.4 Classes for VACs are conducted beyond the regular class hours and preferably in the VIII and IX Semesters.

5.12 **Online Courses**
5.12.1 The Heads of Departments shall facilitate enrolment of students in Massive Open Online Courses (MOOCs) platform such as SWAYAM to provide academic flexibility and enhance the academic career of students.

5.11.2 Students who successfully complete a course in the MOOC platform shall be exempted from one elective course of the programme.

5.12 **Credit Distribution**

The credit distribution is detailed in the Table.

<table>
<thead>
<tr>
<th>Semester I to VI</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Language-I (Tamil or any other Language)</td>
<td>12</td>
</tr>
<tr>
<td>Language-II (English)</td>
<td>12</td>
</tr>
<tr>
<td>Core Courses</td>
<td>60-65</td>
</tr>
<tr>
<td>Allied-I</td>
<td>10</td>
</tr>
<tr>
<td>Allied-II</td>
<td>10</td>
</tr>
<tr>
<td>Electives</td>
<td>15</td>
</tr>
<tr>
<td>Soft skills</td>
<td>12</td>
</tr>
<tr>
<td>Environmental studies (UGC mandated)</td>
<td>2</td>
</tr>
<tr>
<td>Value Education</td>
<td>2</td>
</tr>
<tr>
<td>Experiential learning</td>
<td>4</td>
</tr>
<tr>
<td>Extension activities</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total Credits (Semester I to VI)</strong></td>
<td><strong>140-145</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Semester VII to X</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core Courses</td>
<td>65-75</td>
</tr>
<tr>
<td>Electives</td>
<td>15</td>
</tr>
<tr>
<td>Project</td>
<td>6-8</td>
</tr>
<tr>
<td><strong>Total Credits (Semester VII to X)</strong></td>
<td><strong>90-95</strong></td>
</tr>
</tbody>
</table>

| Total Credits Semester I to X (Minimum requirement for the award of Degree) | *230-240* |

*Each Department shall fix the minimum required credits for award of the Degree within the prescribed range of 230-240 credits.*

5.13 **Credit Assignment**

Each course is assigned credits and credit hours on the following basis:

1. Credit is defined as
2. 1 Lecture period of one hour per week over a semester
3. 1 Tutorial period of one hour per week over a semester
4. 1 Practical/Project period of two or three hours (depending on the discipline) per week over a semester.

6 **Attendance**

6.1 Each faculty handling a course shall be responsible for the maintenance of *Attendance and Assessment Record* for students who have registered for the course.

6.2 The Record shall contain details of the students’ attendance, marks obtained in the Continuous Internal Assessment (CIA) Tests, Assignments and Seminars. In addition the Record shall also contain the organisation of lesson plan of the Course Instructor.
6.3 The record shall be submitted to the Head of the Department once a month for monitoring the attendance and syllabus coverage.

6.4 At the end of the semester, the record shall be duly signed by the Course Instructor and the Head of the Department and placed in safe custody for any future verification.

6.5 The Course Instructor shall intimate to the Head of the Department at least seven calendar days before the last instruction day in the semester about the attendance particulars of all students.

6.6 Each student should earn a minimum of 75% attendance in the courses of the particular semester failing which he or she will not be permitted to write the End-Semester Examination. The student has to redo the semester in the next year.

6.7 Relaxation of attendance requirement up to 10% may be granted for valid reasons such as illness.

7. Mentor-Mentee System

7.1 To help the students in planning their course of study and for general advice on the academic programme, the Head of the Department will attach a certain number of students to a member of the faculty who shall function as a Mentor throughout their period of study.

7.2 The Mentors will guide their mentees with the curriculum, monitor their progress, and provide intellectual and emotional support.

7.3 The Mentors shall also help their mentees to choose appropriate electives and value-added courses, apply for scholarships, undertake projects, prepare for competitive examinations such as NET/SET, GATE etc., attend campus interviews and participate in extracurricular activities.

8. Examinations

8.1 The examination system of the University is designed to systematically test the student's progress in class, laboratory and field work through Continuous Internal Assessment (CIA) Tests and End-Semester Examination (ESE).

8.2 There will be two CIA Tests and one ESE in each semester.

8.3 The Question Papers will be framed to test different levels of learning based on Bloom's taxonomy, viz. Knowledge, Comprehension, Application, Analysis, Synthesis and Evaluation/Creativity.

8.4 Continuous Internal Assessment Tests

8.4.1 The CIA Tests shall be a combination of a variety of tools such as class tests, assignments, seminars, and viva-voce that would be suitable for the course. This requires an element of openness.

8.4.2 The students are to be informed in advance about the assessment procedures.

8.4.3 The pattern of question paper will be decided by the respective faculty.

8.4.4 CIA Test-I will cover the syllabus of the first two units while CIA Test-II will cover the last three units.
8.4.5 CIA Tests will be for one to three hours duration depending on the quantum of syllabus.

8.4.6 A student cannot repeat the CIA Test-I and CIA Test-II. However, if for any valid reason, the student is unable to attend the test, the prerogative of arranging a special test lies with the teacher in consultation with the Head of the Department.

8.5 End Semester Examinations (ESEs)
8.5.1 The ESEs for the odd semester will be conducted in November and for the even semester in May.

8.5.2 A candidate who does not pass the examination in any course(s) will be permitted to reappear in such course(s) in the subsequent semester/year.

8.5.3 The ESE will be of three hours duration and will cover the entire syllabus of the course.

9 Evaluation

9.1 Marks Distribution
9.1.1 Each course, both Theory and Practical as well as Project/Internship/Field work/In-plant training shall be evaluated for a maximum of 100 marks.

9.1.2 For the theory courses, CIA Tests will carry 25% and the ESE, 75% of the marks.

9.1.3 For the Practical courses, the CIA Tests will constitute 40% and the ESE 60% of the marks.

9.2 Assessment of CIA Tests
9.2.1 For the CIA Tests, the assessment will be done by the Course Instructor

9.2.2 For the Theory Courses, the break-up of marks shall be as follows:

<table>
<thead>
<tr>
<th></th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test-I &amp; Test-II</td>
<td>15</td>
</tr>
<tr>
<td>Seminar</td>
<td>5</td>
</tr>
<tr>
<td>Assignment</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>25</td>
</tr>
</tbody>
</table>

9.2.3 For the Practical Courses (wherever applicable), the break-up of marks shall be as follows:

<table>
<thead>
<tr>
<th></th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test-I</td>
<td>15</td>
</tr>
<tr>
<td>Test-II</td>
<td>15</td>
</tr>
<tr>
<td>Viva-voce</td>
<td>10</td>
</tr>
<tr>
<td>Record</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>40</td>
</tr>
</tbody>
</table>
9.3 **Assessment of End-Semester Examinations**
9.3.1 Double Evaluation for the ESE is done by the University Teachers.
9.3.2 In case of a discrepancy of more than 10% between the two examiners in awarding marks, third evaluation will be resorted to.

9.4 **Assessment of Project/Dissertation**
9.4.1 The Project Report/Dissertation shall be submitted as per the guidelines laid down by the University.
9.4.2 The Project Work/Dissertation shall carry a maximum of 100 marks.
9.4.3 CIA for Project will consist of Review of literature, experimentation/field work, attendance etc.
9.4.4 The Project Report evaluation and viva-voce will be conducted by a committee constituted by the Head of the Department.
9.4.5 The Project Evaluation Committee will comprise of the Head of the Department, Project Supervisor, and a senior faculty.
9.4.7 The marks shall be distributed as follows:

<table>
<thead>
<tr>
<th>Continuous Internal Assessment (25 Marks)</th>
<th>End Semester Examination (75 Marks)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Review-I 10</td>
<td>Project / Dissertation Evaluation</td>
</tr>
<tr>
<td></td>
<td>Viva-voce</td>
</tr>
<tr>
<td>Review-II: 15</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>25</td>
</tr>
</tbody>
</table>

9.5 **Assessment of Value Added Courses**
9.5.1 VACs shall be evaluated completely by Internal Examiners.
9.5.2 Two CIA Tests shall be conducted during the semester by the Department(s) offering VAC.
9.5.3 A committee consisting of the Head of the Department, faculty handling the course and a senior faculty member shall monitor the evaluation process.
9.5.4 The grades obtained in VACs will not be included for calculating the GPA.

9.6 **Passing Minimum**
9.6.1 A candidate is declared to have passed in each course if he/she secures not less than 40% marks in the ESE and not less than 50% marks in aggregate taking CIA and ESE marks together.
9.6.4 A candidate who has not secured a minimum of 50% of marks in a course (CIA + ESE) shall reappear for the course in the next semester/year.

10. **Conferment of the Master’s Degree**
A candidate who has secured a minimum of 50% marks in all courses prescribed in the programme and earned the minimum required credits shall be considered to have passed the Master’s Programme.
11. **Marks and Grading**  
11.1 The performance of students in each course is evaluated in terms of Grade Point (GP).

11.2 The sum total performance in each semester is rated by Grade Point Average (GPA) while Cumulative Grade Point Average (CGPA) indicates the Average Grade Point obtained for all the courses completed from the first semester to the current semester.

11.3 The GPA is calculated by the formula

\[
GPA = \frac{\sum_{i=1}^{n} C_i G_i}{\sum_{i=1}^{n} C_i}
\]

where, \( C_i \) is the Credit earned for the Course \( C \) in any semester; 
\( G_i \) is the Grade Point obtained by the student for the Course \( C \) and 
\( n \) is the number of Courses passed in that semester.

11.4 CGPA is the Weighted Average Grade Point of all the Courses passed starting from the first semester to the current semester.

\[
CGPA = \frac{\sum_{i=1}^{m} \sum_{j=1}^{n} C_i G_i}{\sum_{i=1}^{m} \sum_{j=1}^{n} C_i}
\]

where, \( C_i \) is the Credit earned for the Course \( C \) in any semester; 
\( G_i \) is the Grade Point obtained by the student for the Course \( C \) and 
\( m \) is the number of Courses passed in that semester. 
\( C \) is the number of semesters.

11.5 Evaluation of the performance of the student will be rated as shown in the Table.

<table>
<thead>
<tr>
<th>Letter Grade</th>
<th>Grade Points</th>
<th>Marks %</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>10</td>
<td>90 and above</td>
</tr>
<tr>
<td>A</td>
<td>9</td>
<td>80-89</td>
</tr>
<tr>
<td>B</td>
<td>8</td>
<td>70-79</td>
</tr>
<tr>
<td>C</td>
<td>7</td>
<td>60-69</td>
</tr>
<tr>
<td>D</td>
<td>6</td>
<td>55-59</td>
</tr>
<tr>
<td>E</td>
<td>5</td>
<td>50-54</td>
</tr>
<tr>
<td>RA</td>
<td>0</td>
<td>Less than 50</td>
</tr>
<tr>
<td>W</td>
<td>0</td>
<td>Withdrawn from the examination</td>
</tr>
</tbody>
</table>

11.6 **Classification of Results.** The successful candidates are classified as follows:  
11.6.1 For **First Class with Distinction**: Candidates who have passed all the courses prescribed in the Programme *in the first attempt* with a CGPA of 8.25 or above within the programme duration. Candidates who have withdrawn
from the End Semester Examinations are still eligible for First Class with Distinction (*See Section 12 for details*).

