

PONDICHERRY UNIVERSITY  
PUDUCHERRY

B.Sc. BOTANY

*(Choice Based Credit System)*



Syllabus & Regulations

2017-2018 ONWARDS

## **REGULATIONS**

### **Choice Based Credit System**

#### **1. AIM OF THE COURSE**

The degree of **Bachelor of Science in Botany (Choice Based Credit System)** aims to introduce the students to various aspects of Plant Biology and interdisciplinary subjects. At the end of the course, the students are expected to have good working knowledge in the field of Botany and in addition knowledge gained from courses of interdisciplinary in nature.

#### **2. ELIGIBILITY FOR ADMISSION**

Candidate for admission to B.Sc. Botany shall be required to have passed H.Sc. or 10+2 or equivalent course conducted by the Government of Tamil Nadu/ Andhra Pradesh/ Kerala/ CBSE with Botany or Biology as one of the subjects of study or an examination accepted as equivalent thereto and 35 percentage of marks in Part III (aggregate/ Part- III), subject to such conditions as may be prescribed therefore. Maximum age for the admission into B.Sc. Botany programme is 22.

#### **3. DURATION OF THE COURSE**

The course shall be of **Three years** duration spread over **Six semesters**. The maximum duration to complete the course shall be Six years (including completion of arrears, if any).

#### **4. ELIGIBILITY FOR ADMISSION TO EXAMINATION:**

Seventy five (75) percentage of attendance for theory.  
Seventy five (75) percentage of attendance for practical.

#### **5. MEDIUM**

The medium of instruction shall be English.

#### **6. CHOICE BASED CREDIT SYSTEM (CBCS)**

The Choice Based Credit System (CBCS) is being introduced in affiliated colleges of Pondicherry University for select UG courses, including B.Sc. Botany, from the academic year 2017-2018 onwards in accordance with the directives of University Grants Commission (UGC). The system provides an opportunity to students to design curriculum to suit individual needs, mobility across related disciplines and institutions in both horizontal and vertical manner.

This System enables a student to obtain a degree in a subject by earning required number of credits prescribed for that degree. Number of credits earned by the student reflects knowledge or skill acquired and performance in each course is reflected in grades. The grade points earned for each course reflect the student's performance in that course.

The students should study prescribed courses like Discipline Specific Core Courses, Ability Enhancement Compulsory Courses, Skill Enhancement Courses, Public Administration, Environment Awareness etc. They are allowed to exercise choices in

selection of courses that are Discipline Specific Elective Courses, General Electives, and Modern Indian Language etc., out of those offered by departments within college or any other college/institution affiliated to Pondicherry University (PU) or any other PU recognized institutions. While allowing students to exercise choices, Pondicherry University notifies regulations by taking into account the practicality. Overall, CBCS is meant to promote student centric education instead of system centric education that is in vogue at present.

## 7. DEFINITIONS OF KEYWORDS

**7.1 Programme:** An educational program leading to award of a degree/ diploma/ certificate.

**7.2 Programme Committee:** Each Program of Study shall have a Programme Committee to oversee implementation of the program.

**7.3.1 Course:** Usually a course referred to as 'subject' is a component of the Programme of Study. All courses do not carry the same weight. This course is designed to comprise lectures/ tutorials/laboratory work/ field work/ outreach activities/ project work/ vocational training/viva/ seminars/term papers/assignments/ presentations/ self-study etc., or a combination of some of these.

**7.3.2 Core Course:** There are Core Courses in the first four semesters. These courses shall be compulsorily studied by a student.

**7.3.3 Elective Course:** Elective Course is a course which can be chosen from a pool of papers. It may be:

- Supportive to the discipline of study
- Providing an expanded scope
- Enabling an exposure to some other discipline/domain
- Nurturing student's proficiency/skill.

An elective may be "Generic Elective" focusing on those courses which add generic proficiency to the students. An elective may be "Discipline Centric" or may be chosen from an unrelated discipline. It may be called an "Open Elective."

**7.3.4 Foundation Course:** The Foundation Courses may be of two kinds: Compulsory Foundation and Elective foundation. "Compulsory Foundation" courses are the courses based upon the content that leads to Knowledge enhancement. They are mandatory for all disciplines. Elective Foundation courses are value-based and are aimed at providing ethical and humanistic education.

**7.3.5 Repeat Course:** If a student gets (i) less than 40% in the internal assessment and fails in the course or (ii) fails to get the required attendance, the student shall repeat the course when offered.

**7.4 Choice Based Credit System (CBCS):** The CBCS provides choice for students to select from the prescribed courses (core, elective or minor or soft skill courses etc.). Under the CBCS, the requirement for awarding a degree / diploma / certificate is prescribed in terms of number of credits to be completed by the students.

**7.5 Credit:** It is a unit by which the course work is measured. It determines the number of hours of instructions required per week:

Course Name	Credit	Hours of instruction	Weightage (credit/ hours)
MIL	1	2	0.5
ENGLISH	1	2	0.5
DSC (Theory)	1	1	1.0
DSC (Practical)	1	1	1.0
SEC	1	1	1.0
DSE (Theory)	1	1	1
DSE (Practical)	1	2	0.5
GE	1	1	1

(MIL= Modern Indian Languages, DSC= Discipline Specific Core, SEC= Skill Enhancement Course, DSE= Discipline Specific Elective, GE= Generic Elective).

**7.6 Letter Grade:** It is an index of the performance of students in a said course. Grades are denoted by letters O, A+, A, B+, B, C, P and F.

**7.7 Grade Point:** It is a numerical weight allotted to each letter grade on a 10-point scale.

**7.8 Credit Point:** It is the product of grade point and number of credits for a course.

**7.9 Semester Grade Point Average (SGPA):** It is a measure of performance of work done in a semester. SGPA is the ratio of total credit points secured by a student in various courses registered in a semester and the total course credits taken during that semester. It shall be expressed up to two decimal places.

**7.10 Cumulative Grade Point Average (CGPA):** It is a measure of overall cumulative performance of a student over all semesters. The CGPA is the ratio of total credit points secured by a student in various courses in all semesters and the sum of the total credits of all courses in all the semesters. It is expressed up to two decimal places.

**7.11 Transcript or Grade Card or Certificate:** Based on the grades earned, a grade certificate shall be issued to all the registered students after every semester. The grade certificate will display the course details (code, title, number of credits, grade secured) along with SGPA of that semester and CGPA earned till that semester.

**7.12 Academic Year:** Two consecutive (one odd + one even) semesters constitute one Academic year.

**7.13 Semester:** Each semester will consist of 15-18 weeks of academic work equivalent to 90 actual teaching days. The odd semester may be scheduled from July to December and even semester from January to June.

## 8. SCOPE AND COVERAGE

8.1 The CBCS is applicable to all full-time UG Botany approved by the Academic Council.

8.2 Teaching, learning and evaluation shall follow Semester pattern.

8.3 Students who have passed their Higher Secondary Examination under 10+2 system conducted by the Government of Tamil Nadu or any other equivalent system recognized by the Government of Puducherry based on the admission criteria laid down by Pondicherry University are eligible to apply to B.Sc. Botany. The exact eligibility criteria will be as prescribed in the regulations approved by the Academic Council of Pondicherry University on the recommendation of the BOS of the respective Departments from time to time.

8.4 Prescribed B.Sc. Botany consists of six consecutive semesters (three years). The maximum duration allowed for each student to acquire prescribed number of credits in order to complete the Programme of Study shall be twelve consecutive semesters (six years).

8.5 The academic year consists of two consecutive (one odd and one even) semesters.

8.6 The medium of instruction for all the courses, excepting Arabic, Bengali, French, Hindi, Malayalam, Sanskrit, Tamil, and Telugu, shall be English.

## 9. COURSE STRUCTURE

At least 60% (72 Credits) of the total minimum credit requirement must be earned by the student in DSC and DSE courses put together in order to obtain a degree in a specific discipline.

## 10. CREDITS

10.1 One teaching period shall be for 60 minutes duration.

10.2 Number of credits can be earned by a student for the award of B.Sc. Botany is 120. Out of these, minimum 72credits are mandatory from Discipline Specific Core Courses (DSC) and Discipline Specific Elective Courses (DSE) put together for obtaining a degree in a particular discipline. The total number of credits in each semester is 20.

## 11. REGISTRATION

11.1 Every student will be assigned a Faculty Advisor after his/her completion of admission procedure.

11.2 Based on the advice and consent of the Faculty Advisor the student shall register for a set of courses that he/she plans to take up in each semester from among those denoted by the Principal/ HOD.

11.3 The student must take the consent of the course teacher offering course(s) for registration.

11.4 The student is permitted to register for courses not exceeding 30 credits per semester. However, registration for Repeat Courses is allowed in excess of this limit.

11.5 A student, in order to retain his/her status, should register for at least a minimum of 12 credits in a semester.

11.6 Students shall have to register for the courses within the first week of a semester.

11.7 The maximum number of students to be registered in each course shall depend upon the physical/ laboratory facilities available.

11.8 The information concerning the courses to be offered in every department in a semester with credits and pre-requisites, if any, along with the time-slot shall be made available by the Botany Department of the Institution.

11.9 A student shall not be denied registration for whom the courses are Discipline Specific Core Course (DSC) or Discipline Specific Elective (DSE).

11.10 The registration for all other courses shall be done in the spirit of accommodating as many students as possible in the interest of the students.

11.11 Dropping of courses may be allowed to enable students to opt for the courses of their choice within three weeks from the date of registration.

## **12. INTRODUCTION OF COURSES**

12.1 The course code consists of four alphabets representing the discipline of study followed by three numerals. The first numeral '1' stands for level/ year of the course (year of collegiate education), 2 for second year course and 3 for third year course. The second numeral stands for semester (odd or even) and the third numeral is for the serial number of the course.

12.2 The Course Structure and Syllabus for each UG programme shall be finalized and recommended by the Board of Studies (BOS) to be placed in the School Board, and then, in the Academic Council, for consideration and approval.

12.3 The syllabi of B.Sc. Botany course shall be revised at least once in three years, to keep in tune with recent developments in knowledge and innovations. Minor revisions in the already approved syllabus of a particular course may be approved by the Chairman of the Academic Council provided there is proper justification and recommendations by the Chairpersons of the BOS and School Board.

## **13. WORKLOAD OF TEACHERS**

13.1 Every faculty member shall be assigned workload as per the UGC norms.

13.2 In addition to regular handling of classes, teachers are required to participate in preparation of detailed syllabus, designing of the teaching plan, invigilation, paper setting, evaluation of answer scripts during continuous assessment and any other duties as and when assigned by the Principal or University authorities.

13.3 Teachers shall associate with organizing practical lab sessions, field visits, industrial tours, and guided project work etc., as per directives of the Principal/ Head of the institution.

#### 14. PATTERN OF EXAMINATION

14.1 The End-Semester examination (**ESE**) for each course in B.Sc. Botany shall be conducted by the Pondicherry University for a maximum of **75 marks** and Internal Continuous Assessment (**ICA**) for **25 marks**.

14.2 Internal assessment for all theory courses shall be done on the basis of at least two Internal Assessment tests (15 marks), term papers/assignments/seminars/case demonstrations/presentations/ write-ups/viva etc. (5 marks) and attendance (5 marks). The following weightage shall be given to attendance:

95% - 100% (5 marks)

90% - 94% (4 marks)

85% - 89% (3 marks)

80% - 84% (2 marks)

75% - 79% (1 mark)

14.3 Internal Assessment for practical courses involving Laboratory/Field work/Project work is 13, marks for Practical Record is 10, 27 marks for Practical end-semester exam.

14.4 A schedule of Internal Assessment tests shall be prepared by each College commonly to all departments in the beginning of each semester. Internal Assessment marks shall be displayed a week before the commencement of end-semester examinations.

14.5 End-semester examination shall be conducted for all courses offered. The duration of the end-semester examination shall be 3 hours.

14.6 Every student has to pay examination fee per Credit basis as fixed by the University.

14.7 A schedule of end-semester examinations will be prepared and displayed by the University much in advance.

14.8 No student with less than 75% in any particular course shall be permitted to attend the end-semester examination and shall be given grade FA-failure due to lack of attendance. However, an overall condonation of 10% is permitted for valid reasons (NCC, NSS, Swachh Bharat) or medical reasons. A student who has been awarded FA shall repeat the course when offered. The Principal/Head of the Department shall ensure that the candidate is informed about the lack of attendance before the commencement of end-semester examination and confirm that such candidates are not permitted to write the examination.

14.9 To pass a course the student must secure minimum of 40 out of 100 marks (40%) in the internal and the end-semester examination put together.

14.10 A student who has earned the required number of 120 credits by clearing all the required courses shall be declared as pass even if he/she could not clear optional courses which were taken in excess of the required number of courses.

14.11 Result Passing Board for each Programme of Study shall be constituted by the Pondicherry University from time to time.

14.12 Revaluation and re totaling of the answer scripts shall be allowed within the stipulated period of time as decided by the Controller of Examinations (COE) after paying the required amount of fee.