11.6.2 For **First Class**: Candidates who have passed all the courses with a CGPA of 6.5 or above.

11.6.3 For **Second Class**: Candidates who have passed all the courses with a CGPA between 5.0 to less than 6.5.

11.6.4 Candidates who obtain highest marks in all examinations at the first appearance alone will be considered for University Rank.

**11.7 Course-Wise Letter Grades**

11.7.1 The percentage of marks obtained by a candidate in a course will be indicated in a letter grade.

11.7.2 A candidate is considered to have completed a course successfully and earned the credits if he/she secures an overall letter grade other than RA.

11.7.3 A course completed successfully, cannot be repeated for the purpose of improving the Grade Point.

11.7.4 A letter grade RA indicates that the candidate shall reappear for that course. The RA Grade once awarded stays in the grade card of the student and is not deleted even when he/she completes the course successfully later. The grade acquired later by the student will be indicated in the grade sheet of the Odd/Even semester in which the student has re-appeared.

11.7.5 If a student secures RA grade in the Project Work/Field Work/Practical Work/Dissertation, he/she shall improve it and resubmit if it involves only rewriting/ incorporating the clarifications suggested by the evaluators or he/she can re-register and carry out the same in the subsequent semesters for evaluation.

**12. Provision for Withdrawal from the End Semester Examination**

12.1 The letter grade W indicates that a candidate has withdrawn from the examination.

12.2 A candidate is permitted to withdraw from appearing in the ESE for one or more courses in **ANY ONE** of the semesters **ONLY** for exigencies deemed valid by the University authorities.

12.3 Permission for withdrawal from the examination shall be granted only once during the entire duration of the programme.

12.3 Application for withdrawal shall be considered **only** if the student has registered for the course(s), fulfilled the requirements for attendance and CIA tests.

12.4 The application for withdrawal shall be made ten days prior to the commencement of the examination and duly approved by the Controller of Examinations. Notwithstanding the mandatory prerequisite of ten days notice, due consideration will be given under extraordinary circumstances.

12.5 Withdrawal is **not** granted for arrear examinations of courses in previous semesters (for which the student has secured RA Grade) and for the final semester examinations.
12.6 Candidates who have been granted permission to withdraw from the examination shall reappear for the course(s) in the subsequent semester.

12.7 Withdrawal shall not be taken into account as an appearance for the examination when considering the eligibility of the student to qualify for First Class with Distinction.

13. Academic misconduct
Any action that results in an unfair academic advantage/interference with the functioning of the academic community constitutes academic misconduct. This includes but is not limited to cheating, plagiarism, altering academic documents, fabrication/falsification of data, submitting the work of another student, interfering with other students’ work, removing/defacing department library or computer resources, stealing other students’ notes/assignments, electronically interfering with other students’/University’s intellectual property. Since many of these acts may be committed unintentionally due to lack of awareness, students shall be sensitised on issues of academic integrity and ethics.

14. Transitory Regulations
Wherever there has been a change of syllabi, examinations based on the existing syllabus will be conducted for two consecutive years after implementation of the new syllabus in order to enable the students to clear the arrears. Beyond that, the students will have to take up their examinations in equivalent subjects, as per the new syllabus, on the recommendation of the Head of the Department concerned.

15. Notwithstanding anything contained in the above pages as Rules and Regulations governing the Five Year Integrated Master’s Programmes at Annamalai University, the Syndicate is vested with the powers to revise them from time to time on the recommendations of the Academic Council.
# Programme Structure

## (For students admitted in the academic year 2019-2020)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Hours/Week</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>L</td>
<td>P</td>
</tr>
<tr>
<td>Semester-I</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19ITAC11</td>
<td>Language – I</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>19IENC12</td>
<td>Language - II</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>19ICEC13</td>
<td>Civics, Health Sciences &amp; Environmental Awareness</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>19IBOT14</td>
<td>Microbiology and Plant Pathology</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td>19IBOA15</td>
<td>Ancillary – I (Paper –I)</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td>19IBOTE16.1/16.2</td>
<td>Elective – I (DE)</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Semester -II</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19ITAC21</td>
<td>Language – I</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>19IENC22</td>
<td>Language - II</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>19ICAC23</td>
<td>Computer Applications – I</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td>19IBOT24</td>
<td>Algae, Fungi and Lichens</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td>19IBOP25</td>
<td>Practical - I (covering Microbiology, Plant Pathology, Algae, Fungi and Lichens)</td>
<td>-</td>
<td>6</td>
</tr>
<tr>
<td>19IBOA26</td>
<td>Ancillary – I (Paper –II)</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
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13
Research Methodology, Plant Bio-technology and Genetic Engineering

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Total Credits 237

Value Added Courses
On-line Courses (SWAYAM, MOOC and NPTEL)

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L- Lectures; P- Practical; C- Credits; CIA- Continuous Internal Assessment; ESE- End-Semester Examination

Note:
1. Students shall take both Department Electives (DEs) and Interdepartmental Electives (IDEs) from a range of choices available.
2. Students may opt for any Value-added Courses listed in the University website.

Department Electives (DE)
Programme Outcomes (POs)

After the completion of the M.Sc Botany Programme, the students will be in a position to

PO1 Domain knowledge: Demonstrate knowledge of basic concepts, principles and applications of the specific science discipline

PO2 Resource Utilisation: Cultivate the skills to acquire and use appropriate learning resources including library, e-learning resources, ICT tools to enhance knowledge-base and stay abreast of recent developments

PO3 Analytical and Technical Skills: Ability to handle/use appropriate tools/techniques/equipment with an understanding of the standard operating procedures, safety aspects/limitations

PO4 Critical thinking and Problem solving: Identify and critically analyse pertinent problems in the relevant discipline using appropriate tools and techniques as well as approaches to arrive at viable conclusions/solutions

PO5 Project Management: Demonstrate knowledge and scientific understanding to identify research problems, design experiments, use appropriate methodologies, analyse and interpret data and provide solutions. Exhibit organisational skills and the ability to manage time and resources

PO6 Individual and team work: Exhibit the potential to effectively accomplish tasks independently and as a member or leader in diverse teams, and in multidisciplinary settings.

PO7 Effective Communication: Communicate effectively in spoken and written form as well as through electronic media with the scientific community as well as with society at large. Demonstrate the ability to write dissertations, reports, make effective presentations and documentation.

PO8 Environment and Society: Analyse the impact of scientific and technological advances on the environment and society and the need for sustainable development

PO9 Ethics: Commitment to professional ethics and responsibilities

PO10 Life-long learning: Ability to engage in life-long learning in the context of the rapid developments in the discipline

Programme Specific Outcomes (PSOs)

By the end of the Programme, the students will be able to

PSO1 Understand the basic principles of Life forms for the scientific phenomena of Plant Science

PSO2 Understand the enumeration and description of the natural phenomena

PSO3 Appreciate the knowledge on the various branches of Botany (Plant Morphology, Anatomy, Embryology and Physiology)

PSO4 Comprehend the importance of conservation of plant resources

PSO5 Understand the various applications of plants to human welfare
Learning Objectives (LOs):
- To acquire the knowledge on micro organisms
- To know about the plant pathogens

Unit – 1
Introduction to microbiology - Scopes of microbiology – The concept of microbial species – Significance of study of microorganisms – Classification of microorganisms - Five kingdom classification – Eight kingdom classification – Three domain classification.

Unit – 2
Methods in microbiology: Microbial cultures – Physical methods – Chemical methods and Biological methods. Microbial growth – Culture media – Characterization of a medium – Types of Media and Microscopy.

Unit – 3
Virus: Morphology of Virus, Classification of Virus, Transmission of Virus- Virus-vector relationships - Structure of TMV and Bacteria phage: Bacteriophage replication – Lytic and lysogenic cycles. General account on mycoplasma

Unit – 4

Plant Pathology
Unit - 5
History of Plant Pathology – Methods of studying plant disease – Koch’s postulates – Symptoms of Plant Disease – Symptoms Causative organisms and control of the following disease:- Tikka disease (Groundnut), Smuts (Sorghum), Citrus canker- Little leaf of Brinjal, Bunchy top of Banana, Principles of plant disease control.

Text Books:

Supplementary Reading:

Course Outcomes (COs):
On the successful completion of this course the students will be able to
- CO1: Understand classification, characterization, structure of various Microorganisms
- CO2: Understand the culture methods of Microorganism
- CO3: Appreciate the genetic makeup of Microorganisms
- CO4: Comprehend the plant pathogens and control measures
- CO5: Analyze the nature of Plant disease and their symptoms

Outcome Mapping:

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16
Learning Objectives (LOs):
➢ To gain knowledge on the structure, reproduction and life cycle of Algae, Fungi and Lichens

Algae
Unit - 1

Unit – 2
Range of structure and reproduction of Chlamydomonas, Volvox, Chlorella, Sargassum, Polysiponia, Oscillatoria and Anabaena. Economic importance of algae.

Fungi
Unit - 3:
General characters of Fungi, Classification with Text/Reference to Alexopoulos and Mims – range of structure, reproduction, life history. Economic importance of fungi.
Myxomycetes - Stemonitis
Chytridiomycetes – Synchytrium
General characters- classification, life history in Oomycetes : Albugo, Pythium
Plasmodiophoromycetes : Plasmodiophora; Zygomycetes : Mucor.

Unit - 4:

Lichens:
Unit - 5:
Classification, structure, nutrition, reproduction and economic importance of Lichens:- Parmelia, Usnea. Ecological importance of Lichens.