## 15. SUPPLEMENTARY EXAMINATION

15.1 A failed student who meets the attendance requirement may be permitted to register for the next end-semester examination in the following semester itself for theory paper.(eg. for practical papers, those who failed in odd semester practical paper may be permitted to register for next odd end-semester examination).

15.2 Students who have failed due to insufficient attendance and /or less than 40% Internal Assessment marks should repeat the course as and when offered.

## 16. PROGRAMME COMMITTEE

16.1 The Programme Committee (PC) of each department shall be chaired by the Principal / Head of the institution. The HOD, all the faculty members offering DSC and DSE course and two students (one male and one female, where possible) from each class shall be Members of PC.

16.2 The PC shall meet at least once in a semester to discuss implementation of the program. The discussions and resolutions should be on adherence to time-table, proper syllabus coverage, introduction of new courses and all other issues concerning academic matters.

16.3 The minutes of the PCM must be communicated to the Chairman of BOS, Controller of Examinations and Dean, College Development Council of Pondicherry University.

## 17. GRADING AND GRADE CARD

17.1 Letter grades shall be used to assess the performance of students in each course by converting final marks (out of 100) into grades. In case of fractions the marks shall be rounded off to next integer. The following shall be used to convert marks into awarding grades:

Range of Marks	Letter Grade	Grade Point
96-100	O	10
86-95	A+	09
76-85	A	08
66-75	B+	07
56-65	B	06
46-55	C	05
40-45	P	04
Below 40	F	00
Lack of attendance	FA	00



17.2 The SGPA shall also be calculated by taking all courses taken by the student in the semester and CGPA shall also be calculated by taking all the courses taken by the student in all the semesters (refer 16 and 17).

17.3 The University shall award “class” to students who acquired 120 (see 5.6) according to the following:

CGPA	Class
9.00 – 10.00	First Class with Distinction (should not have failed in any course)
7.00 – 8.99	First Class
5.50 – 6.99	Second Class
4.00 – 5.49	Pass

17.4 The Grade card shall be issued to the students containing grades obtained by the student in the previous semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA).

The Grade card shall list the following:

- a. Title of the course taken by the student
- b. Number of credits allotted to the course
- c. The grades secured by the student in each course
- d. Total number of credits earned by the student in that semester
- e. SGPA of the student
- f. Total number of credits earned by the student till that semester
- g. CGPA of the student

## 18. FAIRNESS IN ASSESSMENT

To ensure fairness of examination and evaluation following shall be followed:

18.1 In case of at least 50% of core courses offered in different programmes across the disciplines, the assessment of the theoretical component towards the end of the semester should be undertaken by external examiners from outside the university conducting examination, who may be appointed by the Controller of Examinations. In such courses, the question papers will be set as well as assessed by external examiners.

18.2 In case of the assessment of core practical courses, the team of examiners should be constituted on 50 – 50 % basis. i.e., half of the examiners in the team should be invited from outside the University for conducting examination.

18.3 In case of the assessment of project reports / thesis / dissertation etc. the work should be undertaken by internal as well as external examiners.

## 19. COMPUTATION OF SGPA AND CGPA

Following procedure to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA) shall be followed:

19.1 The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e.,

$$\text{SGPA (Si)} = \Sigma (\text{Ci} \times \text{Gi}) / \Sigma \text{Ci}$$

Where Ci is the number of credits of the i<sup>th</sup> course and Gi is the grade point scored by the student in the i<sup>th</sup> course.

19.2 The CGPA is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme, i.e.

$$\text{CGPA} = \Sigma (\text{Ci} \times \text{Si}) / \Sigma \text{Ci}$$

where Si is the SGPA of the i<sup>th</sup> semester and Ci is the total number of credits in that semester.

19.3 The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

## 20. ILLUSTRATION OF COMPUTATION OF SGPA AND CGPA AND FORMAT FOR TRANSCRIPTS

### 20.1 Computation of SGPA and CGPA

#### 20.1.1 Illustration 1 for calculation of SGPA

The illustration is for a student who has taken six courses of given credits in a semester and performance is given in grade letter which carry certain grade point.

Course	Credit	Grade letter	Grade point	Credit Point Credit x Grade
Course 1	3	A	08	3x08 = 24
Course 2	4	B+	07	4x07 = 28
Course 3	3	B	06	3x06 = 18
Course 4	3	O	10	3x10 = 30
Course 5	3	C	05	3x05 = 15
Course 6	4	B	06	4x06 = 24
	20			139

$$\text{SGPA} = 139/20 = 6.95$$

#### 20.1.2 Illustration 2 for calculation of SGPA

A student registered for 6 (six) courses in a semester. At the end of the semester the student got A grade in a 4 credit course, A grade in 2 credit course B+ in a 3 credit course another B+ in a 3 credit course, B in a 3 credit course and F grade in a 3 credit course. Calculation of SGPA of this student is:

$$\text{SGPA} = (8 \times 4 + 8 \times 2 + 7 \times 3 + 7 \times 3 + 6 \times 3 + 0 \times 3) / (4 + 2 + 3 + 3 + 3 + 3) = (32 + 16 + 21 + 21 + 18 + 0) / 18 = 108 / 18 = 6.00 \text{ Out of } 10.00.$$

SGPA of the student is 6.00.

### 20.2 Illustration for calculation of CGPA (Example)

The illustration is for calculation of CGPA of a student who studied six semesters in a UG program.

Semester	Credits	SGPA
Semester 1	20	6.95
Semester 2	22	7.80
Semester 3	18	5.65
Semester 4	21	6.04
Semester 5	19	7.21
Semester 6	20	7.85
	Total = 120	

CGPA =

$(20 \times 6.95 + 22 \times 7.80 + 18 \times 5.65 + 21 \times 6.04 + 19 \times 7.21 + 20 \times 7.85) \text{ divided by } 120$	$= 139.00 + 171.60 + 101.70 + 126.84 + 136.99 + 157.00 = 833.13 / 120 = 6.94275 \text{ Rounded off to } 6.94$
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CGPA = 6.94. The student has passed in the program and is placed in 2nd Class.

20.3 **Transcript:** the University shall issue a transcript for each semester as given in 14.7 and a consolidated transcript indicating the performance in all semesters.

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**PONDICHERRY UNIVERSITY**  
**COURSE STRUCTURE**  
**B.Sc. BOTANY**  
**(Choice Based Credit System)**  
**(With effect from 2017-2018)**

COURSE	COURSE CODE	TITLE OF THE COURSE/ PAPER	CREDITS/ HOURS ALLOTTED	
			Lecture	Lab
<b>SEMESTER-I</b>			<b>20 Credits</b>	
MIL – 1	LARA/ LBEN/ LHIN/ LMAL/ LSAN/ LTAM/ LTEL 111	Bengali/ Hindi/ Malayalam/ Sanskrit/ Tamil/ Telugu	03/ 06	
ENGLISH – 1	ENGL 112	ENGLISH – I	03/ 06	
DSC – 1A	UBOT 111	Thallophytes, Microbes and Plant Pathology – Theory	04/ 04	
DSC – 2A	UBOT 112	Botany Supportive Paper I- Theory	04/ 04	
AECC – 1	PADM 113	Public Administration	02/02	
Practical	UBOT 111(P)*	Thallophytes, Microbes and Plant Pathology – Practical		02/02
	UBOT 112(P)	Botany Supportive Paper I- Practical		02/02
<b>SEMESTER-II</b>			<b>20 Credits</b>	
MIL – 2	LARA/ LBEN/ LHIN/ LMAL/ LSAN/ LTAM/ LTEL 121	Bengali/ Hindi/ Malayalam/ Sanskrit/ Tamil/ Telugu	03/ 06	
ENGLISH – 2	ENGL 122	ENGLISH – II	03/ 06	
DSC – 1B	UBOT 121	Archegoniatae (Bryophytes, Pteridophytes, Gymnosperms and Paleobotany)- Theory	04/ 04	
DSC – 2B	UBOT 122	Botany Supportive Paper II- Theory	04/ 04	
AECC – 2	ENVS 123	Environmental Studies	02/ 02	
Practical	UBOT 121(P)	Archegoniatae (Bryophytes, Pteridophytes, Gymnosperms and Paleobotany)- Practical		02/ 02
	UBOT 122(P)	Botany Supportive Paper II- Practical		02/ 02
<b>SEMESTER-III</b>			<b>20 Credits</b>	
MIL – 3	LARA/ BEN/ LHIN/ MAL/ LSAN/ LTAM/ LTEL 231	Bengali/ Hindi/ Malayalam/ Sanskrit/ Tamil/ Telugu	03/ 06	
ENGLISH – 3	ENGL 232	ENGLISH – III	03/ 06	
DSC – 1C	UBOT 231	Developmental Botany (Cell Biology, Angiosperm Anatomy and Embryology)- Theory	04/ 04	
DSC – 2C	UBOT 232	Medicinal Botany- Theory	04/ 04	
SEC – 1	UBOT 233	External Morphology of Angiosperms	02/ 04	

Practical	UBOT 231(P)	Developmental Botany (Cell Biology, Angiosperm Anatomy and Embryology)- Practical		02/ 02
	UBOT 232(P)	Medicinal Botany- Practical		02/ 02
<b>SEMESTER-IV 20 Credits</b>				
MIL – 4	LARA/ BEN/ LHIN/ MAL/ LSAN/ LTAM/ LTEL 241	Bengali/ Hindi/ Malayalam/ Sanskrit/ Tamil/ Telugu	03/ 06	
ENGLISH – 4	ENGL 242	ENGLISH – IV	03/ 06	
DSC – 1D	UBOT 241	Field Botany (Ecology and Angiosperm Taxonomy)- Theory	04/ 04	
DSC – 2D	UBOT 242	Economic Botany	04/ 04	
SEC – 2	UBOT 243	Herbal Botany	02/ 02	
Practical	UBOT 241(P)	Field Botany (Ecology and Angiosperm Taxonomy)- Practical		02/ 02
	UBOT 242(P)	Economic Botany - Practical		02/ 02
<b>SEMESTER-V 20 Credits</b>				
SEC – 3	UBOT 351	Genetics	02/ 02	
**DSE – 1A	UBOT 352	Molecular Biology- Theory	04/ 04	
	UBOT 353	Plant Physiology and Biochemistry- Theory	04/ 04	
**DSE – 2A	UBOT 354	Mushroom Culture - Theory	04/ 04	
	UBOT 355	Biofertilizers and Organic Farming – Theory	04/ 04	
**DSE – 3A	UBOT 356	Biostatistics and Computer Applications in Biology- Theory	04/ 04	
**GE – 1	UBOT 357	Intellectual Property Rights	03/ 03	
Practical	UBOT 352(P)	Molecular Biology- Practical		01/ 02
	UBOT 353(P)	Plant Physiology and Biochemistry- Practical		01/ 02
	UBOT 354(P)	Mushroom Culture- Practical		01/ 02
	UBOT 355(P)	Biofertilizers and Organic Farming – Practical		01/ 02
	UBOT 356(P)	Biostatistics and Computer Applications in Biology- Practical		01/ 02
<b>SEMESTER-VI 20 Credits</b>				
SEC – 4	UBOT 361	Horticulture and Plant Breeding	02/ 02	
**DSE – 1B	UBOT 362	Plant Biotechnology- Theory	04/ 04	
	UBOT 363	Project work	04/ 04	01/ 02
**DSE – 2B	UBOT 364	Horticulture- Theory	04/ 04	
**DSE – 3B	UBOT 365	Plant Tissue Culture- Theory	04/ 04	
	UBOT 366	Ethnobotany- Theory	04/ 04	
**GE – 2	UBOT 367	Green House Technology	03/ 03	
Practical	UBOT 362(P)	Plant Biotechnology- Practical		01/ 02
	UBOT 364(P)	Horticulture- Practical		01/ 02
	UBOT 365(P)	Plant Tissue culture – Practical		01/ 02
	UBOT 366(P)	Ethnobotany- Practical		01/ 02

\* Course code ending with (P) denotes practical paper.

\*\* Electives.

**Number of Courses:**

B.Sc. Botany (CBCS)	Course with Credit						
	Semester	MIL	ENG	DSC	DSE	SEC	AECC
<b>I</b>	01	01	02	-	-	01	-
<b>II</b>	01	01	02	-	-	01	--
<b>III</b>	01	01	02	-	01	-	-
<b>IV</b>	01	01	02	-	01	-	-
<b>V</b>	-	-	-	03	01	-	01
<b>VI</b>	-	-	-	03	01	-	01
<b>Total</b>	<b>04</b>	<b>04</b>	<b>08</b>	<b>06</b>	<b>04</b>	<b>02</b>	<b>02</b>
<b>Total No. of Papers = 30</b>							

**DETAILS OF COURSES FOR B.Sc. BOTANY**

**I. DSC 1 - DISCIPLINE SPECIFIC CORE –(for Botany main) (COMPULSORY)**

(Four papers)

1. Thallophytes, Microbes and Plant Pathology
2. Archegoniatae (Bryophytes, Pteridophytes, Gymnosperms and Paleobotany)
3. Developmental Botany (Cell Biology, Angiosperm Anatomy and Embryology)
4. Field Botany (Ecology and Angiosperm Taxonomy)

**DSC 2- DISCIPLINE SPECIFIC CORE- (For Zoology/ Chemistry main)**

(Two papers)

1. Botany Supportive Paper I
2. Botany Supportive Paper II

**DSC 3- DISCIPLINE SPECIFIC CORE- (For Non-Botany main)**

(Two papers)

1. Medicinal Botany
2. Economic Botany

**II. SEC- SKILL ENHANCEMENT COURSES- (for Botany main)**

(Four papers)

1. External Morphology of Angiosperms
2. Herbal Botany
3. Genetics
4. Horticulture and Plant Breeding

**III. DSE- DISCIPLINE SPECIFIC ELECTIVES**

**DSE-1A (for Botany main)**

(Any one paper)

1. Molecular Biology
2. Plant Physiology and Biochemistry

**DSE-1B (for Botany main)**

(Any one paper)

1. Plant Biotechnology
2. Project work

**DSE-2A & DSE-3A** (for Non-Botany main)

(Any two papers)

1. Mushroom Culture
2. Biofertilizers and Organic Farming
3. Biostatistics and Computer Applications in Biology

**DSE-2B & DSE- 3B** (for Non-Botany main)

(Any two papers)

1. Horticulture
2. Plant Tissue Culture
3. Ethnobotany

**IV. GE- GENERIC ELECTIVE** (for Non-Botany main)

**GE- 1**

1. Intellectual Property Rights

**GE- 2**

1. Green House Technology

**V. MIL- MODERN INDIAN LANGUAGES**

Bengali/ Hindi/ Malayalam/ Sanskrit/ Tamil/ Telugu

**VI. ENGLISH**

**VII. AECC-ABILITY ENHANCEMENT COURSES- (COMPULSORY)**

1. Public Administration
2. Environmental Studies

**Courses to be studied by B.Sc. Botany (main) students**

COURSE	COURSE CODE	TITLE OF THE COURSE/ PAPER
<b>SEMESTER-I</b>		<b>20 Credits</b>
MIL – 1	LARA/LBEN/ LHIN/ LMAL/ LSAN/ LTAM/ LTEL 111	Bengali/ Hindi/ Malayalam/ Sanskrit/ Tamil/ Telugu
ENGLISH – 1	ENGL 112	ENGLISH – I
DSC – 1A	UBOT 111	Thallophytes, Microbes and Plant Pathology- Theory
DSC – 2A	XXXX 112	Zoology I- Theory
AECC – 1	PADM 113	Public Administration
Practical	UBOT 111(P)*	Thallophytes, Microbes and Plant Pathology–Practical
	XXXX 112(P)	Zoology I- Practical
<b>SEMESTER-II</b>		<b>20 Credits</b>
MIL – 2	LARA/ LBEN/ LHIN/ LMAL/ LSAN/ LTAM/ LTEL 121	Bengali/ Hindi/ Malayalam/ Sanskrit/ Tamil/ Telugu
ENGLISH – 2	ENGL 122	ENGLISH – II
DSC – 1B	UBOT 121	Archegoniatae (Bryophytes, Pteridophytes, Gymnosperms and Paleobotany)- Theory
DSC – 2B	XXXX 122	Zoology II- Theory
AECC – 2	ENV5 123	Environmental Studies
Practical	UBOT 121(P)	Archegoniatae (Bryophytes, Pteridophytes, Gymnosperms and Paleobotany)- Practical
	XXXX 122(P)	Zoology- II- Practical
<b>SEMESTER-III</b>		<b>20 Credits</b>
MIL – 3	LARA/ BEN/ LHIN/ MAL/ LSAN/ LTAM/ LTEL 231	Bengali/ Hindi/ Malayalam/ Sanskrit/ Tamil/ Telugu
ENGLISH – 3	ENGL 232	ENGLISH – III
DSC – 1C	UBOT 231	Developmental Botany (Cell Biology, Angiosperm Anatomy and Embryology)- Theory
DSC – 2C	XXXX 232	Chemistry I- Theory
SEC – 1	UBOT 233	External Morphology of Angiosperms
Practical	UBOT 231(P)	Developmental Botany (Cell Biology, Angiosperm Anatomy and Embryology)- Practical
	XXXX 232(P)	Chemistry I- Practical
<b>SEMESTER-IV</b>		<b>20 Credits</b>
MIL – 4	LARA/ BEN/ LHIN/ MAL/ LSAN/ LTAM/	Bengali/ Hindi/ Malayalam/ Sanskrit/ Tamil/





**DISCIPLINE SPECIFIC CORE COURSES- BOTANY  
(COMPULSORY)**

## Discipline Specific Core- Botany –Paper I

### Thallophytes, Microbes and Plant Pathology

(Credits: Theory-4, Practical-2)

#### THEORY

Course Code: UBOT 111

Lectures: 60

Max. Marks =100 (ICA = 25 + ESE = 75)

#### Unit 1: Algae

(15 Lectures)

General characteristics; Ecology and distribution; Range of thallus organization and reproduction; Classification of algae (Chapman, 1970); Morphology of the following: *Nostoc*, *Oedogonium*, *Caulerpa*, *Sargassum*, *Polysiphonia*. Pigments (Phycobilins) and Economic importance of algae (Biodiesel and Single Cell Protein- *Spirulina*).

#### Unit 2: Fungi

(15 Lectures)

General characteristics, ecology and significance, range of thallus organization, cell wall composition, nutrition, reproduction and classification (Alexopoulos and Mims, 1996); Life cycle of *Dictyostelium* (Mold), *Mucor* (Zygomycota), *Aspergillus*, *Yeast* (Ascomycota), and *Agaricus* (Basidiomycota),

#### Unit 3: Lichens and Mycorrhiza

(10 Lectures)

Symbiotic Associations-Lichens: General account, Types of lichens: Crustose, Foliose and Fruticose. Reproduction and significance.

Mycorrhiza: ectomycorrhiza and endomycorrhiza and their significance.

#### Unit 4: Bacteria and Viruses

(8 Lectures)

Bacterial classification: Bergey's manual (9<sup>th</sup> edition)- outline. Gram's staining of Bacteria. Structure and reproduction of *E.coli*. Viruses- general account. Structure and reproduction of Tobacco Mosaic Virus (TMV).

#### Unit 5: Plant Pathology

(12 Lectures)

Study of diseases caused by the following: *Puccinia*, *Colletotrichum*, and *Pyricularia oryzae*.

#### PRACTICAL

1. Study of vegetative and reproductive structures of *Nostoc*, *Volvox* (electron micrographs), *Oedogonium*, *Caulerpa*, *Sargassum* and *Polysiphonia* through temporary preparations and permanent slides.

5. *Rhizopus* and *Penicillium*: Asexual stage from temporary mounts and sexual structures through permanent slides.

6. *Yeast*: Specimens/photographs and tease mounts.

7. *Agaricus*: Sectioning of gills; Culture.

8. Lichens: Study of growth forms of lichens (crustose, foliose and fruticose).

9. Mycorrhiza: ectomycorrhiza and endomycorrhiza (Photographs).

10. Study of the following diseases: *Puccinia*, *Colletotrichum* and *Pyricularia oryzae*.

#### Suggested Readings

1. Alexopoulos C.J., Mims C.W. and Blackwell M. 2002. Introductory Mycology (4<sup>th</sup> ed.). John Wiley and Sons (Asia), Singapore.

2. Gangulee H.C. and Kar A.K. 2011. College Botany (Vol. II).New Central Book Agency. Calcutta.
3. Kumar H.D. 1999. Introductory Phycology (2<sup>nd</sup>ed.). Affiliated East-West Press Pvt. Ltd. Delhi.
4. Pelczar Jr. M.J., Chan E.C.S. and Krieg N.R. 2009. Microbiology: Application Based Approach. Tata McGraw-Hill Education. New Delhi.
5. Raven P.H., Johnson G.B., Losos J.B. and Singer S.R., 2005. Biology. Tata McGraw Hill. New Delhi.
6. Sethi I.K. and Walia S.K. 2011.Text book of Fungi & Their Allies, MacMillan Publishers Pvt. Ltd. New Delhi.
7. Tortora G.J., Funke B.R. and Case C.L. 2010. Microbiology: An Introduction (10<sup>th</sup>ed.). Pearson Benjamin Cummings. U.S.A.

## Discipline Specific Core- Botany –Paper II

### Archegoniatae (Bryophytes, Pteridophytes, Gymnosperms and Paleobotany)

(Credits: Theory-4, Practical-2)

#### THEORY

Course Code: UBOT 121

Lectures: 60

Max. Marks =100 (ICA = 25 + ESE = 75)

#### Unit : Amphibians of Plant Kingdom

(12 Lectures)

Unifying features of archegoniates, Transition to land habit. Bryophytes: Alternation of generations. General characteristics, Range of thallus organization. Classification- outline (Schuster, 1966; up to family).

Morphology, anatomy and reproduction of *Marchantia* (Hornworts), *Anthoceros* (Liverworts), and *Funaria* (Mosses). (Developmental details not to be included). Economic importance of bryophytes.

#### Unit 2: Pteridophytes

(14 Lectures)

General characteristics, G.M.Smith (1955) Classification(up to Class), Introduction to early land plants.

Morphology, anatomy and reproduction of *Psilotum*, *Lycopodium*, *Equisetum* and *Marsilea*. (Developmental details not to be included). Heterospory and seed habit, stelar evolution. Economic importance of Pteridophytes.

#### Unit 3: Gymnosperms

(14 Lectures)

General characteristics, classification according to K.R.Sporne (1962; up to class).

Occurrence, external morphology, anatomy and reproduction of *Cycas*, *Pinus* and *Gnetum*. (Developmental details not to be included).

Wood yielding gymnosperms, secondary metabolites from gymnosperms.

#### Unit 4: Paleobotany

(12 Lectures)

General account on fossils and fossilization; kinds of preservation: compressions, coal balls, impressions, incrustations (Casts), petrifications (mineralized plants), compactions (Mummified plants), ambers. Geological time scale, computation of age of fossils(radio carbon dating).Economic importance of Fossils.

#### Unit 5: Fossil Botany

(12 Lectures)

Detailed study of the following fossil Pteridophytes: *Rhynia*, *Lepidodendron*.

Detailed study of the following fossil Gymnosperms: *Calamites* and *Williamsonia*.

#### PRACTICAL

External and internal morphology of the following plants:

1. *Anthoceros*.
2. *Marchantia*.
3. *Funaria*.
4. *Psilotum*.
5. *Lycopodium*.
6. *Equisetum*.
7. *Marsilea*.
8. *Cycas*.

9. *Pinus*.
10. *Gnetum*.
11. Study of the structure of fossil plants: *Rhynia*, *Lepidodendron*, *Calamites* and *Williamsonia*.

### **Suggested Readings**

1. Arnold C.A. 2008. An Introduction to Palaeobotany. Read Books. New York.
2. Bhatnagar S.P. and Moitra A. 1996. Gymnosperms. New Age International (P) Ltd Publishers. New Delhi.
3. Pandey B.P. 2012. College Botany(Vol. II). S.Chand & Company Pvt. Ltd. New Delhi.
4. Parihar N.S. 1991. An introduction to Embryophyta (Vol.I). Bryophyta. Central Book Depot. Allahabad.
5. Rashid A. 1999. An Introduction to Pteridophyta: Diversity, Development, Differentiation (2<sup>nd</sup> revised ed.). Vikas Publishing House Pvt Ltd. New Delhi.
6. Vashishta B.R. 1995. Botany for degree students: Bryophyta. S.Chand & Company Ltd. New Delhi.
7. Vashishta P.C., Sinha A.K. and Kumar A. 2010. Pteridophyta. S.Chand & Company Pvt. Ltd. New Delhi.

## Discipline Specific Core- Botany –Paper III

### Developmental Botany (Cell Biology, Angiosperm Anatomy and Embryology)

(Credits: Theory-4Practical-2)  
**THEORY**

**Course Code: UBOT 231**

**Lectures: 60**  
**Max. Marks =100 (ICA = 25 + ESE = 75)**

#### **Unit 1: Introduction to Cell Science (12 Lectures)**

Ultra-structure of Eukaryotic cell. Structure and functions of the organelles: Cell wall, Cell Membrane, Cytoskeleton, Nucleus, Mitochondria, Chloroplast, Dictyosomes.  
Overview of Cell Cycle, Mitosis and Meiosis - Molecular controls of cell cycle.

#### **Unit 2: Tissues and Organs (12 Lectures)**

Root (Histogen theory) and shoot apical meristems (Tunica-Corpus theory); Simple tissue (Parenchyma, Collenchyma, Sclerenchyma) and Complex tissues (Xylem and Phloem).  
Primary structure of dicot and monocot root, stem and leaf. Adaptive and productive systems – epidermis, cuticle, stomata-types, guard cells, subsidiary cells.

#### **Unit 3: Secondary Growth (10 Lectures)**

Vascular cambium – structure and function, fusiform initials, ray initials, seasonal activity-annual rings. Secondary growth in root and stem, periderm, Wood (heartwood and sapwood). Anomalous secondary growth (*Dracaena*).

#### **Unit 4: Organization of Flower and Pollination (12 Lectures)**

Structure of anther and pollen; Structure and types of ovules; Types of embryo sacs, organization and ultrastructure of mature embryo sac.  
Pollination mechanisms and adaptations.