Text Books:

Supplementary Reading:

Course Outcomes (COs):
On the successful completion of this course the students will be able to
CO1: Appreciate the comparative account of various algae
CO2: Understand the structure and reproduction of fungi
CO3: Comprehend the structure of lichens and their importance
CO4: Appreciate the economic importance of Algae, Fungi and Lichens

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Semester – II 19IBOP25: Practical - I (covering Microbiology, Plant Pathology, Algae, Fungi and Lichens)

Learning Objectives (LOs):
- To know about the microbes
- To gain knowledge on Algae, Fungi and Lichen

Microbiology and Plant Pathology
1. To study the structure of compound and dissection microscope
2. Preparation of culture media for bacteria, fungi-sterilization procedures
3. Isolation of rhizosphere, rhizoplane, phylloplane microorganisms
4. Isolation of pure culture from soil-serial dilution
5. Gram staining procedure
6. Verification of Koch’s postulates
7. Identification of Plant diseases included in the theory syllabus

Algae
Chlamydomonas, Volvox, Chlorella, Sargassum, Polysiponia, Oscillatoria and Anabaene

Fungi
Stemonitis, Synchytrium, Albugo, Pythium, Plasmodiophora, Mucor, Yeast, Penicillium, Peziza, Puccinia, Polyporus, Cercospora

Lichens
Parmelia, Usnea

Course Outcomes (COs):
On the successful completion of this course the students will be able to
CO1: Analyze the various microbes (virus and bacteria)
CO2: Analyze the algae, fungi and lichens

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Semester – III 19IBOT33: Bryophytes and Pteridophytes

Learning Objectives (LOs):
- To acquire the knowledge on the structure of Bryophytes and Pteridophytes

Unit – 1 Bryophytes
Introduction, General characteristic features, classification (Watson’s), origin and evolution and alternation of generation
Unit – 2
Life cycle, Structure and reproduction (Vegetative, Asexual and Sexual) of Marchantia, Anthoceros, Porella and Funaria

Unit – 3 Pteridophytes
Introduction, General characteristic features, classification (Reimer’s 1954) and Stelar evolution in Pteridophytes

Unit – 4
Reproduction (Vegetative, Asexual and Sexual) Apogamy and Apospory, Heterospory and Seed habit

Unit – 5
Life cycle, Structure and reproduction of Fossil forms, Rhynia and Asteroxylon, Living forms Lycopodium, Equisetum, Adiantum and Marsilea

Text Books:

Supplementary Reading:

Course Outcomes(COs):
On the successful completion of this course the students will be able to
CO1: Comprehend the Morphology and Systematic positions of Bryophytes
CO2: Appreciate the Morphology and systematic positions of Pteridophytes
CO3: Understand the economic importance of Pteridophytes
CO4: Comprehend the heterospory and the evolution of seed

Outcome Mapping:

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Learning Objectives(LOs):
➢ To gain knowledge on Bryophytes
➢ To know about the morphology of Pteridophytes.

Bryophytes:
Marchantia, Anthoceros, Porella and Funaria

Pteridophytes
Fossil Forms:
Rhynia and Asteroxylon

Living Forms:
Lycopodium, Equisetum, Adiantum and Marsilea

Course Outcomes(COs):
On the successful completion of this course the students will be able to
CO1: Identify the given Bryophytes
CO2: Identify the given Pteridophytes

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Semester – IV 19IBOT43: Gymnosperms and Palaeobotany Credits: 4 Hours: 4

Learning Objectives (LOs):
- To acquire knowledge on the structure and reproduction of Gymnosperms.
- To know the types of fossils and the techniques used to study the fossils

Gymnosperms
Unit - 1
General Characters and Classification of Gymnosperms by K.R. Sporne. Economic importance. Structure, reproduction and life cycle of Cycas

Unit - 2
External morphology, Internal structure of root, stem and leaves of Pinus, Reproduction and Life Cycle of Pinus

Unit - 3
External morphology, Internal structure of root, stem and leaves of Gnetum, Reproduction and Life cycle of Gnetum

Palaeobotany
Unit - 4
General Account of Palaeobotany. Types of fossils, process of preservation, techniques of fossil study. Study of Pollen (Palynology) – Acetolysis.

Unit - 5
Geological time scale – Determination of geological age of fossil (Carbon dating). Knowledge, Conservation and exploration of fossil fuels

Text Books:

Supplementary Reading:

Course Outcomes (COs)
On the successful completion of this course the students will be able to
CO1: Understand the knowledge on the structure and reproduction of Gymnosperms
CO2: Comprehend the economic importance of Gymnosperms
CO3: Comprehend the advanced characters of Gnetopsida
CO4: Understand the types of fossils and the techniques used for their study
CO5: Appreciate the fossil fuels and their conservations
Semester – IV
19IBOT44: Morphology of Angiosperms
Credits: 5
Hours: 5

Learning Objectives (LO):
➢ To acquire knowledge on the morphological features of angiosperms.

Unit – 1
Parts of Plant: Root – Characteristics of the root; Tap root and its modifications; Branched root modification – Pneumatophores; Adventitious root and its modification; Epiphytes, Velamen and Assimilatory roots.
The Stem – Characteristics of the Stem; Nodes, Internodes and Buds. Modifications of Stem – Aerial and Sub aerial modifications – Thorn, Phylloclade, Cladode and Bulbil.

Unit – 2
Leaf: Phyllotaxy; Parts and Types of Leaves; Stipules and their kinds; Margin, Surface and Shape of leaves; Venation; simple and compound leaves; Modification of leaves and Heterophylly.

Unit – 3
Inflorescence: Racemose and its types; Cymose and its types; Special types of Inflorescences.
Flower: Perianth; Position of floral leaves on the Thalamus. Bract and its kinds; Symmetry of the flower – Actinomorphy and Zygomorphy; Polypetalous and Gamopetalous flowers; Aestivation; Cohesion and Adhesion of stamens.
Gynoecium - Apocarpous and Syncarpous; Pistillode; Placentation; Structure and types of Ovule.

Unit – 4
Methods of pollination and process of fertilization, Double fertilization and Triple fusion - Development of Embryo: Dicot and Monocot embryos;
Seed - Albulinous and Exalbulinous seeds.

Unit – 5
Fruit: Development of Fruit – Dehiscence of fruits;
Classification - Simple – Dry dehiscent and Dry indehiscent; Splitting of Schizocarpic fruits;
Simple, fleshy and its types; Aggregate and Multiple fruits.
Dispersal of seeds and fruits.

Text Books:

Supplementary Reading:
Course Outcomes (COs)
On the successful completion of this course the students will be able to

CO1: Understand the Morphology of the root, shoot and leaf of plants
CO2: Comprehend the inflorescence type of various angiospermous plants
CO3: Appreciate the pollination mechanism involved in angiosperms
CO4: Analyze the types of fruits in Angiosperms

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Learning Objectives (LOs):
➢ To know about the characteristic features of Gymnosperms
➢ To gain knowledge of fossils

Gymnosperms:
Identification and description of Cycas, Pinus, and Gnetum

Palaeobotany:
Study of fossil types such as Impression, compression, casts, molds and petrifications.

Course Outcomes (COs):
On the successful completion of this course the students will be able to

CO1: Identify the given gymnosperms
CO2: Analyze the type of plant fossil

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Semester – V  19IBOT51: Anatomy and Embryology of Angiosperms  Credits:5  Hours:5

Learning Objectives (LO):
➢ To understand the anatomy and Embryology of Angiosperms.

Anatomy
Unit – 1:

Unit – 2:

Unit – 3:
General structure of wood; characteristics of growth rings. Leaf anatomy: Internal structure of a monocotyledons and dicotyledons leaves – Stomata and its types.
Embryology of Angiosperms:
Unit - 4:
Structure of anther and pistil – types of pollination – Microsporogenesis: Morphology, cytology, development and formation of male gametes – role of vegetative and generative nuclei – pollen wall ornamentation.

Unit - 5:
Megasporogenesis: Types and organization of the embryo sac – role of synergids and antipodal haustoria, nutrition of embryo sac – Double Fertilization – Triple fusion, Embryo development in dicot and monocots.

Text Books:

Supplementary Reading:

Course Outcomes (COs)
On the successful completion of this course the students will be able to
CO1: Comprehend the plant tissue types
CO2: Understand the anatomy of leaves and stomatal types
CO3: Comprehend the properties of wood
CO4: Understand the Microsporogenesis and Megasporogenesis
CO5: Appreciate the types of embryo in plants

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Semester – V 19IBOT52: Taxonomy of Angiosperms, Economic Botany and Evolution Credits: Hours: 4

Learning Objectives (LOs):
- To acquire the knowledge on the salient features, classification and the economic importance of angiosperms
- To find out the evolutionary concepts

Taxonomy of Angiosperms:
Unit – 1
Taxonomic hierarchy, ICN, Principles of ICN, Naming of Taxa (genus and species), author citation. Type Concept

Unit – 2
A detailed study on the diagnostic features and the economic importance of the following families
Nymphaeaceae
   Capparidaceae
   Portulacaceae
   Malvaceae
   Rutaceae
   Lythraceae

Unit - 3
   Asteraceae
   Solanaceae
   Asclepiadaceae
   Convolvulaceae
   Bignoniaceae
   Amaranthaceae
   Commelinaceae
   Zingiberaceae
   Cannaceae
   Poaceae

Economic Botany:

Unit - 4
   Importance of Economic Botany. Brief account of Binomial, sources and uses of the following : Fruits and vegetables – Mango, Papaya, Guava and Banana – Brinjal, Raphanus and cabbage. Cereals, millets, pulses and nuts-Rice, wheat, ragi, red gram, black gram, and Cashew - Fibres and fibre yielding plants – Textile fibres – Surface fibres (cotton) – Soft or bast fibres (Jute) – Hard fibres (coir) - Spices and Condiments -roots (Ferula asafoetida) underground stem (Allium cepa), bark (Cinnamomum zeylanicum) Drugs – obtained from roots, underground stems, bark, stems, leaves, flowers, fruits, seeds and entire plants

Evolution:

Unit - 5

Text Books:

Supplementary Reading:

Course Outcomes(COs):
On the successful completion of this course the students will be able to
   CO1: Understand the basic principles of systematics
   CO2: Understand the plant nomenclature
   CO3: Comprehend the specimen preparation for Herbarium
   CO4: Appreciate the diagnostic features and the economic importance of various Angiosperms.
CO5: Understand the various concepts of origin and evolution of life

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Semester – V 19IBOT53: Biological Techniques Credits:5 Hours:4

Learning Objectives(LO):
- To acquire the knowledge on various biological techniques

Unit – 1

Unit- 2
Calorimetry and Photometry – Beer- Lambers Law; Colorimeter and Spectrophotometer, Electromagnetic Spectrum, UV Spectroscopy, pH Meter, EC Meter.

Unit - 3
Chromatography: Principles and applications, mobile and stationery phase, Rf value, paper chromatography, TLC, HPLC and Ion-Exchange chromatography.