#### **Unit 5: Fertilization, Embryo and Endosperm (14 Lectures)**

Double fertilization; Seed-structure, appendages and dispersal mechanisms.  
Endosperm types, structure and functions; Dicot and monocot embryo; Embryo-endosperm relationship.  
Apomixis and polyembryony: Definition, types and practical applications.

### **PRACTICAL**

1. To study eukaryotic cells with the help of light and electron micrographs.
2. Study of the photomicrographs of cell organelles.
3. To study the structure of plant cell through temporary mounts.
4. Study of mitosis and meiosis (temporary mounts and permanent slides).
5. Study of meristems through permanent slides and photographs.
6. Tissues (parenchyma, collenchyma and sclerenchyma); Macerated xylary elements, Phloem (Permanent slides, photographs)
7. Stem: Monocot: *Zea mays*; Dicot: *Helianthus*; Secondary: *Helianthus* (sections).
8. Root: Monocot: *Zea mays*; Dicot: *Helianthus*; Secondary: *Helianthus* (sections).
9. Leaf: Dicot and Monocot leaf (sections).
10. Structure of anther (young and mature), tapetum (amoeboid and secretory) (sections).
11. Types of ovules: anatropous, orthotropous, circinotropous, amphitropous/

campylotropous.

12. Female gametophyte: *Polygonum* (monosporic) type of Embryo sac Development (Permanent slides/photographs).
13. Ultrastructure of mature egg apparatus cells through electron micrographs.
14. Pollination types and seed dispersal mechanisms (including appendages, aril, caruncle) (Photographs and specimens).
15. Dissection of embryo/endosperm from developing seeds.
16. Calculation of percentage of germinated pollen in a given medium.

### **Suggested Readings**

1. Becker W.M., Kleinsmith L.J., Hardin J. and Bertoni G. P. 2009. The World of the Cell (7<sup>th</sup>ed.). Pearson Benjamin Cummings Publishing. San Francisco.
2. Bhojwani S.S. and Bhatnagar S.P. 2011. Embryology of Angiosperms (5<sup>th</sup>ed.). Vikas Publication House Pvt. Ltd. New Delhi.
3. Cooper G.M. and Hausman R.E. 2009. The Cell: A Molecular Approach. (5<sup>th</sup>ed.). ASM Press & Sunderland. Washington, D.C.
4. De Robertis E.D.P. and De Robertis E.M.F. 2006. Cell and Molecular Biology. 8<sup>th</sup>ed.). Lippincott Williams and Wilkins. Philadelphia.
5. Dickison W.C. 2000. Integrative Plant Anatomy. Academic Press. San Diego.
6. Evert R.R. 2006. Esau's Plant Anatomy. John Wiley & Sons Inc. New Jersey.
7. Fahn A. 1990. Plant Anatomy (4<sup>th</sup>ed.). Pergamon Press. Oxford.
8. Gangulee H.C., Das K.S. and Datta C. 1988. College Botany (Vol.I). New Central Book Agency (P) Ltd. Calcutta.
9. John Jothi Prakash E. 1987. A Text Book of Plant Anatomy. Emkay Publications. Delhi.
10. Karp G. 2010. Cell and Molecular Biology: Concepts and Experiments (6<sup>th</sup>ed.). John Wiley & Sons. Inc. New York.
11. Pandey B.P. 2001. Plant Anatomy. S.Chand & Company Ltd. New Delhi.
12. Rudall P.J. 2007. Anatomy of Flowering Plants: An Introduction of Structure and Development (3<sup>rd</sup>ed.). Cambridge University Press. Cambridge.



## Discipline Specific Core- Botany –Paper IV

### Field Botany (Ecology and Angiosperm Taxonomy)

(Credits: Theory-4, Practical-2)  
**THEORY**

**Course Code: UBOT 241**

**Lectures: 60**  
**Max. Marks =100 (ICA = 25 + ESE = 75)**

#### **Unit 1: Introduction and Ecological factors (12 Lectures)**

Plant as a living entity- their relationship with Biotic and Abiotic factors. Soil: origin, formation, composition, soil profile, soil erosion and conservation. Water: states of water in the environment, precipitation types. Plant habitats- their types. Adaptations of hydrophytes and xerophytes.

#### **Unit 2: Plant communities and Ecosystem (12 Lectures)**

Characters; Ecotone and edge effect; Succession; Processes and types. Structure; energy flow trophic organisation; Food chains and food webs, Ecological pyramids, production and productivity; Biogeochemical cycle; Cycle of carbon, nitrogen and phosphorous. Principles of biogeographical zones; Endemism.

#### **Unit 3: Angiosperm Taxonomy- Introduction and Identification (10 Lectures)**

Classification, Nomenclature and Identification.  
Functions of Herbaria, important herbaria and botanical gardens of the world and India (BSI); Documentation: Flora, Keys (Indented and Bracketed).  
Ranks, categories and taxonomic groups. Principles and rules (ICBN); binominal system, typification, author citation, effective and valid publication, rejection of names, principle of priority and its limitations.

#### **Unit 4: Angiosperm Classification and Polypetalae Families (14 Lectures)**

Types of classification- artificial, natural and phylogenetic. Bentham and Hooker (up to series), Engler and Prantl (upto series/ order).  
Study of the following Polypetalae families and their economic importance: Annonaceae, Rutaceae, Anacardiaceae, Fabaceae, Caesalpiniaceae, Mimosaceae and Cucurbitaceae.

#### **Unit 5: Gamopetalae, Monochlamydeae and Monocot Families (12 Lectures)**

Study of the following Gamopetalae families and their economic importance: Asteraceae, Asclepiadaceae, Solanaceae, Lamiaceae.  
Study of the following Monochlamydeae family and their economic importance: Euphorbiaceae.  
Study of the following Monocot families and their economic importance: Liliaceae, and Poaceae.

### **PRACTICAL**

1. Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer/ hygrometer, rain gauge and lux meter.
2. Determination of pH, and analysis of two soil samples for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency by rapid field test.

3. (a) Study of morphological adaptations of hydrophytes and xerophytes (four each).  
(b) Study of biotic interactions of the following: Stem parasite (*Cuscuta*), Root parasite (Orobanche), Epiphytes, Predation (Insectivorous plants).
4. Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus by species area curve method (species to be listed).
5. Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer's frequency distribution law.
6. Study of vegetative and floral characters of the families mentioned in the theory (Description, L.S. of flower, section of ovary, floral diagram/s, floral formula/e and systematic position according to Bentham & Hooker's system of classification).
7. Mounting of a properly dried and pressed specimen of any ten plant species with herbarium label (to be submitted along with Field Note).
8. Study tour (female staff should accompany girl students).

### **Suggested Readings**

1. Kormondy E.J. 1996. Concepts of Ecology (4<sup>th</sup> ed.). Prentice Hall. USA.
2. Kumaresan V. and Annie R. 2013. Taxonomy-Systematic Botany, Economic Botany, Ethnobotany. Saras Publication. Nagercoil.
3. Lawrence G.H.M. 1951. Taxonomy of Vascular Plants. Oxford & IBH Co. Pvt. Ltd. New Delhi.
4. Pandey B.P. 2005. Taxonomy of Angiosperms. S.Chand & Company Pvt. Ltd. New Delhi.
5. Pandey B.P. 2012. College Botany (Vol. II). S.Chand & Company Pvt. Ltd. New Delhi.
6. Pandey B.P. 2010. Modern Practical Botany (Vol. II). S.Chand & Company Ltd. New Delhi.
7. Sharma P.D. 2010. Ecology and Environment (8<sup>th</sup> ed.). Rastogi Publications. Meerut.
8. Simpson M.G. 2006. Plant Systematics. Elsevier Academic Press. San Diego, CA, U.S.A.
9. Singh G. 2012. Plant Systematics: Theory and Practice (3<sup>rd</sup> ed.). Oxford & IBH Pvt. Ltd. New Delhi.
10. Singh G. 2010. Plant Systematics: An Integrated Approach (3<sup>rd</sup> ed.). Science Publishers. USA.

**Discipline Specific Core- (for Zoology/ Chemistry main)**

**Botany Supportive Paper I  
(Bacteria, Algae, Fungi, Archegoniatae, Angiosperms and Economic Botany)**

**(Credits: Theory-4, Practical-2)  
THEORY**

**Course Code: UBOT 112**

**Lectures: 60  
Max. Marks =100 (ICA = 25 + ESE = 75)**

**Unit I: Monerans (12 Lectures)**

Salient features of bacterium and cyanobacterium. Ultrastructure and reproduction of *Escherichia coli* and *Nostoc*.

**Unit II: Algae and Fungi (12 Lectures)**

General characters of Algae and Fungi. Study of structure and reproduction of *Volvox* and *Oedogonium*; *Aspergillus* and *Puccinia*.

**Unit III: Archegoniatae (12 Lectures)**

Salient features of Bryophytes, Pteridophytes and Gymnosperms. Structure, reproduction and life cycle of the following genera: *Marchantia*, *Selaginella* and *Pinus*.

**Unit IV: Angiosperms (12 Lectures)**

Introduction to flower, fruit and seeds. Study of Angiospermic families: Annonaceae, Asclepiadaceae, Nyctaginaceae and Poaceae.

**Unit V: Economic Botany (12 Lectures)**

Binomial, family and morphology of the useful parts of the following categories: Cereals (rice, wheat, barley), Millets (finger millet, pearl millet, broom-corn), Pulses (green gram, ground nut, soya bean), Oils (sunflower, coconut, gingelly), Spices (clove, pepper, cardamom), Beverages (cocoa, tea, coffee) and Medicines (*Adhatoda*, ginger, *Aloe*).

**PRACTICAL**

1. Study of genera included in Unit I, II and III.
2. Study of families included in Unit IV.
3. Study of products of economic importance included in Unit V.

**Suggested Readings**

1. Kumaresan V. and Annie R. 2013. Taxonomy-Systematic Botany, Economic Botany, Ethnobotany. Saras Publication. Nagercoil.
2. Pandey B.P. College Botany (Vol.I). 2010. S.Chand and Company Ltd. New Delhi.
3. Rashid A. 1998. An introduction to Bryophyta. Vikas Publishing House (P) Ltd. New Delhi.
4. Singh G. 2010. Plant Systematics: An Integrated Approach. Science Publishers. USA.
5. Srivastava H.N. 1998. Gymnosperms. Pradeep Publications. Jalandhar.
6. Vasishta B.R., Sinha A.K. and Kumar A. 2010. Botany for degree students- Pteridophyta. S. Chand and Company Ltd. New Delhi.
7. Vasishta B.R., Sinha A.K. and Kumar A. 2011. Botany for degree students- Bryophyta. S.Chand and Company Ltd. New Delhi.

8. Vasishta P.C., Sinha A.K. and Kumar A.2006. Botany for degree students- Gymnosperms. S.Chand and Company Ltd. New Delhi.
- 9.Vasishta B.R., Sinha A.K. and Singh V.P. 2010. Botany for degree students- Algae. S.Chand and Company Ltd. New Delhi.
10. Vasishta B.R. and Sinha A.K. 2010. Botany for degree students- Fungi. S.Chand and Company Ltd. New Delhi.

**Discipline Specific Core- (for Zoology/ Chemistry main)**

**Botany Supportive Paper II  
(Cytology, Anatomy, Physiology, Microbiology and Plant Ecology)**

**(Credits: Theory-4, Practical-2)**

**THEORY**

**Course Code: UBOT 122**

**Lectures: 60**

**Max. Marks =100 (ICA = 25 + ESE = 75)**

**Unit I: Cell and Organelles**

**(10 Lectures)**

Study of plant cell organelles with emphasis on cell wall, Chloroplast, Mitochondria and Nucleus.

**Unit II: Plant Anatomy**

**(12 Lectures)**

Anatomy of primary and secondary structure of dicot- stem and root; primary structure of stem and root in monocot, anatomy of dicot and monocot leaf.

**Unit III: Plant Physiology**

**(12 Lectures)**

Brief study of mechanism of ion uptake and transport, photosynthesis (photochemical reactions, carbon assimilation reactions- $C_3$  and  $C_4$  cycles), nitrogen fixation by symbiotic bacteria and phytohormones (auxins and cytokinins).

**Unit IV: Microbiology**

**(14 Lectures)**

Survey of useful microbes: Agricultural uses of microbes: biodegradation and biodeterioration. Soil microflora- biofertilizers. Industrial uses of microbes (fermentation, alcoholic beverages); Food microbiology (microbial spoilage of food, microbial contamination of milk and water).

**Unit V: Plant Ecology**

**(12 Lectures)**

Plant Ecology: Brief study of ecosystems, plants as primary producers, food chain and food web, ecological pyramids. Forests their importance and conservation, urban and rural forestry. Plants as pollution indicators.

**PRACTICAL**

1. Study of Cell Organelles include in Unit I from electron micrographs.
2. Anatomical studies of plant parts included in Unit II.
3. To perform simple experiments as included in Unit III.
4. Study of microbes as included in Unit IV.
5. Study of ecological processes included in Unit V.