Unit - 4
Centrifugation: Principles and Applications, Types of Centrifuges, parts of centrifuges, Velocity gradient centrifugation, Differential centrifugation

Unit - 5
Electrophoresis: Principles and Applications. Separation of micro and macromolecules by Agarose Gel Electrophoresis, SDS –PAGE, Blotting techniques

Text Books:

Supplementary Reading:

Course Outcomes(COs):
On the successful completion of this course the students will be able to
CO1: Understand the working principles of various Microscopes
CO2: Comprehend various chromatographic techniques and their working principles
CO3: Appreciate the centrifugation methods
CO4: Understand the various Electrophoretic methods

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Credits: 6
Hours: 12

Learning Objectives (LOs):

- To find out the Morphology, anatomy and Taxonomy of angiosperms and the economic importance
- To study the embryology of angiosperms

Morphology of Angiosperms

1. Parts of a plant
2. Types of Root and their modifications
3. Types of Stem and their modifications
4. Types of Leaves and their modifications
5. Inflorescence and their types
6. Floral parts of monocots
7. Floral parts of dicots
8. Methods of Pollination and process of fertilization
9. Classification of fruits and their characteristic features
10. Seed structure in monocot and dicot plants
11. Mechanisms of Fruit and Seed dispersal
12. Seed Germination Methods

Anatomy:

1. Examination of Root and Shoot Apices; Maceration,
2. Study of simple tissues and complex tissues.
3. Study of cross section in monocot and dicot root.
4. Study of monocot and dicot stem
5. Study of monocot and dicot leaf.
6. Types of stomata and stomatal index.
7. Anomalous secondary thickening in Bougainvillea, Boerhaavia and Nyctanthes stem.

Embryology

1. Dissection of polinium from Calotropis
2. Dissection of embryo from Tridax and Cleome
3. Development of microsporangium, pollengrains and their variations,
4. Different types of ovary, ovules and placentation,
5. Female gametophyte – monosporic, bisporic and tetrasporic embryo sacs
6. Endosperms and their haustorial apparatus,
7. Dissection of Anther and angiosperm embryos.

Taxonomy of Angiosperms, Economic Botany and Evolution:
1. Detailed study of the families mentioned in the theory with representative species from the local area.
2. Familiarity of the binomial nomenclature of the available species from the local flora using Gamble flora.
3. Identification of family, genus, species and morphology of the useful parts of plants mentioned in the theory.
4. Darwin, Lamarck, Anatomical evidence of Evolution

Biological techniques
1. Principles, identification and components of Light, Polarizing, TEM and SEM
2. Measurement of stomatal index using micrometry
3. Fixing, Embedding and Sectioning with microtome
4. Single and Double stained slide preparation with hand and microtome sections
5. Measurement of soil pH
6. Measurement of electrical conductivity
7. Separation of biological compounds using paper and TLC chromatography
8. Electrophoresis separation of proteins by SDS-PAGE

Course Outcomes (COs):
On the successful completion of this course the students will be able to
CO1: Identify the given plant family
CO2: Identify the given plant material of economic importance
CO3: Analyze the technique involved permanent slide preparation
CO4: Understand evolutionary concepts

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Semester – VI 19IBOT61: Cytology, Genetics and Plant Breeding Credits: 5 Hours: 4

Learning Objectives (LOs):
➢ To acquire knowledge on the structure of cell and cell organelles
➢ To develop skill on genetics and Plant breeding

Unit – 1

Types of cell division – Amitosis, Mitosis and Meiosis – Karyokinesis and Cytokinesis – Significance of mitosis and meiosis.

Unit – 2

Unit – 3
Mendelian genetics – Introduction, Mendel’s laws. Monohybrid cross, Dihybrid cross, Test cross, Back cross. Non-Mendelian Genetics- Introduction, Incomplete dominance and
Interaction of genes, Multiple alleles, Quantitative inheritance, linkage and crossing over, significance of crossing over, sex determination.

Unit – 4
Construction of chromosome map in *Drosophila*. Three point cross. Mutations – Spontaneous and Induced mutations, Molecular basis of gene mutations, Point and Frame shift mutations.

**Plant Breeding**

Unit – 5
Objectives of Plant breeding, Breeding methods: Methods of Plant breeding in self and cross pollinated crops. Hybrid vigour and hybridization. Breeding for special purposes- Breeding for diseases & pest resistance – breeding for quality- breeding for hybrid varieties.

**Text Books:**

**Supplementary Reading:**

**Course Outcomes (COs):**
On the successful completion this course the students will be able to
CO1: Understand the general features of cell and cell organelles.
CO2: Comprehend the structure of Chromosomes and their types
CO3: Understand the basic principles of Mendelian genetics
CO4: Understand the effect of mutation on Plant development
CO5: Appreciate the technique involved in Plant Breeding

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Semester – VI 19IBOT62: Plant Physiology and Biochemistry Credits: 5 Hours: 5

**Learning Objectives (LO):**
➢ To acquire knowledge on Physiology and Biochemistry of plants

**Plant physiology**

Unit - 1
Absorption and translocation of minerals. Mineral nutrients – micro and macro nutrients and their role.

Unit - 2

Unit - 3
Respiration: Aerobic and anaerobic - Glycolysis, Kreb’s cycle and electron transport system, factors affecting respiration, photo-respiration and its significance.

Unit - 4
Photoperiodism, Vernalization and Senescence.

Biochemistry:
Unit - 5

Text Books:

Supplementary Reading:

Course Outcomes (COs):
On the successful completion of this course the students will be able to
CO1: Understand the importance of water in the functioning plants
CO2: Comprehend the process of Photosynthesis
CO3: Understand the plant respiration mechanism and its types
CO4: Appreciate the knowledge of Plant nitrogen Metabolism
CO5: Understand the structure, classification and properties of Carbohydrates, lipids and proteins

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Semester – VI 19IBOT63: Ecology and Biodiversity Credits: 5 Hours: 5

Learning Objectives:
- To acquire knowledge on the basic concepts of Ecology
- To know about Biodiversity and its conservation

Ecology
Unit – 1

Structure and functions of ecosystems – Producer, Consumer and Decomposer. Energy flow– Food chain, Food web, Trophic level and Ecological pyramids. Types of ecosystems. Terrestrial (Forest, Desert and Grassland) and Aquatic (Freshwater, Marine) Biogeochemical cycle: Hydrological, Gaseous and Sedimentary cycle.

Unit – 2
Natural resources – Forest, water, mineral, food, energy and land –conservation of natural resources.


Unit – 3
Pollution – causes, effects and control of: Air, Water, Soil, Thermal, Noise and Radioactive pollution. Climate change: Global warming, Acid rain, Ozone layer depletion. Disaster management- Floods, earthquake, Cyclone, Tsunami and land slide.

Biodiversity
Unit – 4
Introduction – Definition – Genetic, species and ecosystem diversity – Values of biodiversity – biodiversity at global, national and local level. India as mega diversity nation – causes for loss of biodiversity – conservation of biodiversity (In situ and Ex situ) – Hot spots of biodiversity – Endangered and Endemic species of India

Unit – 5
Principles of Phytogeography –Vegetational types of India – Endemism – Age and area hypothesis – Altitudinal and latitudinal distribution of vegetation-continuous and discontinuous distribution of vegetation - Application of Remote sensing to ecological studies.

Text Books:

Supplementary Reading:

Course Outcomes(COs):
On the successful completion of this course the students will be able to

CO1: Understand the basic and applied aspects of Environmental Biology
CO2: Understand the various types of pollution and its control measures
CO3: Comprehend the principles of biodiversity and their conservation

Outcome Mapping:

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Semester – VI  19IBOT64: Molecular Biology, Genetic Engineering and Biotechnology  
Credits:5  Hours:4

Learning Objectives(LOs):
- To study the basic concept of Molecular Biology
- To gain knowledge on applications of Genetic Engineering

Molecular Biology
Unit – 1
Nucleic Acid – structure and properties (Physical, chemical, spectroscopic and thermal), DNA types (A,B,C and Z), Watson and Crick model of DNA. DNA synthesis and replication, DNA Polymerase, Methylation of DNA, damage and repair of DNA, RNA synthesis - type, RNA polymerase role, transcription - initiation, elongation, termination, post transcriptional changes in RNA.

Unit - 2
Genetic code – Types of codons, Translation ribosomes assembly, formation of initiation complex, initiation factors, elongation and termination, Wobbel hypothesis, translational proof reading, translation inhibitors, post-translational modification of proteins, general principles of gene regulation, gene regulation in prokaryotes, Operon concepts, Lac Operon, positive and negative control, catabolite respiration- Gene silencing

Genetic Engineering
Unit - 3
Basic principles: Restriction endonucleases – method of gene transfer-Electrophoration – microinjection – plasmid and cosmids, phagemids. cDNA libraries, Southern and Northern blotting techniques

Unit – 4
Genetic Engineering of nif genes in non-leguminous plants- marker gene, enzymes, Organization and integration, Fungicidal and herbicidal resistance markers - biocontrol method of pest and disease. Transgenic plants (Bt-cotton, Bt- tomato and golden rice)

Biotechnology
Unit – 5

Text Books:
4. Sambamurthy A.V.S.S.; 2008; Molecular Biology; Narosa Publishers- New Delhi

Supplementary Reading:

Course Outcomes(COs):
On the successful completion of this course the students will be able to
CO1: Understand the molecular mechanisms of gene and protein expression
CO2: Appreciate the gene manipulations in plants
CO3: Comprehend transgenic plants and their uses
CO4: Understand the principles of tissue culture and its uses

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Semester – VI 19IBOT65: Practical – V (covering Cytology, Genetics, Plant Breeding, Plant Physiology, Biochemistry, Ecology, Biodiversity, Molecular Biology, Genetic Engineering and Biotechnology)

Credits: 6
Hours: 12

Learning Objectives (LOs):
- To study the basic principles of Cell Biology
- To know the plant physiology and biochemistry
- To study the ecological principles

Practicals

Cell Biology
1. Learning and perfecting squash and smear techniques.
2. Study of cell division: Mitosis – *Allium cepa*, *Rhoeo*.
4. Preparation of idiogram.
5. Study of special types of chromosomes

Genetics and Plant Breeding
- Monohybrid cross and test cross, Dihybrid cross and test cross, Incomplete dominance, Gene interaction, Quantitative inheritance, Sex – Linked Inheritance, Chromosome map.
- Emasculation – Cross pollination, Hybridization Techniques

Plant Physiology and Biochemistry
1. Determination of osmotic potential by plasmolytic method.
2. Effect of monochromatic light on apparent photosynthesis
3. Separation of chloroplast pigments using paper chromatographic technique
4. Estimation of chlorophyll content using Arnon’s method
5. Rice coleoptile straight growth test for Indole acetic acid
6. Estimation of Protein content
7. Estimation of Reducing sugar content
8. Estimation of Starch content
9. Estimation of Lipid content
10. Estimation of $\alpha$- amylase and $\beta$- amylase

Ecology and Biodiversity:
1. Identification of plants in Botanical Garden
2. Determination of Abundance of a particular species in a given area.
3. Determination of frequency of a particular species in a given area.
4. Determination of density of a particular species in a given area.
5. Determination of the biomass of a particular area.
6. Determination of the biotic components of pond ecosystem.
7. Determination of the biotic components of Grassland ecosystem.
8. Ecological adaptations of plants:
Hydrophytes: *Hydrilla, Eichhornia, Nymphaea*
Xerophytes: *Nerium, Casuarina, Opuntia*

9. Special mode of Nutrition (adaptation)
   (i) Symbiosis: Root nodules of blackgram
   (ii) Mycorrhiza: Root of *Pinus*
   (iii) Epiphyte: *Vanda*
   (iv) Insectivorus: *Nepenthes*
   (v) Parasitic Plant: *Cuscuta*

10. Determination of soil properties (pH, EC, moisture content, temperature, soil texture)

**Molecular Biology, Genetic Engineering and Biotechnology:**
1. Isolation of DNA from tender coconut
2. Separation of plant genomic DNA by electrophoresis
3. Quality checking of DNA by Electrophoresis
4. Southern blotting (Demonstration)
5. Western blot - detection of proteins (Demonstration)
6. Explaining the process of making Transgenic crops (Bt cotton, Bt Brinjal, Golden rice and Milk products)
7. Sterilisation of Explants
8. Preparation of Media
9. Callus, Embryo and Shoot tip culture
10. Artificial seeds and method of protection (synthetic seed)
11. Isolation of Protoplast by Enzymatic method

**Course Outcomes (COs):**
On the successful completion of this course the students will be able to
CO1: Understand cell and cell organelles
CO2: Analyze the principles of genetics and plant breeding
CO3: Understand the principles of plant physiology and biochemistry
CO4: Understand the techniques involved in genetic engineering and biotechnology
CO5: Comprehend the basic plant breeding methods

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**Semester - VII 19IBOT71: Plant Diversity – I (Algae and Bryophytes)**

**Credits:** 4

**Hours:** 4

**Learning Objectives (LOs):**
- To acquire knowledge on the structure, reproduction and life cycle of algae and Bryophytes.