**Suggested Readings**

1. De Robertis E.D.P. and De Robertis E.M.F. 2006. Cell and Molecular Biology. 8<sup>th</sup> ed.). Lippincott Williams and Wilkins. Philadelphia.
2. Dickison W.C. 2000. Integrative Plant Anatomy. Academic Press. San Diego.
3. John JothiPrakash E. 1987. A Text Book of Plant Anatomy. Emkay Publications. Delhi.
4. Kormondy E.J. 1996. Concepts of Ecology (4<sup>th</sup>ed.). Prentice Hall, U.S.A.
5. Regland A. and Arumugan N. 2016. Fundamentals of Plant Anatomy and Microtechniques. Saras Publication. Nagercoil, Tamil Nadu.

6. Salisbury F.B. and Rose C.W. 1986. Plant Physiology(3<sup>rd</sup>ed.). CBS Publishers and Distributers. New Delhi.
7. Stanier R.V., Adelberg E.A. and Ingraham J.L. 1978. General Microbiology (4<sup>th</sup> ed.). Macmillan, London, UK.
8. Taiz L. and Zeiger E. 2010. Plant Physiology (5<sup>th</sup>ed.). Sinauer Associates Inc. U.S.A.
9. Thorpe N.O. 1984. Cell Biology. John Wiley & Sons, New York. USA.

## Discipline Specific Core- (for Non-Botany)

### Medicinal Botany

(Credits: Theory-4, Practical-2)

#### THEORY

Course Code: UBOT 232

Lectures: 60

Max. Marks =100 (ICA = 25 + ESE = 75)

#### Unit 1: Introduction

(10 Lectures)

Introduction- Health through herbs. Historical back ground, present status, scope of medicinal botany, Indian contribution to medicinal botany, Ethnobotany, a brief outline on traditional systems of medicine – Ayurvedha, Siddha, Unani, Naturopathy and Homeopathy.

#### Unit 2: Raw materials for Drugs from Plants I

(10 Lectures)

Plant secondary metabolites of medical importance: source, description of the products, chemical constituents, active principles and therapeutic uses of the following:

- i. **Carbohydrates** - Ispaghula (*Plantago ovata*), Agar (*Gracilaria*).
- ii. **Glycosides** - Senna (*Cassia* sp), *Digitalis*, *Glycorrhiza* and *Aloe*.

#### Unit 3: Raw materials for Drugs from Plants II

(16 Lectures)

Plant secondary metabolites of medical importance: source, description of the products, chemical constituents, active principles and therapeutic uses of the following:

- i. **Tannins** - *Acacia* and Myrobalan (*Terminlia chebula*).
- ii. **Fixed oils** - Groundnut oil (*Arachis hypogea*) and Castor oil (*Ricinus communis*).
- iii. **Volatile oils** - *Eucalyptus*, Clove, lemon and *Ocimum*.
- iv. **Resins** - Asafoetida and *Pinus*.
- v. **Alkaloids** - *Cinchona*, *Rauwolfia*, *Atropa*, *Opium*, *Vasaka* (*Adhatoda zeylanica*) and *Ephedra*.
- vi. **Steroids** – *Solanum* and *Dioscorea*.

#### Unit-4: Plant Toxins

(6 Lectures)

Toxins of plant origin: Allergens, Teratogens and hallucinogens from hemp and mycotoxins and aflatoxins from fungi.

#### Unit-5: Antibiotics

(12 Lectures)

Introduction to Antibiotics: Properties and Functions of antibiotics. Extraction, chemistry and therapeutic uses of the antibiotics obtained from *Penicillium*, *Aspergillus*, and *Streptomyces*. General account on neutraceuticals and cosmoceuticals.

#### PRACTICAL

1. Morphological and anatomical studies of crude drugs of plants included in the syllabus.
2. Identification of crude drugs by histochemical and phytochemical methods.
3. Identification of drug adulterants.

#### Suggested Readings

1. Evans W.C. 1989. Trease and Evans Pharmacognosy (13<sup>th</sup>ed.). Baillière Tindall. London.
2. Kadavul K. 2016. Hand Book on Utilization of Medicinal Plants. Published by author.No.9, 4<sup>th</sup> Cross Street, Vengateswara Nagar-East, Puducherry-605013.

3. Kokate C.K., Purohit A.P. and Gokhale, S.B. 2003. Pharmacognosy (23<sup>rd</sup>ed.). Nirali Prakashan. Pune.
4. Purohit and Vyas. 2008. Medicinal Plant Cultivation: A Scientific Approach (2<sup>nd</sup>ed.). Agrobios. India.
5. Trivedi P.C. 2006. Medicinal Plants: Ethnobotanical Approach. Agrobios. India.



**Discipline Specific Core- (for Non-Botany)**

**Economic Botany**

**(Credits: Theory-4, Practical-2)**

**THEORY**

**Course Code: UBOT 242**

**Lectures: 60**

**Max. Marks =100 (ICA = 25 + ESE = 75)**

**Unit 1: Origin of Crop Plants**

**(16 Lectures)**

Introduction to Economic Botany. Vavilov's centres of origin of crop plants. Origin, distribution, brief idea of cultivation and economic uses of the following Food plants:

- i. **Cereals** (rice, wheat and maize)
- ii. **Pulses** (gram, arhar and pea)
- iii. **Vegetables** (potato, tomato and onion)

**Unit 2: Fibre Plants**

**(10 Lectures)**

Origin, distribution, brief idea of cultivation and economic uses of the following Fibre plants:

- i. Cotton
- ii. Jute
- iii. Flax

**Unit 3: Timber Plants**

**(10 Lectures)**

Origin, distribution, brief idea of cultivation and economic uses of the following Timber plants:

- (i) Neem
- (ii) Teak
- (iii) Cedar

**Unit 4: Oil Plants**

**(12 Lectures)**

Origin, distribution, brief idea of cultivation and economic uses of the following Oil plants:

- i. Groundnut
- ii. Sunflower
- iii. Coconut

**Unit 4: Spices and Condiments**

**(12 Lectures)**

Origin, distribution, brief idea of cultivation and economic uses of the following Spices:

- i. Coriander
- ii. Clove
- iii. Ginger

**PRACTICAL**

1. Study of morphological features of food plants, vegetables, fibre yielding plants, oil yielding plants, Spices and Condiments.
2. Study of anatomical features of *Coriander*, Clove, Ginger *Azadirachta*, *Withania*.
3. Histochemical localization starch in rice and potato.
4. Economic significance of tea, coffee, rubber, sugarcane

**Suggested Readings:**

1. Gonsalves J. 2010. Economic Botany and Ethnobotany. International Scientific Publishing Academy. New Delhi.
2. Kumaresan V. and Annie R. 2013. Taxonomy-Systematic Botany, Economic Botany, Ethnobotany. Saras Publication. Nagercoil.
3. Kocchar S.L. 2009. Economic Botany in The Tropics (3<sup>rd</sup> ed.), MacMillan Publishers India Ltd. New Delhi.
4. Pooja. 2005. Economic Botany. Discovery Publishing House. New Delhi.
5. Sambamurthy A.V.S.S. and Subramanyam N.S. 1989. A Textbook of Economic Botany. Wiley Eastern Ltd. New Delhi.
6. Sharma O.P. 1996. Hills Economic Botany. Tata McGraw Hill Co. Ltd. New Delhi.
7. Simpson B.B. and Conner-Ogorzaly M. 1986. Economic Botany- Plants in Our World. McGraw Hill. New York.
8. Verma V. 2009. Text Book of Economic Botany. Ane Books Pvt. Ltd. New Delhi.

**SKILL ENHANCEMENT COURSES**  
**(for BOTANY main)**

**Skill Enhancement Course- (for Botany main)**

**External Morphology of Angiosperms**

**(Credits: Theory- 2)  
THEORY**

**Course Code: UBOT 233**

**Lectures: 30**

**Max. Marks =100 (ICA = 25 + ESE = 75)**

**Unit 1: History of Plant identification and Root Morphology (6 Lectures)**

Need for correct identification of plants. Plants and Health. History of morphology of Angiosperms (brief). Types of roots (adventitious and tap root), Modifications of roots- storage roots, anchorage roots, respiratory roots or pneumatophores. Economic importance of roots. Alternate foods- tubers.

**Unit 2: Stem Morphology (6 Lectures)**

Stem morphology: Forms- Erect forms (herbs, shrubs and trees), Weak forms (creepers, climbers, trailers). Modifications of stem (rhizomes, stem-tubers, bulb, corm). Runner, stolon, sucker, offset, phyllode/ cladophyll, cladode, thorn, bulbil. Alternate foods-fibre.

**Unit 3: Leaf Morphology (6 Lectures)**

Phyllotaxy, shape of leaves, leaf tip, leaf margin, leaf modifications. Stipule, petiole. Dorsiventral and isobilateral leaves. Venation: parallel and reticulate. Simple leaves and compound leaves (pinnate and foliate leaves). Unipinnate, bipinnate, tripinnate; paripinnate and imparipinnate. Trichomes of leaves.

**Unit 4: Inflorescence and Flower Morphology (6 Lectures)**

Inflorescence types: Raceme- Panicle, corymb, spike, spadix, umbel, capitulum/ head, catkin. Cyme- solitary, simple, monochasial cyme, dichasial cyme, polychasial cyme. Special types of inflorescence (hypanthodium), verticillaster, cyathium, thyrus, fascicle. Flower- a modified shoot. Peduncle, scape, bract, bracteole, calyx, corolla, androecium and gynoecium. Horticultural applications of flowers.

**Unit 5: Fruit and Seed Morphology (6 Lectures)**

Types of fruits- simple fruits (fleshy and dry fruits), compound fruits. Importance of fruits in plant classification. Seeds: a fertilized ovule. Endosperms. Fruits for crude drug preparation.

**Suggested Readings**

1. Baruah A. 2008. Advanced Morphology of Angiosperms. Aavishkar Publishers Distributors, Jaipur.
2. Gangulee H.C., Das K.S. and Dutta C. 1988. College Botany (Vol.I). New Central Book Agency. Calcutta.
3. Jones Jr. S.B. and Luchsinger A.E. 1987. Plant Systematics. McGraw-Hill Book Company. New York.
4. Lawrence G.H.M. 1951. Taxonomy of Vascular Plants. Oxford & IBH Co. Pvt. Ltd. New Delhi.
5. Simpson M.G. 2006. Plant Systematics. Elsevier Academic Press. San Diego, CA, U.S.A.
6. Singh G. 2010. Plant Systematics: An Integrated Approach (3<sup>rd</sup> ed.). Science Publishers. U.S.A.
7. Venkateswarlu V. 1974. External Morphology of Angiosperms. S.Chand & Co. (Pvt) Ltd. New Delhi.

**Skill Enhancement Course- (for Botany main)**

**Herbal Botany**

**(Credits: Theory- 2)  
THEORY**

**Course Code: UBOT 243**

**Lectures: 30**

**Max. Marks =100 (ICA = 25 + ESE = 75)**

**Unit 1: Introduction to Herbal Medicines**

**(6 Lectures)**

Herbal medicines. Definition of medical terms. Pharmacognosy- role of medicinal plants in Indian traditional medicine; cultivation - harvesting - processing - storage and utilization of medicinal plants.

**Unit 2: Pharmacognosy and Medicinal uses of Herbs**

**(6 Lectures)**

Medicinal uses of the following herbs in curing various ailments; Tulsi, Ginger, Fenugreek, Indian Goose berry (Amla) and Ashoka.

**Unit 3: Pharmacognosy**

**(6 Lectures)**

Phytochemical screening tests for secondary metabolites: alkaloids, flavonoids, steroids, triterpenoids, phenolic compounds (one example for each). Analytical pharmacognosy: Drug adulteration - types, methods of drug evaluation. Biological testing of herbal drugs.

**Unit 4: Phytochemistry of medicinal herbs**

**(6 Lectures)**

Phytochemistry–preparation of crude extracts: active principles and methods of their testing - identification and utilization of the medicinal herbs; *Catharanthus roseus* (cardiotonic), *Withania somnifera*(drugs acting on nervous system) and *Centella asiatica* (memory booster).

**Unit 5: Common medicinal formulations**

**(6 Lectures)**

Common medicinal preparation: decoction, ointment, tincture, surnas. Brief account on Traditional Knowledge Digital dictionary (TKDL).Guidelines of WHO on standard herbal medicine.

**Suggested Readings**

1. Anne Green 2000. Principles of Ayurveda. Thomsons, London.
2. Arber A. 2000. Herbal plants and Drugs: Their Origin and Evolution. Mangal Deep Publications. Jaipur.
3. Chopra R.N., Nayar S.L. and Chopra I.C. 1956.Glossary of Indian medicinal plants. C.S.I.R. New Delhi.
4. Evans W.C. 1989. Trease and Evans Pharmacognosy (13<sup>th</sup>ed.). Baillière Tindall. London.
5. KhareC.P. 2007. Indian Medicinal Plants An Illustrated Dictionary. Springer Science+ Business Media, LLC.
6. Kokate C.K., Purohit A.P. and Gokhale S.B. 1999.Pharmacognosy. Nirali Prakashan. Pune.
7. Miller L. and Miller B.1998. Ayurveda and Aromatherapy: The Earth Essential Guide to Ancient Wisdom and Modern Healing. Lotus Press.USA.
8. Sivarajan V.V. and Indra B. 1994. Ayurvedic drugs and their plant source. Oxford IBH - publishing Co. New Delhi.