**Algae**

Unit – 1
Introduction, General Characteristic features, Classification(Fritsch,1949), range of structure, reproduction and evolutionary trends of; Chlorophyceae (*Chlamydomonas, Volvox, Chlorella, Hydrodictyon, Ulothrix, Ulva, Draparnaldia, Oedogonium, Caulerpa, Acetabularia, Halimeda, Codium, Valonia, Chara, Nitella. Desmids*), Xanthophyceae (*Voucheria*) Bacillariophyceae(*Diatom*).
Range of structure, reproduction and evolutionary trends of Phaeophyceae (*Ectocarpus, Padina, Stoechospermum, Sargassum, Turbinaria*), Rhodophyceae (*Batrochospermum, Polysiphonia, Gracilaria*), and Cyanophyceae (*Microcystis, Lyngbya, Spirulina, Nostoc, Anabaena, Scytonema* and *Stigonema*).

**Unit – 3**


**Bryophytes**

**Unit- 4**


**Unit- 5**


**Text Books:**

**Supplementary Reading:**

**Course Outcome (COs):**
On the successful completion of this course the students will be able to

CO1: Identify, classify and describe the morphological nature of various types of algae
CO2: Understand the occurrence, structure and life cycle of algae and bryophytes
CO3: Appreciate the phylogeny and evolutionary relationship in non-flowering plants
CO4: Gain adequate knowledge on comparative account of various algae and bryophytes
CO5: Comprehend the economic importance of Algae and Bryophytes

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**Semester - VII**

19IBOT72: Fungi, Lichens and Plant Pathology

**Credits:** 4

**Hours:** 4

**Learning Objectives (LOs):**
- To study the classification, structure and reproductive features of fungi and lichens
To study the basic principles of plant pathology

Fungi

Unit – 1

Unit – 2

Lichens

Unit – 3
General account of structure and life cycle of Lichens-broad outline of classification. Structure, reproduction and lifecycle of the following types: a) *Parmelia*; b) *Usnea*. Ecological role and economic importance of lichens.

Plant Pathology

Unit – 4

Unit - 5
Etiology, Symptoms-Causative agents and Control of the following diseases: Tobacco Mosaic , Bunchy top of Banana- Leaf spot in Cotton- Sheath Blight of Paddy- Citrus canker- Soft rot in vegetables. Little leaf of Brinjal; Blast of Paddy, Red rot of Sugar cane, Leaf spot diseases of groundnut and Damping-off of vegetable seedlings. Plant disease management - Principles and methods of disease control – Chemical, Biological and Agronomical Practices - Legislation and quarantine practices in India.

Text Books:

Supplementary Reading:

Course Outcomes(COs)
On the successful completion of this course the students will be able to
CO1: Gain adequate knowledge on comparative account of various fungi, lichens and plant pathogens
CO2: Appreciate the salient features of Fungi and lichens
CO3: Appreciate the disease of various crop plants
CO4: Understand the host parasite interaction process
CO5: Appreciate the economic importance of fungi and lichens

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Semester – VII

19IBOT73: Microbiology and Immunology

Credits: 4
Hours: 4

Learning Objectives (LOs):
- To study the classification, structure and reproductive features of bacteria and viruses.
- To understand the basic concepts of immunology

Microbiology

Unit – 1
General account of Bacteria, Nutrition and growth curve of Bacteria, Methods of culturing bacteria, kinds of media and preparation techniques, – Isolation: serial dilution technique - pure culture – maintenance and preservation- inoculation of bacteria- Bacterial staining methods – Stains and dyes, Gram’s, flagellar and other types of staining.

Unit – 2

Unit – 3

Immunology

Unit – 4
Immunology – Structure and development of immune system- Types of immunity – Cells of the immune system- Innate and adaptive immunity – Antibodies- antigen antibody reactions – detailed aspects of receptor and functions of T cell and B cell. The immune response, cytokines, immunity in health and disease

Unit – 5
Text Books:

Supplementary Reading:

Course Outcomes (COs):
On the successful completion of this course the students will be able to
CO1: Analyze the classification and structure of microorganisms
CO2: Understand the various microbial culture techniques
CO3: Learn about the advantages of microorganisms to the society
CO4: Comprehend the techniques followed in immunology

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Semester – VII 19IBOP 74: Practical – I (covering Plant Diversity – I, Fungi, Lichens, Plant Pathology, Microbiology and Immunology)

Learning Objectives (LOs):
- To observe the structure of Algae, Bryophytes, Fungi and Lichens
- To observe the staining methods of Microorganism
- To find out the blood group

Algae

Bryophytes
Riccia, Targionia, Marchantia, Reboulia. Dumortiera, Pallavicinia, Riccardia, Porella, Anthoceros, Sphagnum and Bryum.

Fungi:
Structure, reproduction and diagnostic features of Stemonitis, Physarum, Olpidium, Phytophthora, Peronospora, Pilobolus, Saccharomyces, Aspergillus, Xylaria, Claviceps, Peziza, Morechella, Lycoperdon, Ustilago, Polyorus, Alternaria, Fusarium

Lichens:
Collection and identification of lichen specimens and make labelled sketches of specimens. Study the external and internal structures of the types mentioned.

Plant Pathology:
Verification of Koch’s postulates. Identification of plant diseases included in theory syllabus.

Microbiology

Immunology: Blood group determination (Demonstration)

Course Outcomes (COs):
On the successful completion of this course the students will be able to
CO1: Identify the given algae, Bryophytes, fungi and Lichens
CO2: Analyze the various microorganisms
CO3: Identify the type of Blood Group

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Semester – VIII

19IBOT81: Plant Diversity – II
(Pteridophytes, Gymnosperms and Palaeobotany)
Credits: 4
Hours: 4

Learning Objectives (LOs):
➢ To acquire knowledge on living and fossils forms of Pteridophytes and Gymnosperms.

Pteridophytes
Unit – 1

Unit - 2

Gymnosperms
Unit – 3
Classification of Gymnosperms (Sporne,1965). A general account of distribution, morphology, anatomy, reproduction, phylogeny and relationship of the following orders with special reference to the genera mentioned against each order.

Cycadopsida
1. Pteridospermales
   Lyginopteridaceae : Lyginopteris, Heterangium, Lagenostoma.
   Medullosaceae : Medullosa, Trigonocarpus
   Glossopteridaceae : Glossopteris
   Caytoniaceae : Caytonia.
2. Bennettitales
   Cycadeoideaceae : Cycadeoidea.
3. Pentoxylae
   Pentoxylaceae : Pentoxylon
4. Cycadales  
   Cycadaceae: Cycas  

**Unit – 4**  
**Coniferopsida**  
1. Cordaitales.  
   Cordaitaceae: Cordaites.  
2. Coniferales.  
   Cupressaceae: Cupressus  
   Podocarpaceae: Podocarpus  
   Araucariaceae: Araucaria  
3. Taxales  
   Taxaceae: Taxus.  
4. Ginkgoales  
   Ginkgoaceae: Ginkgo  

**Gnetopsida**  
   Gnetaceae: Gnetum  


**Palaeobotany**  
**Unit – 5**  

**Text Books:**  

**Supplementary Reading:**  

**Course Outcomes (COs):**  
On the successful completion of this course the students will be able to  
CO1: Gain adequate knowledge on comparative account of Pteridophytes  
CO2: Comprehend the structure of Gymnosperms  
CO3: Understand the palaeobotany to trace the evolution of plants  
CO4: Appreciate the economic importance of Pteridology and Gymnosperms  
CO5: Understand the types of fossil fuels and their conservation  

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Learning Objectives:
- To acquire the knowledge on anatomy and embryology of vascular plants
- To apply knowledge on the organ development in plants

Plant Anatomy
Unit – 1

Unit – 2
Structure and location of tissue system- primary and secondary structure of root and stem of dicot and monocot, vascular cambium, cork cambium, periderm formation lenticels, anomalous secondary thickening, wood anatomy-physical chemical properties of wood compression and tension wood, nodal and leaf anatomy. Vascular skeleton of flower and fruit. Ecological anatomy.

Embryology
Unit - 3
Flower structure and development- Micropsporogenesis and male gametophyte development – Megasporogenesis and female gametophyte development. Pollination, fertilization, embryo development – dicot, monocot endosperms and their types

Unit - 4
Pollen pistil interaction – self imcompatibility – barrier of fertilization –control of fertilization and current concept of fertilization - polyembryony – apomixis- parthenocarpy and practical applications – experimental embryology

Morphogenesis
Unit - 5
Polarity, symmetry and totipotency. Morphogenic centres of origin and organization, differentiation, dedifferentiation, redifferentiation of cells and organs. Morphogenetic factors shoot, root, leaf development and phyllotaxy. Transition to floral meristem and floral development in Arabidopsis and Antirrhinum

Text Books:

Supplementary Reading:

Course Outcomes(COs):
On the successful completion of this course the students will be able to
CO1: Analyze the various tissues in plants, their structure and functions
CO2: Understand the secondary growth in dicot and monocot plants
CO3: Comprehend the embryo and endosperm development in plants
CO4: Appreciate the development of various organs in plants
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Semester - VII 19IBOT83: Cell Biology, Genetics and Plant Breeding Credits: 4 Hours: 4

Learning Objectives (LOs):
- To acquire the knowledge on Plant cell and cell organelles
- To understand the genetics and breeding of plants

Cell Biology
Unit – 1

Unit – 2
Cell division: Types of cell divisions, Events of cell division, Differences between mitosis and meiosis - Molecular basis of cell cycle. Synopsis, synaptinemal complex, mechanism of crossing over and formation of chiasma. Chromosomes: Types, fine structure of eukaryotic chromosome – kinetochore, chromomeres, satellite, Euchromatin and Heterochromatin- special types of chromosomes - Chromosome banding and chromosome painting. Chromosomal variation and aberration, Karyotype analysis

Genetics
Unit – 3

Unit – 4

Plant Breeding
Unit - 5

Text Books:

Supplementary Reading:
2. Gardner, Simmons, Snustad; 2006; Principles of Genetics; Wiley student edition.