**Skill Enhancement Course- (for Botany main)**

**Genetics**

**(Credits: Theory-2)**

**THEORY**

**Course Code: UBOT 351**

**Lectures: 30**

**Max. Marks =100 (ICA = 25 + ESE = 75)**

**Unit 1: Heredity**

**(6 Lectures)**

Brief life history of Mendel experiments, terminologies, Laws of inheritance, Modified Mendelian ratios: Lethal alleles; Co-dominance, incomplete dominance; complementary genes; duplicate genes; epistasis. Pedigree chart. Multiple allelism.

**Unit 2: Linkage and Crossing over**

**(6 Lectures)**

Linkage: complete and incomplete linkage, coupling & repulsion, recombination frequency, linkage maps based on two and three point test crosses. Crossing over: concept and significance, cytological proof of crossing over.

**Unit 3: Fine structure of genes and Chromosome**

**(6 lectures)**

Classical vs molecular concepts of gene; Cis-Trans complementation test for functional allelism; Allele frequencies, Genotype frequencies, Hardy-Weinberg Law, role of natural selection mutation, genetic drift. Genetic variation and Speciation.

**Unit 4: Mutations and Chromosomal Aberrations**

**(6 Lectures)**

Types of mutations, effects of physical & chemical mutagens. Numerical chromosomal changes: Euploidy, Polyploidy and Aneuploidy; Structural chromosomal changes: Deletions, Duplications, Inversions & Translocations.

**Unit 5: Extra-chromosomal inheritance and Applied Genetics**

**(6 Lectures)**

Cytoplasmic Inheritance: Kappa particles in Paramecium, leaf variegation in *Mirabilis jalapa*, Male sterility. Pleiotropism.

**Suggested Readings**

1. Acquaah G. 2010. Principles of Plant Genetics and Breeding. Wiley India Pvt Ltd. New Delhi.
2. Chaudhari H.K. 1984. Elementary Principles of Plant Breeding (2<sup>nd</sup> ed.). Oxford – IBH. New Delhi.
3. Gardner E.J., Simmons M.J. and Snustad D.P. 2005. Principles of Genetics (8<sup>th</sup> ed.). Wiley India.
4. Guttman B., Griffiths A., Suzuki D. and Cullis T. 2011. Genetics: The Code of Life. Rosen Publishing, New York.
5. Klug W.S., Cummings M.R., Spencer C. and Palladino M. 2011. Concepts of Genetics (10<sup>th</sup> ed.). Benjamin Cummings. U.K.
6. Griffiths A.J.F., Wessler S.R., Carroll S.B. and Doebley J. 2010. Introduction to Genetic Analysis (10<sup>th</sup> ed.). W. H. Freeman and Co. U.S.A.
7. Pierce B.A. 2011. Genetics: A Conceptual Approach (4<sup>th</sup> ed.). Macmillan Higher Education Learning. U.K.
8. Snustad D.P. and Simmons M.J. 2010. Principles of Genetics (5<sup>th</sup> ed.). John Wiley & Sons Inc. India.

**Skill Enhancement Course- (for Botany main)**

**Horticulture and Plant Breeding**

**(Credits: Theory- 2)**

**THEORY**

**Course code: UBOT 361**

**Lectures: 30**

**Max. Marks =100 (ICA = 25 + ESE = 75)**

**Unit 1: Landscaping and Gardening**

**(6 Lectures)**

Importance and classification of horticultural crops - their culture and nutritive value, area and production, exports and imports, fruit and vegetable zones of India and of different states, nursery management practices, soil and climate. Irrigation, fertilizer application, pest and diseases, propagation methods.

**Unit 2: Orchard and Kitchen Gardening**

**(6 Lectures)**

Vegetable gardens, nutrition and kitchen garden and other types of gardens – principles, planning and layout, management of orchards, planting systems and planting densities. Rejuvenation of old orchards, top working, frame working, principles of organic farming.

**Unit 3: Plant Reproduction**

**(6 Lectures)**

Breeding systems: modes of reproduction in crop plants. Important achievements and undesirable consequences of plant breeding.

Plant reproduction- Types: vegetative (cuttings, grafting, budding, layering), sexual and apomixes; their effect on generating and fixing genotypic variation.

**Unit 4: Methods of Crop Improvement**

**(8 Lectures)**

Introduction: Centres of origin and domestication of crop plants, plant genetic resources; Acclimatization; Selection methods- pureline and mass selection for self pollinated, cross pollinated and vegetatively propagated plants.

Hybridization: for Self pollinated, Cross pollinated and vegetatively propagated plants – Procedure, advantages and limitations.

**Unit 5: Inbreeding depression and Heterosis**

**(4 Lectures)**

History, genetic basis of inbreeding depression and heterosis; Applications.

**Suggested Readings**

1. Chaudhari H.K. 1984. Elementary Principles of Plant Breeding (2<sup>nd</sup>ed.). Oxford-IBH. New Delhi.
2. Christopher E.P. 2001. Introductory Horticulture. Biotech Books. New Delhi.
3. Hartmann H.T., Kester D.E., Davies JR. F.T. and Geneve R.L. 2011. Hartmann & Kester's Plant Propagation: Principles and Practices (8<sup>th</sup>ed.). PHI Learning Pvt. Ltd. Delhi.
4. Hayes H.K. 2007. Methods of Plant Breeding. Kosta press. USA.
5. Sharma J.R. 1994. Principles and Practices of Plant Breeding. Tata McGraw Hill Publishing Co. Ltd. New Delhi.
6. Singh B.D. 2005. Plant Breeding: Principles and Methods (7<sup>th</sup>ed.). Kalyani Publishers. New Delhi.
7. Sheela V.L. 2011. Horticulture. MJP Publishers. Chennai.
8. Shukla R.S and Chandel P.S. 1996. Cytogenetic, Evolution and Plant Breeding. S.Chand & Co. New Delhi.
9. Vijendra Das L.D. 2006. Genetics and Plant Breeding, New Age International. New Delhi.

**DISCIPLINE SPECIFIC ELECTIVES**  
**(for BOTANY main)**



**DISCIPLINE SPECIFIC ELECTIVES- (for BOTANY main)**

**Molecular Biology**

**(Credits: Theory- 4, Practical- 1)  
THEORY**

**Course Code: UBOT 352**

**Lectures: 60**

**Max. Marks =100 (ICA = 25 + ESE = 75)**

**Unit 1: The Genetic Material**

**(14 Lectures)**

Nature of genetic material and fine structure of gene. Griffith effect, transforming principle, Hershey & Chase experiment, RNA as genetic material (TMV). Cis-trans test. Structure of DNA and RNA- Nucleoside and Nucleotides. DNA Double helix: B-form, A-form & Z-form. Chemical bonds-base pair rules. Types of RNA- mRNA, rRNA, tRNA (in prokaryotes and Eukaryotes) and miRNA (in eukaryotes).

**Unit 2: Replication and Transcription of DNA**

**(14 Lectures)**

Replication of DNA- Messelson & Stahl experiment, semi-conservative, bidirectional, semi continuous model-reverse transcription.

Transcriptional machinery and key events - RNA polymerase, promoter gene- initiation, elongation and termination (in prokaryotes and eukaryotes). Modification and processing of mRNA in eukaryotes.

**Unit 3: Protein synthesis**

**(8 Lectures)**

Translation- features of genetic code- Wobble hypothesis, role of t-RNA and ribosomes. Initiation, elongation and termination- peptidyl transferase.

**Unit 4: Gene Regulation Gene Mutation**

**(12 Lectures)**

Regulation of gene expression- regulation at transcriptional level. Lac Operon- negative and positive control.

Gene mutation- frame shift, substitution mutation, tautomerization, depurination, base analogues, chemical and physical mutagens.

**Unit 5: Polymerase chain reaction**

**(12 Lectures)**

Gene amplification (Polymerase chain reaction -PCR). Basic PCR and its modification. Application of PCR in Agriculture, Medicine and Forensics.

Sequencing of DNA: Maxam and Gilbert method, Sanger's method.

**PRACTICAL**

1. Isolation of DNA from plant tissues.
2. Isolation of RNA from plant tissues.
3. Isolation of bacterial plasmids.
4. Separation of DNA by Agarose gel electrophoresis.
5. Separation of RNA by Agarose gel electrophoresis.
6. Staining of nucleic acid *in vivo* (Giemsa stain).

**Suggested Readings**

1. Allison L.A. 2007. Fundamental Molecular Biology. Blackwell Publishing. U.S.A.

2. Cooper G.M. and Hausman R.E. 2009. *The Cell: A Molecular Approach*. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
3. De Robertis E.D.P. and De Robertis E.M.F. 2006. *Cell and Molecular Biology* (8<sup>th</sup> ed). Lippincott Williams and Wilkins. Philadelphia.
4. Friefelder D. 1987. *Molecular Biology* (2<sup>nd</sup> ed.). Narosa Publishing House. New Delhi.
5. Karp G. 2010. *Cell and Molecular Biology: Concepts and Experiments*(6<sup>th</sup>ed.). John Wiley & Sons. Inc.
6. Krebs J.E., Goldstein E.S. and Kilpatrick S.T. 2014. Jones & Bartlett Learning, LLC. Burlington, MA.
7. Sheeler P. and Bianchi D.E. 2006. *Cell and Molecular Biology* (3<sup>rd</sup>ed.). Wiley India (P.) Ltd. New Delhi.
8. Smith- Keatry P. 1991. *Molecular Genetics*, MacMillan Publication Co. Ltd. London.
9. Verma P.S. and Agarwal V.K. 2009. *Molecular Biology*. S.Chand & Company Ltd. New Delhi.
10. Watson J.D., Baker T.A., Bell S.P., Gann A., Levine M. and Losick R. 2004. *Molecular Biology of the Gene*. Dorling Kindersley Publishing Inc. New Delhi.

**DISCIPLINE SPECIFIC ELECTIVES- (for BOTANY main)**

**Plant Physiology and Biochemistry**

**(Credits: Theory- 4, Practical-1)**

**THEORY**

**Course Code: UBOT 353**

**Lectures: 60**

**Max. Marks =100 (ICA = 25 + ESE = 75)**

**Unit 1: Plant-water relations and Mineral Nutrition**

**(16 Lectures)**

Water as a universal solvent. Water potential and its components.

Factors affecting transpiration; Root pressure and guttation.

Essential growth elements, macro and micronutrients; Criteria of essentiality of elements;

Role of essential elements; Transport of ions across cell membrane (active and passive transport), carriers, channels and pumps.

**Unit 2: Carbohydrates and Lipids**

**(14 Lectures)**

Carbohydrates: importance, classification, structure and properties.

Glycolysis, anaerobic respiration, TCA cycle; Oxidative phosphorylation, Glyoxylate, Oxidative Pentose Phosphate Pathway.

Lipids: importance, classification, structure and properties. Fatty acids – nomenclature and types. Biosynthesis of fatty acids (Palmitic acid).

**Unit 3: Photosynthesis and Translocation of solutes**

**(14 Lectures)**

Photosynthetic Pigments (Chl *a*, *b*, xanthophylls, carotene); Photosystem I and II, reaction center, antenna molecules; Electron transport and mechanism of ATP synthesis; C<sub>3</sub>, C<sub>4</sub> and CAM pathways of carbon fixation; Photorespiration.

Transpiration- Ascent of sap (Cohesion and Tension hypothesis) and its significance.

Composition of phloem sap, girdling experiment; Pressure flow model; Phloem loading and unloading.

**Unit 4: Amino acids, Proteins and Enzymes**

**(10 Lectures)**

Amino acids and Proteins: importance, classification and structure.

Enzymes: nomenclature, classification. Structure and properties. Mechanism of enzyme catalysis and enzyme inhibition.

**Unit 5: Environmental Plant Physiology**

**(6 Lectures)**

Photoperiodism (SDP, LDP, Day neutral plants); Phytochrome (discovery and structure), red and far red light responses on photomorphogenesis. Vernalization. Phytohormones (natural Auxins and Gibberellins).

Plant Stress- definition. Plant responses to Abiotic Stresses: - cold, drought, salt and UV.

**PRACTICAL**

1. Determination of osmotic potential of plant cell sap by plasmolytic method.

2. To study the effect of two environmental factors (light and wind) on transpiration by excised twig.

3. Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophyte.

4. Demonstration of Hill reaction.

5. Demonstration of the activity of catalase and study of the effect of pH and enzyme

concentration.

6. To study the effect of light intensity and bicarbonate concentration on O<sub>2</sub> evolution in photosynthesis.
7. Comparison of the rate of respiration in any two parts of a plant.
8. Separation of amino acids by paper chromatography.
9. Separation of photosynthetic pigments by paper chromatography.