Course Outcomes(COs):
On the successful completion of this course the students will be able to
CO1: Understand the structure of cell and cell organelles
CO2: Appreciate the cell division
CO3: Comprehend the Mendelian principles of Genetics
CO4: Understand the mutational changes in plants
CO5: Appreciate the Principles of Plant breeding

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Credits: 6
Hours: 12

Learning Objectives(LOs):
- To find out the cell structure and cell organelles
- To know about the Mendalian inheritance
- To gain knowledge on various propagation methods

Pteridology

Gymnosperms
- Identification and characteristic features of Lyginopteris, Heterangium, Lagenostoma, Trignocarpus, Cycas, Cupressus, Podocarpus, Araucaria, Ginkgo, and Gnetum.

Palaeobotany
- Compression, Impression, Petrified Fossils, Cast and mold, Amber and coal ball

Anatomy:
- Examination of root and shoot apices; maceration, clearing and peeling techniques; primary and secondary structure of dicot, monocot stem; anomalous secondary thickening in Bougainvillaeae, Boerhaavia, Nyctanthes, Bignonia, Aristolochia, Strychnos and Dracaena. nodal anatomy – different types of nodes. Different types of stomata.
Embryology
1. Different stages of anther, embryo sac, endosperm and embryo development
2. Pollen germination and viability test
3. Dissection of embryo – Tridax, Crotalaria and Cleome
4. Endosperm and endosperm haustoria – Cucurbitaceae members

Morphogenesis
1. Wounding of young stem and study of the wound healing response
2. Effect of removal of leaf primordium and auxiliary buds

Cell Biology
1. Squash and smear techniques
2. Study of cell division – mitosis (Allium cepa, Rhoeo, Urena, Scilla)
3. Study of meiosis - (Allium cepa, Helianthus, Tredescantia flower buds)
4. Study of chromosomal aberrations and polyploidy
5. Karyotype analysis – Idiogram preparation
6. Study of special types of chromosomes

Genetics
1. Genetics problems in Mendelian inheritance, gene interaction, quantitative inheritance, multiple alleles, sex linkage and genetic maps

Plant Breeding
1. Methods of vegetative propagation – Layering, Budding and Grafting
2. Hybridization techniques

Course Outcomes (COs):
On the successful completion of this course the students will be able to
   CO1: Analyze the structure of cell division
   CO2: Analyze the chromosome types
   CO3: Understand the Mendalian inheritance
   CO4: Comprehend the various Plant propagation methods

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Semester - IX 19IBOT91: Taxonomy of Angiosperms and Economic Botany Credits: 3 Hours: 4

Learning Objectives (LO):
➢ To acquire knowledge on morphology, taxonomy and the economic importance of Angiosperms.

Taxonomy of Angiosperms
Unit 1
Essentials of taxonomy. Historical account on classification of angiosperms.
A detailed account of the systems of classification of Linnaeus, Bentham and Hooker, Engler and Prantl and a general account on the system of classification of Takhtajan.
Chemothaxonomy and Numerical taxonomy. APG IV System and its significance.
Nomenclature and taxonomical techniques. Plant Nomenclature – Brief history on the origin and development of nomenclature; Detailed study of the major provisions of the International Code of Nomenclature (ICN) for algae, fungi and plants– Effective and valid
publications, Role of priority and its limitation, typification, different kinds of types, author citation, rejection and retention of names and conserved names.

Unit- 2
Methods of Plant exploration; Management of herbaria, major herbaria in India and the World, Specimen preparation for herbarium, Role of herbaria in taxonomy. Botanical Survey of India (BSI).

Unit – 3
A detailed study of the following families with their interrelationship and phylogeny
- Annonaceae
- Portulacaceae
- Sterculiaceae
- Zygophyllaceae
- Rhamnaceae
- Sapindaceae
- Fabaceae
- Combretaceae
- Myrtaceae
- Lythraceae
- Passifloraceae
- Cucurbitaceae
- Apiaceae

Unit – 4
A detailed study of the following families with their interrelationship and phylogeny
- Rubiaceae
- Apocynaceae
- Gentianaceae
- Boraginaceae
- Scrophulariaceae
- Acanthaceae
- Lamiaceae
- Nyctaginaceae
- Verbenaceae
- Euphorbiaceae
- Casuarinaceae
- Liliaceae
- Poaceae

Economic Botany
Unit – 5
A brief account of botany, cultivation and utilization of cereals, pulses, nuts, vegetables and fruits - spices and condiments- fats and oils-essential oils- commercial crops- wheat, cotton and sugarcane, fibres, timbers- tannins, resins, alkaloids- Drug yielding plants- Plants as a source of renewable energy – Ethnobotany and its importance.

Text Books:

**Supplementary Reading:**

**Course Outcomes (COs):**
On the successful completion of this course the students will be able to
- CO1: Understand the classification and nomenclature of plants
- CO2: Appreciate the application of computers in plant taxonomy
- CO3: Comprehend the characteristic features of various families of angiosperms
- CO4: Understand the economic importance of Angiospermic plants

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**Semester - IX**
**IBOT92: Biochemistry and Molecular Biology**

**Credits:** 4  
**Hours:** 4

**Learning Objectives (LO):**
- To acquire the knowledge on biochemistry and Molecular biology of plants

**Biochemistry**

**Unit – 1**
- Carbohydrates: Classification of carbohydrates; Structure and properties of monosaccharides, Oligosaccharides, Polysaccharides – Glycoproteins. Protein and Amino acids: Structure, Classification and properties; Peptides - Structure: Primary, secondary, Ramachandran plot, tertiary and quaternary structures. Classification of Lipids: Structure and properties of fatty acids, phospholipids, glycolipids, lipoproteins, cholesterol - structure and functions. Nucleic acid (DNA and RNA) – Chemical composition, properties, Watson and Crick structure of DNA, types and functions of RNA

**Unit – 2**

**Molecular Biology**

**Unit – 3**
Unit - 4


Unit – 5


Text Books:
3. Sambamurty A.V.S.S.; 2008; Molecular Biology; Narosa Publishers- New Delhi

Supplementary Reading:

Course Outcomes (COs):
On the successful completion of this course the students will be able to
CO1: Understand the structural features of carbohydrates, proteins and lipids
CO2: Appreciate the properties of enzymes
CO3: Understand the structure of DNA
CO4: Appreciate the protein synthesis

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Learning Objectives:
➢ To know the principles of various biological techniques and their applications
➢ To acquire basic knowledge on Research methodology and computer application

Unit – 1


Unit – 2
Calorimeter-Principles and Applications – Spectrophotometry – UV-visible – Infrared-
Atomic absorption Spectrophotometer – Chromatography – TLC, Column, GC, HPLC and
Affinity.
Electrophoresis – General principles – Native PAGE and SDS- PAGE – Agarose gel.
Blotting techniques- Southern, Northern and Western.
ELISA, RIA, Polymerase Chain Reaction, RAPD, RFLP, SSR, DNA finger printing
and FISH techniques

Research Methodology
Unit – 3
Scientific writing – Characteristics, Logical format for writing thesis and papers
Essential features of abstracts - components of thesis writing-
Introduction – Review of literature – Primary, secondary references
Materials and methods- Effective illustration- Tables and figures- Discussions, Reference
styles – Harvard and Van couver system

Unit – 4
IPR Patents - Patent procedures– Patenting information systems and services in
India - Trade secrets - Copy rights and Trade marks - Patenting biological materials -
Higher plants and transgenic organisms.
Plant variety protection - Plant breeder’s rights - Farmer’s rights - WTO – GATT, TRIPS.
Bioethics – Biosafety regulations, IBSC, Good Laboratory practices.

Unit – 5
Computer in Biological science, scope and prospects.
Operation system – Definition- classification- input and output devices.
Introduction to windows operating system- MS windows – MS-Word-folders, files, MS Excel
– MS Power point - creating slides – templates – animation and transitions - Data storage –
Data analysis - On line publications: Electronic journals - Internet-World Wide Web-search
engines – their functions- Email-e-access data base concepts and implication.
Biostatistics packages- Data base preparation- Graphic applications in biology.

Text Books:
   Ltd, New Delhi.
   publishers, Chennai.

Supplementary Reading:
2. Connor and Peter Woodford, 1979. Writing scientific paper in English. Pitman Publ. Co,
   U.K.
   Cambridge University Press.

Course Outcomes(COs):
On the successful completion of this course the students will be able to
CO1: Understand the basic working principles of various microscopes
CO2: Analyze the working principles of Calorimeter, Spectrophotometer, Electrophorosis.
CO3: Understand the art of scientific writing
CO4: Appreciate various patents
CO5: Comprehend the computer applications in scientific research

Outcome Mapping:
Semester - IX  
19IBOT94: Plant Biotechnology and Genetic Engineering  
Credits:4  
Hours:4

Learning Objectives (LOs):
➢ To understand different biotechnological methods  
➢ To develop skills on genetic engineering of plants

Plant Biotechnology  
Unit – 1  

Unit - 2  

Genetic Engineering  
Unit – 3  

Unit - 4  

Unit – 5  

Text Books:  

Supplementary Reading:  
Course Outcomes (COs):
On the successful completion this course the students will be able to
CO1: Understand the methods of gene transfer
CO2: Appreciate the recombinant DNA technology
CO3: Understand the applications of Biotechnology in Transgenic crop plants

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Semester - IX
19IBOP 95: Practical – III (covering Taxonomy of Angiosperms, Economic Botany, Biochemistry, Molecular Biology, Biological Techniques, Research Methodology, Plant Bio-technology and Genetic Engineering)

Credits: 6
Hours: 12

Learning Objectives (LOs):
- To identify the families of angiosperms
- To know about the various biochemical experiments
- To gain knowledge on the various experiments on Biotechnology and Genetic Engineering

Taxonomy of Angiosperms
Detailed study of the families mentioned in the theory with two representative species from the local area.
Familiarity of the binomial nomenclature of the available species from the local flora using Gamble’s flora.
Solving the taxonomical problems

Economic Botany
Identification of family, genus, species and morphology of the useful parts of plants mentioned in the theory.