### **Suggested Readings**

1. Battacharya D. 1999. Experiments in Plant Physiology- A Laboratory Manual. Narosa Publishing House. New Delhi.
2. Hopkins W.G. and Huner N.P. 2009. Introduction to Plant Physiology (4<sup>th</sup> ed.). John Wiley & Sons. U.S.A.
3. Murray R.K., Granner D.K., Mayes P.A. and Rodwell V.W. 2000. Harper's Illustrated Biochemistry (26<sup>th</sup> Ed.). McGraw-Hill Company Inc. U.S.A.
4. Narayanan L.M., Meyyan R.P., Nallasingam K., Prasanna Kumar S., Arumugam N. and Fatima D. 2014. Biochemistry. Saras Publication. Nagercoil, Tamil Nadu.
5. Nelson D.L. and Cox M.M. 2017. Lehninger Principles of Biochemistry (7<sup>th</sup> ed.). W.H. Freeman. London.
6. Rodwell V.W., Bender D., Botham K.M., Kennelly P.J. and Weil P.A. 2015. Harpers Illustrated Biochemistry (30<sup>th</sup> ed.). The McGraw-Hill Education. USA.
7. Salisbury F.B. and Ross C.W. 1986. Plant Physiology (3<sup>rd</sup> ed.). CBS Publishers & Distributors. New Delhi.
8. Taiz L. and Zeiger E. 2010. Plant Physiology (5<sup>th</sup> ed.). Sinauer Associates Inc. U.S.A.

**DISCIPLINE SPECIFIC ELECTIVES- (for BOTANY main)**

**Plant Biotechnology**

**(Credits: Theory- 4, Practical- 1)**

**THEORY**

**Course Code: UBOT 362**

**Lectures: 60**

**Max. Marks =100 (ICA = 25 + ESE = 75)**

**Unit 1: Plant Tissue Culture, Design of Lab and Media (12 Lectures)**

Plant tissue culture: Definition, History of Plant Tissue Culture (PTC). Cellular differentiation and redifferentiation. Totipotency. Designing of PTC lab. Sterilization procedures for chemicals and glassware. Outlines on PTC media- (MS medium in detail). Plant growth regulators. Gelling agents (Agar). Types of explants.

**Unit 2: Types of Tissue Cultures- I and Secondary metabolites (12 Lectures)**

Callus culture and cell suspension culture. Direct and indirect organogenesis. Somaclonal variations and their uses in agriculture.

Basics of Secondary metabolite production of Shikonin from *Lithospermum erythrorhizon*; Morphine from *Papaver somniferum*; Vincristine from *Catharanthus roseus*.

**Unit 3: Types of Tissue Cultures- II (12 Lectures)**

Meristem culture- virus free plant production. Micropropagation (using axillary and apical bud cultures). Anther and pollen cultures. Protoplast isolation and culture. Somatic hybridization: selection of somatic hybrids and cybrids. Somatic embryogenesis- artificial seed production.

**Unit 4: Genetic Engineering and Cloning Vectors (12 Lectures)**

Principles and tools of genetic engineering: Restriction endonucleases- Type II enzymes; nomenclature. DNA ligase and DNA Polymerases.

Cloning Vectors –Bacterial vectors (pBR322, pUC8), Viral vectors (M13,  $\lambda$  phage), Hybrid vectors (cosmids), Artificial Chromosomes (Bacterial and Yeast).

**Unit 5: Transgenic Plants, Bioethics and Biosafety (12 Lectures)**

*Agrobacterium* (Ti plasmid) mediated gene transfer. Particle gun bombardment, Microinjection, Electroporation. Introduction to molecular markers.

Production of transgenic plants: Insect resistance (*Bt* gene), Bruise resistance and drought resistance.

Introduction to Golden Rice, Plantibodies, Edible vaccines, Bioplastics. Bioethics and Biosafety of GM crops.

**PRACTICAL**

1. Murashige and Skoog medium preparation.
2. Sterilization and inoculation of explants on culture media.
3. Callus culture.
4. Micropropagation (axillary bud or terminal bud).
5. Anther and Ovary culture.
6. Protoplast isolation and culture- demonstration.
7. Identification of photographs pertaining to chapters mentioned in the theory.

8. Identification of Crown gall disease by specimen or photograph.

### **Suggested Readings**

1. Brown T.A. 2001. Gene Cloning and DNA Analysis- An Introduction (4<sup>th</sup>ed.).Blackwell Science. Oxford.
2. Clark D.P. and Pazdernik N.J. 2009. Biotechnology- Applying the Genetic Revolution. Elsevier Academic Press. USA.
3. Das H.K. 2010.Textbook of Biotechnology (4<sup>th</sup>ed.). Wiley India Pvt Ltd. New Delhi.
4. Chawla H.C. 2003. Plant Biotechnology- Laboratory Manual for Plant Biotechnology. Oxford& IBH Publishing Co. Pvt. Ltd. New Delhi.
5. Desmond S.T. Nicholl. 2010. An Introduction to Genetic Engineering. Cambridge University Press. New Delhi.
- 6.. Dubey R.C. 2006. A Text Book of Biotechnology. S.Chand & Company Ltd. New Delhil.
7. Gupta P.K. 2000. Elements of Biotechnology. Rastogi Publications. Meerut.
8. Harisha S. 2007. Biotechnology Procedures and Experiments Handbook. Infinity Science Press Llc. Hingham. MA.
9. Ignacimuthu S. 2003. Plant Biotechnology. Oxford& IBH Publishing Co. Pvt. Ltd. New Delhi.
10. Keshavachandran R. and Peter, K.V. 2008. Plant Biotechnology- Methods in Tissue Culture and Gene Transfer. University Press (India) Pvt. Ltd. Hyderabad.
11. Kumar H.D. 1998. Modern Concepts of Biotechnology. Vikas Publishing House Pvt Ltd. New Delhi
12. Kumaresan V. 2010. Biotechnology. Saras Publication. Nagercoil. Tamil Nadu.
13. Mosier N.S. and Ladisch M.R. 2009. Modern Biotechnology- Connecting Innovations in Microbiology and Biochemistry to Engineering Fundamentals. John Wiley & Sons Inc. New Jersey.
14. Prakash J. and Pierik R.L.M. 1993. Plant Biotechnology- Commercial prospects and Problems. Science Publishers, Inc. U.S.A.
15. Primrose S., Twyman R. and Old B. 2001. Principles of Gene Manipulation (6<sup>th</sup> ed.). Blackwell Science. Oxford.
16. Verma P.S. and Agarwal V.K. 2009.Genetic Engineering. S.Chand & Co. Ltd. New Delhi.

**DISCIPLINE SPECIFIC ELECTIVES- (for BOTANY main)**

**Project Work**

**(Credits: 5)**

**Course Code: UBOT 363**

**Lectures: 60**

**Max. Marks =100**

**(ICA = 20 + Dissertation = 70+ Viva voce=10)**

With a view to develop creative thinking, team spirit and skill, a project work at preliminary level will be assigned to students, in groups. The project period is spread over about 4 months (i.e. from January to April) with a weekly work load of six hours. Project will be of a long assignment paper type, combined with field and lab work. Topics for project will be chosen from classical and applied fields.

The project report in the form of dissertation is prepared and submitted by the students will be evaluated by the External and Internal Examiners who attend the practical examination work, relating to semester VI. Head of the Department will chair the evaluation panel and proceedings of viva voce. It carries a maximum of 100 marks which include 20 marks for ICA, 70 marks for project report (valued by both External examiner and Internal Examiner- average marks will be calculated) and 10 marks for viva voce (valued by both External examiner and Internal Examiner- average marks will be calculated).

**DISCIPLINE SPECIFIC ELECTIVES**  
**(for Non-BOTANY main)**



## DISCIPLINE SPECIFIC ELECTIVES- (for Non-BOTANY main)

### Mushroom Culture

(Credits: Theory- 4, Practical- 1)

Course Code: UBOT 354

Lectures: 60

Max. Marks =100 (ICA = 25 + ESE = 75)

#### Unit 1: History of Mushroom Culture

(12 Lectures)

Mushroom as food. Medicinal value of edible mushrooms; Poisonous mushrooms. Types of edible mushrooms available in India – *Volvariella volvacea*, *Pleurotus citrinopileatus*, *Agaricus bisporus*.

#### Unit 2: Infrastructure and Inputs

(12 Lectures)

Mushroom Cultivation: Infrastructure and implements-mushroom sheds, design, conditions, materials- Factors influencing mushroom cultivation.

#### Unit 3: Stages in Mushroom Production

(12 Lectures)

Medium preparation, preparation of spawn- quality of good spawn, multiplication. Mushroom bed preparation. Casing; pests, diseases and abnormalities.

#### Unit 4: Harvest and Storage

(12 Lectures)

Harvest methods. Storage: Short-term storage (Refrigeration – up to 24 hours). Long term storage, drying, storage in salt solutions. Nutritive values– Proteins, amino acids, mineral elements. Nutrition - Carbohydrates, Crude fibre content - Vitamins.

#### Unit 5: Mushroom Recipes

(12 Lectures)

Types of recipes prepared from mushroom. Research Centres- National level and Regional level. Cost benefit analysis - Marketing in India and abroad.

### PRACTICAL

1. Sterilization of paddy straw.
2. Preparation of bed inside the polythene bags and
3. Incubation of bags.
4. Preparation of spawn.
5. Visit to a mushroom culture unit/ industry

### Suggested Readings

1. Hirst B. 2015. Mushrooms: A Beginners Guide to Home Cultivation. Create space Independent Publishing Platform. USA.
3. Marimuthu T., Krishnamoorthy A.S., Sivaprakasam K. and Jayarajan R. 1991. Oyster Mushrooms. Department of Plant Pathology, TNAU, Coimbatore.
4. Pandey R.K. and Ghosh S.K. 1998. Hand book on mushroom cultivation. Emkay Publications. Delhi.
5. Swaminathan M.S. 1990. Food and Nutrition. The Bangalore Printing and Publishing Co. Ltd. Bangalore.
6. Tewari and Pankaj Kapoor S.C. 1988. Mushroom cultivation, Mittal Publications. New Delhi.

## DISCIPLINE SPECIFIC ELECTIVES- (for Non-BOTANY main)

### Biofertilizers and Organic Farming

(Credits: Theory- 4, Practical- 1)

Course Code: UBOT 355

Lectures: 60

Max. Marks =100 (ICA = 25 + ESE = 75)

#### Unit 1: Manures and Biofertilizers (10 Lectures)

Need for fertilizers, manures. Manure composition. Manures for crop productivity. Differences between fertilizers and biofertilizers: pH changes and water contamination.

#### Unit 2: Bacterial Biofertilizers (14 Lectures)

General account on the microbes used as biofertilizer. *Azotobacter*: classification, characteristics– crop response to *Azotobacter* inoculum, maintenance and mass multiplication. *Rhizobium* – isolation, identification, mass multiplication, carrier based inoculants, Actinorrhizal symbiosis.

#### Unit 3: Algal Biofertilizers (12 Lectures)

*Azospirillum*: isolation and mass multiplication – carrier based inoculant, associative effect of different microorganisms. *Azolla* and *Anabaena azollae* association, nitrogen fixation, factors affecting growth, *Azolla* in rice cultivation.

#### Unit 4: Fungal Biofertilizers (12 Lectures)

Mycorrhizal association, types of mycorrhizal association, taxonomy, occurrence and distribution, phosphorus nutrition, growth and yield, colonization of VAM – isolation and inoculum production of VAM, and its influence on growth and yield of crop plants.

#### Unit 5: Organic Farming (12 Lectures)

Organic farming – Green manuring and organic fertilizers, Recycling of bio-degradable municipal, agricultural and industrial wastes, Biocompost making- types, method of vermicomposting, Panchakavya. Biological pest control (neem)

### PRACTICAL

1. Isolation and culture of *Rhizobium* and Algae.
2. Anatomy of *Azolla* leaf and identification of *Anabaena azollae*.
3. Mass cultivation of *Azolla*.
4. Isolation and culture of VAM.
5. Compost preparation- green manure, vermicompost.

### Suggested Readings

1. Dubey R.C. 2005. A Text book of Biotechnology. S.Chand & Co. New Delhi.
2. Kumaresan V. 2005. Biotechnology. Saras Publications. New Delhi.
3. John Jothi Prakash E. 2004. Outlines of Plant Biotechnology. Emkay Publication. New Delhi.
4. Sathe T.V. 2004. Vermiculture and Organic Farming. Daya Publishers. New Delhi.
5. Subha Rao N.S. 2000. Soil Microbiology, Oxford & IBH Publishers. New Delhi.
6. Vayas S.C, Vayas S. and Modi H.A. 1998. Bio-fertilizers and organic Farming Akta Prakashan. Nadiad.

**DISCIPLINE SPECIFIC ELECTIVES- (for Non-BOTANY main)**

**Biostatistics and Computer Applications in Biology**

**(Credits: Theory-4, Practical-1)  
THEORY**

**Course Code: UBOT 356**

**Lectures: 60  
Max. Marks =100 (ICA = 25 + ESE = 75)**

**Unit 1: Biostatistics-I (12 Lectures)**

Introduction to Biostatistics, definition, characteristics, importance and usefulness, limitations. Collection, classification and presentation of data (tabulation, graphical representation-Histogram, simple bar, multiple bar and divided bar diagrams, pie diagram, frequency curve and frequency polygon). Frequency distribution: definition, types, class width, class mark, class frequency, relative frequency, percentage frequency and frequency density.