Biochemistry
1. Estimation of total phenols
2. Estimation of amino acids by ninhydrin method
3. Estimation of protein
4. Extraction and estimation of lipids
5. Assay of the enzyme catalase
6. Assay of the enzyme peroxidase
7. Extraction and separation of known and unknown amino acids by using paper chromatography method
8. Estimation of reducing sugar content
9. Estimation of starch content

Molecular Biology
1. Isolation of high molecular weight genomic DNA from rice
2. Isolation of DNA from tender coconut
3. Separation of plant genomic DNA by electrophoresis
4. Qualification of Plant Genomic DNA by Spectrophotometric method
5. Quality checking of DNA by Electrophoresis
6. RAPD Techniques
7. Isolation of plasmid DNA
8. Southern blotting (Demonstration)
9. Western blot - detection of proteins (Demonstration)
Biological Techniques & Research Methodology
1. Principles, identification and components of Light, Polarizing, TEM, SEM, ELISA and PCR
2. Electrophoretic separation of proteins by native and SDS-PAGE
3. Separation of DNA with agarose gel
4. RAPD
5. Acquiring of basic skills in Internet browsing
6. Familiarization of web browsers and search engines

Plant Biotechnology & Genetic Engineering
1. Isolation of single cell protein
2. PCR – Technique with known primers
3. Bio control of plant insects using Bacillus thuringiensis
4. Bio control of plant insects using PHV.
5. Preparation of explants
6. Establishment and maintenance of carrot callus
7. Initiation and establishment of cell suspension culture of carrot
8. Embryogenesis in cultured cells of carrot
9. Microspore culture- preparation of artificial seeds

Course Outcomes (COs):
On the successful completion of this course the students will be able to

CO1: Identify the given plant family
CO2: Analyze the given instrument
CO3: Analyze the experiments related to Biotechnology and Genetic engineering

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Semester - X 19IBOT101: Plant Physiology Credits: 4 Hours: 4

Learning Objectives (LO):
➢ To acquire knowledge on physiological aspects of plants

Unit – 1

Unit – 2
Unit – 3


Nitrogen fixation (biological - symbiotic and non-symbiotic), physiology and biochemistry of nitrogen fixation

Unit – 4


Unit – 5


Text Books:

Supplementary Reading:

Course Outcomes(COs):
On the successful completion of this course the students will be able to

CO1: Understand the process of photosynthesis, respiration and nitrogen metabolism

CO2: Comprehend plant growth hormones

CO3: Understand the responses of plants to biotic and abiotic stresses

CO4: Comprehend the relationship between water and plants

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Semester - X 19IBOT102: Environmental Biology and Evolution Credits:4 Hours:4

Learning Objectives:

➢ To acquire knowledge on the components of environment.
➢ To know about Biodiversity and its conservation

**Environmental Biology**

Unit – 1

Biomagnification: Eutrophication.
Disaster Management: Earthquake, Volcanoes, Landslides and Tsunami.

Unit - 2
Biodiversity: Concepts, types, measures and distribution of diversity, Major Biomes of the world – Biogeographical zones of India- Vegetational types of India: Forest types, Grassland types.
Economic values of biodiversity, Loss of biodiversity. Endemism, Hotspots, Red data book, endangered plants and animals of India

Unit - 3

Unit - 4

**Evolution**

Unit – 5

**Text Books:**

**Supplementary Reading:**

**Course Outcomes(COs):**
On the successful completion of this course the students will be able to
CO1: Understand the ecosystem structure and functions
CO2: Comprehend the vegetation types of India
CO3: Appreciate the biodiversity conservation through In-situ and Ex-situ
CO4: Analyze the origin and evolution of life
CO5: Understand the study of vegetation

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Semester - IV 19IBOP 103: Practical – IV (covering Plant Physiology, Environmental Biology and Evolution) Credits: 6 Hours: 12

Learning Objectives (LOs):
- To know about the various Plant Physiological experiments
- To gain knowledge on the various methods of vegetation study

Plant Physiology
1. Determination of osmotic potential by plasmolytic method.
2. Determination of water potential using gravimetric method.
3. Determination of water potential using dye method (Chardakov’s method).
4. Effect of Monochromatic light on apparent photosynthesis.
5. Effect of CO\textsubscript{2} concentration on apparent photosynthesis.
7. Separation of chloroplast pigments using paper chromatographic technique.
8. Estimation of chlorophyll content using Arnon’s method.
9. Determination of rate of photosynthesis using O\textsubscript{2} electrode.
10. Experiment to study the rate of Hill activity of isolated chloroplast by dye-reduction.
11. Rice coleoptile growth test for Indole Acetic Acid.
12. Effect of Auxin on root initiation
13. Experiments to show the herbicidal action of Auxin (2-4D).
15. Estimation of Proline content
16. Estimation of Glycinebetaine content
17. Determination of Relative water content
18. Estimation of Ascorbic Acid

Methods of studying vegetation
1. Quadrat method: List quadrat, count-quadrat, minimum size of the quadrat for a given vegetation. Abundance, relative frequency, relative density and relative dominance. Important value index and polygraph charting

Pollution studies
Effect of industrial effluents on seed germination, - Estimation of dust pollution on plants. - Ecological Instruments- Ecological adaptation of plants.

Water analysis
1. Estimation of EC, pH, turbidity and TDS.
2. Estimation of sulphate and nitrate
3. Analysis of Na, K, Ca and Cl in pond water
Soil analysis
1. Estimation of EC, pH
2. Soil moisture content
3. Soil N, P, K, Ca, Mg

Evolution
Charts – Evidences of evolution, Lamarckism, Darwin and DeVries,

Course Outcomes (COs):
On the successful completion of this course the students will be able to
CO1: Understand the physiological process of plants
CO2: Analyze the various experiments related to environmental biology
CO3: Analyze the various evidences of evolution

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DEPARTMENT ELECTIVES (DE)
19IBOTE 16.1: Mushroom Cultivation

Learning Objectives (LOs):
- To introduce the potential of Mushroom as the dietary supplement
- To introduce the cultivation techniques, problems faced and management of mushroom cultivation including harvesting and processing

Unit – 1 Introduction
Historical perspectives; classification of mushrooms, nutritional and dietary values of musrooms, edible and poisonous mushrooms

Unit – 2 Compost and Composting

Unit – 3 Spaen and Spawning
Facilities required for spawn preparation. Preparation of spawn substrate, preparation of pure culture, media used in raising pure culture, culture maintenance, storage of spawn.

Unit – 4 Cultivation Techniques for Selected Mushrooms

Unit – 5 Pests Management during Mushroom Cultivation
Diseases and competitor moulds of mushrooms and their management. Dry bubble disease – Verticillium fungicola, Wet bubble disease – Mysogone perniciosia, cobweb – Clasdogotrym dendroides and Green mould - Trichoderma sp. Flies and mites

Text Books:
3) Pathak Yadav Gour.2010. Mushroom production and processing Technology. Agrobios, India

Supplementary Reading:
2) Muruc Kumar. 2014. Mushroom cultivation. Neha publishers and Distributors

Course Outcomes (COs):
On the successful completion of this course the students will be able to
CO1: Appreciate the Principle involved in Mushroom Cultivation
CO2: Comprehend the knowledge on edible and poisonous mushroom
CO3: Understand the cultivation methods of Mushroom
CO4: Appreciate the knowledge on pest and disease control methods of mushroom

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19IBOTE 16.2: Herbal Science

Learning Objectives(LOs):
✓ To study the Medicinal plants and its importance
✓ To find out the methods of cultivation and marketing of medicinal plants

Unit – 1 Morphology of Angiosperms

Unit – 2 Internal structure of Plant
Angiosperms anatomy – Tissue system- basic internal anatomical fatures of monocot and dicot root, stem, bark and leaf, fruit and seed anatomy –structure of wood- types of wood secretory cells – type, Lacticifers – germs- mucilage – resin

Unit – 3 Study of the following families – giving importance to morphological features and medicinal importance
Rutaceae, Meliaceae, Rubiaceae, Asteraceae, Aselepiadaceae, Apocynaceae, Lamiaceae, Euphorbiaceae, Liliaceae and Zingiperaceae

Unit - 4 Production technology of Medicinal crops

Unit – 5 Marketing Herbal Products
Herbal Marketing – Concept and definition – Marketing of folk and traditional medicine and raw material- herbal marketing techniques – quality control – market structure, model and price determination – Herbal Market Identification- closed marketing system and multilevel marketing (MLM) – Scope of contract farming in herbal production- Government inter reunion in herbal marketing- organizations for research and development – training needs for herbal farmers

Textbook:

Supplementary Reading:

Course Outcomes (COs):
On the successful completion of this course the students will be able to

CO1: Understand the role of Biotechnology in Fruit culture
CO2: Appreciate the cultivation of fruit trees
CO3: Comprehend the health benefits of various fruits
CO4: Appreciate the post harvest methods of fruits
CO5: Comprehend the knowledge on fruit processing industries

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19IBOTE 36.1: Floriculture

Credits:3
Hours:3

Learning Objectives (LOs):
- To acquire knowledge on the flowers and their uses
- To understand the different cultivation practices of flower crops
- To apply the knowledge on post harvest technology of ornamental flowers

Unit – 1
Present scenario and scope of floriculture in global market. Employment avenues in floriculture sector. Study of outdoor room concept: public area, private area and service area. Different features of gardens like gate, walls, arches, pergolas, paths, roads, edges, hedges, stepping stones, sun dial, bird bath, statues, water fountain, lawns, herbaceous borders, bonsai, topiary etc.

Unit – 2
Concept of CAD (Computer aided designs) for landscape designs. Methods of establishing lawns and their management including irrigation, fertilization, mowing, insect-pest and diseases and their control. Production of indoor plants and their maintenance.

Unit - 3
Commercial cultivation of rose, chrysanthemum, gladiolus, marigold, tuberose, jasmine and crossandra. Protected cultivation of commercial flower crops like rose, carnation, chrysanthemum, gerbera, orchids, antirrhinum etc. Flower arrangements: types and styles.

Unit – 4
Methods of dry flower making like air drying, embedded drying, water drying, press drying, glycerin drying, freeze drying etc. and other value added products

Unit – 5
Post-harvest handling of commercial flower crops including harvesting, pre cooling, pulsing, holding, dry and wet storage, packing, packaging and transportation.

Textbooks:

Supplementary Reading:

Course Outcomes (COs):
On the successful completion of this course the students will be able to
CO1: Comprehend cultivation methods and ornamental flower crops
CO2: Appreciate the knowledge on post harvest technology flowers
CO3: Understand the process of cultivation of indoor plants

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19IBOTE 36.1: Pomology

Credits: 3
Hours: 3

Learning Objectives (LOs):
- To acquire knowledge in the fruits and its uses
- To understand the different cultivation of fruit crops
- To apply the knowledge on post harvest technology of fruits

Unit - 1
Importance of fruit culture (economic preposition, health benefits etc.) Setting up of industry based on the fruits present position and scope of fruit processing and equipments required for setting up a processing unit. Cultivation of tropical fruits (mango, banana, papaya, sapota, pineapple etc.).

Unit - 2
Cultivation of sub-tropical fruits (pomeranate, litchi, citrus, grapes, ber, aonpla etc.) their Cultivation of temperature fruits (apple, pear, plum, Alume, Peach, apricot, walnut, almond) cultivation practices with special reference to origin, varieties (cultivars, climate, soil,
land preparation, planting, manuring, irrigation, harvesting, ripening of fruits, grading, packaging, marketing) control of insect pest and diseases. Cultivation of temperate of fruits (apple, pear, plum, peach, apricot, walnut, almond).

Unit – 3
Root stocks of different fruit crops, their propagation, nursery management. Management of rootstocks and mother stocks. Fertigation in fruit crops

Unit - 4
Role of biotechnology and micro–propagation of importance fruits crops. Orchard rejuvenation, head back and high density planting in fruits.

Unit - 5
Maturity standards, harvesting, ripening, grading of fruits etc. Mechanized harvesting of fruits. Packing, storage and value addition and value added products from fruits. Pesticide use, safety of operators and consumers, concept of minimum residue limit in fruits crops

Text Books:

Supplementary Reading:

Course Outcomes (COs):
On the successful completion of this course the students will be able to
CO1: Understand the role of Biotechnology in Fruit culture
CO2: Appreciate the cultivation of fruit trees
CO3: Comprehend the health benefits of various fruits
CO4: Appreciate the post harvest methods of fruits
CO5: Comprehend the knowledge on fruit processing industries

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19IBOTE 55.1: Biofertilizers

Learning Objectives(LOs):
✓ To gain knowledge on the various Biofertilizers

Unit – 1
Biofertilizers – Definition and types, importance of biofertilizers in agriculture

Unit – 2
Characteristics of biofertilizers- Rhizopium, Azotobactor, Azospirillum, Phosphate solubilizing microorganisms, Cyanobacteria, Azolla, Mycorrhizae

Credits: 3
Hours: 3
Unit – 3
Symbiosis: Physiology, biochemistry and molecular genetics of symbiosis – Enzyme and their regulation, nitrogenase, hydrogenase

Unit – 4
Production technology: Strain selection, sterilization, growth and fermentation, mass production of various biofertilizers.

Unit – 5
Application technology: standards and quality control, application for field and tree crops, nursery plants and seedlings. Application method for different biofertilizers.

Text Books:
1) Rangaswamy and Bagyaraj. Agricultural Microbiology. Prentice Hall India
2) Subbasrao, N.S. Biofertilizers in Agriculture

Supplementary Reading:
2. Alex Ander, M. Introduction to Soil Microbiology
3. Subbarao, N.S. Soil Microorganism and Plant growth

Course Outcomes (COs):
On the successful completion of this course the students will be able to
CO1: Understand the importance of Biofertilizers
CO2: Appreciate the production technology of Biofertilizers
CO3: Comprehend the steps involved in Biofertilizer production

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19IBOTE 55.2: Micropropagation
Credits:3
Hours:3

Learning Objectives (LOs):
✓ To gain knowledge on the various micropropagation methods of plants

Unit – 1

Unit – 2

Unit – 3
Techniques of Invitro culture for Micropropagation procedures – Establishment and stabilization- shoot multiplication – Root formation – Acclimation to greenhouse conditions.

Unit – 4
Plant Micropropagation – Herbaceous ornamentals – Forage and grain legumes and vine crops – woody legumes- Forest species – Explants used in Tissue culture – Protoplasts of Tree cultivars – Vitrification.

Unit – 5

**Text Books:**

**Supplementary Reading:**

**Course Outcomes (COs):**
On the successful completion of this course the students will be able to
CO1: Appreciate the knowledge on various vegetative propagation methods of plants
CO2: Understand the micropropagation methods of plants
CO3: Comprehend the Micropropagation methods of ornamental plants
CO4: Appreciate the various organ culture methods of plants

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**Learning Objectives (LOs):**
- To acquire knowledge and skills in herbarium keeping
- To understand the principles of herbarium management

**Unit – 1: Herbarium and Specimen collection**

**Unit – 2: Drying, mounting, preserving and labelling of specimens**
Pressing -standard and special pressing methods. Drying and drying methods of specimens. Mounting-equipment, procedure and special preservation and storage methods for algae, fungi, lichen, bryophytes, succulents and aquatic plants. Labelling-arranging and attaching specimens, annotation slips.

**Unit - 3: Physical and scientific curation**
Storing specimens, guidelines for handling specimens, labelling specimens, filling specimens, Quick guide. Scientific curation- Taxonomy and nomenclature, identifying specimens, library and literature. Collectors, itineraries, maps and gazetteers. Centralized
accessioning, recording and dispatch procedures. Preventing from insect damage. Special curation (eg succulents, palms).

**Unit - 4: Computerization, E-herbarium and arrangement**

Computerization of specimens, removing samples from specimens, removing and repairing specimens, duplicates. Collections of illustrations and photographic records. Family arrangement of specimen collections. Rearranging the collection according to a new publication. Photography of herbarium sheets and plants in the field. E-herbarium making.

**Unit - 5: Starting a new Herbarium and record keeping**

Starting a new Herbarium-purpose, determining basic needs, registering of Index herbarium, infrastructure and functional areas. Equipment and suppliers. Handling specimens and helping visitors. Herbarium services, Herbarium management. All records and correspondence concerning exchanges, loans and agreement, gifts, and accessions. Annual report.

**Textbooks:**


**Supplementary Reading:**


**Course Outcomes(COs):**

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

- **CO1:** Understand the herbarium and its types
- **CO2:** Appreciate the process of Herbarium specimen preparation
- **CO3:** Comprehend the physical and scientific curing of herbarium specimen
- **CO4:** Gain adequate knowledge on E-herbarium
- **CO5:** Understand the process involved in starting a new herbarium

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**Learning Objectives(LOs):**

- To know about the principles and scope of forest management
- To study about the forest biotechnology

**Unit - 1**

Forestry-Definition, Classification, scope of forestry, forest utilization, major and minor forest products, commercial Timber yielding plants of South India.

**Credits:3**

**Hours:3**

19IBOTE 85.2: Forest Technology
Forest types of India, social forestry village forestry, farm forest, avenues.

**Unit - 2**
Principle and scope of forest management, elements of mensuration, sampling use of diameter (Girth) height and area spacement rotation, concept of sustained yield-conservation and conservation strategies ,sustainable development.
Wild life-Important animals of South India, preservation, sanctuaries endangered species causes for destruction and need for protection- wild life preservation act.

**Unit - 3**
Elements of silviculture - silviculture of the following species:-
- Tectona grandis
- Casuarina equisitifolia
- Eucalyptus
- Bomboosa sp
- Santalum album

Silvicultural systems - clear felling, simple coppice and selection felling.

**Unit - 4**
Wood structure , physical, chemical and mechanical properties of wood. Wood preservation, wood seasoning and wood preservatives.

**Unit- 5**
Tree Improvement -Genetic variation, geographic variation, genotype and phenotype, Tree improvement methods -species introduction, hybridization, Individual tree selection, vegetative propagation, grafting, biotechnology for forestry.

**Textbooks:**

**Supplementary Reading:**
1. Agarwal A, 1985. Forest of India. as cited in P. Leelakrishnan, Environmental Law in India, Butterworths India, New Delhi

**Course Outcomes(COs):**
On the successful completion of this course the students will be able to
CO1: Understand the forest types of India
CO2: Appreciate the value of wild life conservation
CO3: Gain adequate knowledge on silviculture
CO4: Comprehend the physical, chemical and mechanical properties of wood
CO5: Understand the methods of studying the form

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Learning Objectives (LOs):
- To understand the Post harvest technology of fruits
- To study about the principles of seed storage
- To acquire knowledge on seed certification.

Unit – 1

Unit – 2
Rose, Jasmine, Crossandra, Marigold, Dhalia and Anthurium, Micropropagation of orchids- Shadenet and green house cultivation.

Unit – 3

Unit – 4
Seed production in self and cross pollinated crops. Classes of seed: Nucleus, breeder, foundation and certified seeds - Seed harvesting, seed processing, seed treatments, seed testing and seed sampling. Viability and vigour - Seed borne pathogens - Seed certification, standard inspection, legislation and seed law-enforcement.

Unit – 5
Introduction: production of fruits- quality losses of fruits, Determination of harvest maturity and handling methods - Factors affecting fruits during storage, package design, packaging types.

Textbooks:

Supplementary Reading:

Course Outcomes (COs):
On the successful completion of this course the students will be able to
CO1: Understand the forest types of India
CO2: Appreciate the value of wild life conservation
CO3: Gain adequate knowledge on silviculture
CO4: Comprehend the physical, chemical and mechanical properties of wood
CO5: Understand the methods of studying the form

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Learning Objectives (LOs):
- To acquire knowledge on medicinal and aromatic plants
- To understand antioxidant metabolism
- To study about post harvest technology in medicinal plants

Unit – 1
Medicinal and Aromatic Plants – Importance and Scope – Classification of medicinal plants – based on morphology of useful parts, habit, taxonomical, pharmacological, chemical and Ayurvedic formulations – Cultivation of medicinal and aromatic plants – History of herbal medicine- Contribution of the Egyptians, Chinese, Greeks, Arabs and Indians - Different systems of herbal medicine: Ayurveda, Siddha and Unani.

Unit – 2

Unit – 3
General properties of Alcohols, Aldehyde, Glutaraldehyde, Halogens, Phenols, Gases, Surface active agents and Metallic salts ; Secondary Metabolites - Classification, General characters, Chemical nature, Extraction and Estimation methods for Alkaloids, Flavonoids, Terpenoids and Phenolic compounds -Separation, Identification and Characterization of the potential bioactive compounds using UV, FTIR, $^1$H NMR, $^{13}$C NMR, 2D NMR,GC-MS and XRD. Bioactive molecules – Antibacterial, Antifungal, Antiplasmodial, Larvicidal and Antiviral drugs – mode of its action.

Unit – 4

Unit – 5
Post-harvest technology in medicinal plants: scope and importance. Processing and utilization – Storage of crude drugs, Adulteration with reference to plant drugs, types of adulterants and methods of adulteration, Identification of adulterants. - Importance of herbal marketing -Future prospects and constraints of the herbal drug industry - Regulatory status of herbal medicine in India.

Textbooks:
Supplementary Reading:

Course Outcomes (COs):
On the successful completion of this course the students will be able to

CO1: Understand the history of herbal medicine
CO2: Appreciate the quality control of medicinal plant preparation
CO3: Comprehend the bioactive compounds found in plants
CO4: Understand the plant defense mechanism
CO5: Gain adequate knowledge on post-harvest technology in medicinal plants

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