**Unit 2: Biotstatistics-II (12 Lectures)**

Measures of central tendency- Characteristics: definition and calculations of mean, median, and mode. Measures of variation- standard deviation and standard error.

**Unit 3: Basics of Computer (12 Lectures)**

Types of computers, accessories and its functions, input-output devices, concepts of different operation systems, details of Networks, Internet and email. Database types and its uses, fundamentals of digital imaging, uses of different programming languages.

**Unit 4: Softwares used in Biology (12 Lectures)**

Outline of MS-Office (MS-Word, MS-Excel and MS-Power point). Database softwares- MS access, Image editing softwares (Photoshop), Biological Sequence Searching and Comparison softwares (BLAST), Search engines (Google, Mozilla Firefox), GIS softwares (Google Earth).

**Unit 5: Computer Applications in Biology (12 Lectures)**

Introduction to Bioinformatics and its applications, EMBL and GenBank Data Libraries, PIR Database, Fundamentals of Geographic Information Systems (GIS) and Remote Sensing and its uses in biology. Information systems- BTIS, ENVIS.  
Introduction to statistical softwares- SPSS and PSPP (open source), use for descriptive statistical analysis.

**PRACTICAL**

1. Tabulation of biological data.
2. Calculation of mean, median, mode, standard deviation and standard error using biological data.
3. To plot and import Graphs and Charts using biological and statistical data in MS-office.
4. Search biological information (texts and images) using Internet.
5. Biological sequence searching using BLAST software.

### Suggested Readings

1. Banerjee P.K. 2009 Introduction to Biostatistics- A Text Book of Biometry. S.Chand& Co. New Delhi.
2. Bemis K. PSPP: Purdue STAT 582 User Manual.[http://www.stat.purdue.edu/~jennings/stat582/software/pspp\\_manual.pdf](http://www.stat.purdue.edu/~jennings/stat582/software/pspp_manual.pdf)
3. Chernick M.R. and Friis R.H. 2003. Introductory Biostatistics for the Health Sciences: Modern Applications including Bootstrap. John Wiley & Sons. New Jersey.
3. Cox J. Lambert J. and Frye C. 2011. Step by Step: Microsoft Office Professional 2010. Microsoft Press. Washington.<https://capdtron.files.wordpress.com/2013/01/office-professional-2010-step-by-step.pdf>
4. Daniel W.W. 2005. Biostatistics: A Foundation for Analysis in the Health Sciences (7<sup>th</sup> ed.). John Wiley & Sons (Asia) Pvt. Ltd. Singapore.
5. Lambert J. and Frye C. 2015. Microsoft Office 2016 Step by Step. Microsoft Press. USA. <https://ptgmedia.pearsoncmg.com/images/9780735699236/samplepages/9780735699236.pdf>
6. PSPP Users' Guide. GNU PSPP Statistical Analysis Software Release 0.10.2.<http://www.gnu.org/software/pspp/manual/pspp.pdf>
7. PSPP Tutorial. <https://www.youtube.com/watch?v=GG-wbMS9i7g>
8. Rutkosky 2007. MS Office. BPB Publication. New Delhi.
9. Genebank: <https://www.ncbi.nlm.nih.gov/genbank/>
10. EMBL Nucleotide Sequence Database <http://www.ebi.ac.uk/>

**DISCIPLINE SPECIFIC ELECTIVES- (for Non-BOTANY main)**

**Horticulture**

**(Credits: Theory- 4, Practical- 1)**

**THEORY**

**Course Code: UBOT 364**

**Lectures: 60**

**Max. Marks =100 (ICA = 25 + ESE = 75)**

**Unit 1: Landscaping and Gardening**

**(12 Lectures)**

Plants of aesthetic interest. Gardening types. Importance and classification of horticultural crops - their culture and nutritive value, area and production, exports and imports, fruit and vegetable zones of India and of different states, nursery management practices, soil and climate. Irrigation, fertilizer application, pest and diseases.

**Unit 2: Orchard and Kitchen Garden Layout**

**(12 Lectures)**

Vegetable gardens, nutrition and kitchen garden and other types of gardens – principles, planning and layout, management of orchards, planting systems and planting densities. Rejuvenation of old orchards, top working, frame working, principles of organic farming.

**Unit 3: Nursery and Canopy Management**

**(12 Lectures)**

Production and practices for fruit, vegetable and floriculture crops, propagation- cutting, layering, grafting. Principles and methods of pruning.

**Unit 4: Cropping Systems**

**(12 Lectures)**

Types and use of growth regulators in horticulture, water management, weed management, fertility management, cropping systems: intercropping, multi-tier cropping, mulching, bearing habits, factors influencing the fruitfulness and unfruitfulness.

**Unit 5: Disease Control and Pest Management**

**(12 Lectures)**

Horticultural crop diseases by:

- (i) Rodents
- (ii) Viruses
- (iii) Insects

**PRACTICAL**

1. Vegetable gardening.
2. Making of kitchen garden.
3. Pruning of crop plants.
4. Study of effect of growth regulators, Auxin (IAA, NAA), Cytokinins (Zeatin, BAP), Gibberellins on plant growth.

**Suggested Readings**

1. Adams C.R. and Early M.P. 2004. Principles of Horticulture. Butterworth Heinemann. Oxford University Press. Oxford.
2. Bansil P.C. 2008. Horticulture in India. CBS Publishers and Distributors. New Delhi.
3. Chadha K.L. 2001. Handbook of Horticulture. ICAR, New Delhi.
4. Chattopadhyay P.K.2001. A text book on Pomology (Fundamentals of fruit growing). Kalyani Publication. New Delhi.

5. Christopher E.P. 2001. Introductory Horticulture. Biotech Books. New Delhi.
6. Hartmann H.T., Kester D.E., Davies JR. F.T. and Geneve R.L. 2011. Hartmann & Kester's Plant Propagation: Principles and Practices (8<sup>th</sup>ed.). PHI Learning Pvt. Ltd. Delhi.
7. Jitendra Singh. 2006. Basic Horticulture. Kalyani Publishers. New Delhi.
8. Kumar N. 1997. Introduction to Horticulture. Rajalakshmi Publication. Nagercoil.
9. Rajan S. and Markose B.L. 2007. Propagation of horticultural crops. New India Publishing. New Delhi.
10. Senn T.L., Andrews F.S. and Halfacre P.G. 1975. Fundamentals of Horticulture. Tata McGraw Hill Publishing Co. New Delhi.
11. Sheela V.L. 2011. Horticulture. MJP Publishers. Chennai.
12. Vijaikumar Uma Rao. 2008. Horticulture terms – Definitions and Terminology. IBD Publishers. Dehradun.

**DISCIPLINE SPECIFIC ELECTIVES- (for Non- BOTANY main)**

**Plant Tissue Culture**

**(Credits: Theory- 4, Practical- 1)**

**THEORY**

**Course Code: UBOT 365**

**Lectures: 60**

**Max. Marks =100 (ICA = 25 + ESE = 75)**

**Unit 1: Introduction and History**

**(6 Lectures)**

History of Plant Tissue Culture (PTC). Totipotency, Dedifferentiation, Redifferentiation.

**Unit 2: Culture Media**

**(14 Lectures)**

General account on Plant Tissue Culture Media: Murashige and Skoog medium- Macronutrients, Micronutrients, Vitamins, Carbon sources, Agar (solidifying agent), Organic supplements. Plant Growth Regulators- PGRs: Auxins, Cytokinins, Gibberellins, Abscisic acid and Ethylene.

**Unit 3: Sterilization Procedures**

**(14 Lectures)**

Sterilization procedures:- Physical methods: Wet method - autoclave, water bath, Dry methods: Hot air oven, Microwave oven. Chemical methods: use of alcohols, formaldehyde, phenol, sodium hypochlorite, mercuric chloride. Surface sterilization of explants, cleaning of hand.

**Unit 4: *In Vitro* Cultures**

**(12 Lectures)**

Callus induction, Cell suspension cultures, Somatic embryogenesis- artificial seeds.

Somaclonal variations.

Micropropagation using meristems and nodal explants.

Haploid plant production through androgenesis and gynogenesis.

Embryo and endosperm culture with their applications.

**Unit 5: Applications of PTC**

**(12 Lectures)**

Secondary metabolites production in cultures. Production of plumbagin from *Plumbago zeylanica*, vincristine from *Catherathus roseus*, azadiractin from *Azadirachta indica*.

Applications of plant tissue cultures in Agriculture.

**PRACTICAL**

1. Sterilization of glassware and culture media.
2. Preparation of MS medium.
3. Surface sterilization of explants.
4. Callus induction
5. Micropropagation using nodal explants and shoot tip explants.
6. Anther culture.

**Suggested Readings**

1. Bhojwani S.S. and Razdan M.K. 1996. Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
2. Dods J.H. and Robers L.W. 1995. Experiments in Plant Tissue Culture (3<sup>rd</sup> ed.). Cambridge University Press. Cambridge.

3. Gamborg O.L. and Philip, G.C. 1995. Plant Cell, Tissue and Organ Culture. Narosa Publishing House. New Delhi.
4. Gupta P.K. 1995. Elements of Biotechnology. Rastogi Publication. Meerut.
5. Keshavachandran R. and Peter K.V. 2008. Plant Biotechnology: Methods in Tissue Culture and Gene Transfer. Universities Press (India) Pvt. Ltd. Hyderabad.
6. Kumaresan V. 2015. Plant Biotechnology. Saras Publication. Nagercoil.
7. Misra S.P. 2015. Plant Tissue Culture (2<sup>nd</sup> ed.). Ane Book Pvt. Ltd. Chennai.
8. Narayanasamy S. 1994. Plant Cell and Tissue Culture. Tata McGraw-Hill Publishing Company Ltd. New Delhi.



## DISCIPLINE SPECIFIC ELECTIVES- (for Non-BOTANY main)

### Ethnobotany

(Credits: Theory-4, Practical-1)  
THEORY

Course Code: UBOT 366

Lectures: 60  
Max. Marks =100 (ICA = 25 + ESE = 75)

#### Unit 1: Ethnobotany (12 Lectures)

Introduction, concept, scope and objectives; Ethnobotany as an interdisciplinary science. The relevance of ethnobotany in the present context; Major and minor ethnic groups or Tribals of India, and their life styles. Plants used by the tribals: (a) Food plants (b) intoxicants and beverages (c) Resins and oils and miscellaneous uses.

#### Unit 2: Methodology of Ethnobotanical Studies (8 Lectures)

(a) Field work (b) Herbarium (c) Ancient Literature (d) Archaeological findings (e) temples and sacred places.

#### Unit 3: Role of Ethnobotany in Modern Medicine (16 Lectures)

Medico-ethnobotanical sources in India; Significance of the following plants in ethnobotanical practices (along with their habitat and morphology) (a) *Azadirachta indica* (b) *Ocimum sanctum* (c) *Vitex negundo*. (d) *Gloriosa superba* (e) *Tribulus terrestris* (f) *Pongamia pinnata* (g) *Cassia auriculata* (h) *Indigofera tinctoria*. Role of ethnobotany in modern medicine with special example *Rauwolfia serpentina*, *Trichopus zeylanicus*, *Artemisia annua*, *Withania somnifera*.

#### Unit 4: Conservation of Plant Genetic Resources (12 Lectures)

Role of ethnic groups in conservation of plant genetic resources. Endangered taxa and forest management (participatory forest management).

#### Unit 5: Ethnobotany and Legal Aspects (12 Lectures)

Ethnobotany as a tool to protect interests of ethnic groups. Sharing of wealth concept with few examples from India. Biopiracy, Intellectual Property Rights and Traditional Knowledge-Patent

### PRACTICAL

1. Field visit to meet ethnic people of hills and preparation and submission of report on Botanical names, vernacular name, family, uses of plants for traditional medicines.
2. Preparation of 5 Herbarium of ethnobotanically important plants.
3. Study of habitat of ethnobotanical plants mentioned in theory.
4. Study of morphology of plants used in traditional medicine.

### Suggested Readings

1. Colton C.M. 1997. Ethnobotany – Principles and applications. John Wiley and Sons. Lichester.
2. Jain S.K. 1995. Manual of Ethnobotany. Scientific Publishers. Jodhpur.
3. Jain S.K. (ed.). 1981. Glimpses of Indian Ethnobotany. Oxford and IBH. New Delhi.
4. Jain S.K. 1990. Contributions of Indian ethnobotany. Scientific publishers. Jodhpur.

5. Kumaresan V. and Annie R. 2013. Taxonomy-Systematic Botany, Economic Botany, Ethnobotany. Saras Publication. Nagercoil.
6. Pullaiah T. and Krishnamurthy K.V. and Bahadur B. 2017. Ethnobotany of India: The Indo-Gangetic Region and Central India (Vol. 5). Apple Academic Press. USA.
7. Rama Ro N. and Henry A.N. 1996. The Ethnobotany of Eastern Ghats in Andhra Pradesh, India. Botanical Survey of India. Howrah.
8. Sinha R.K. 1969. Ethnobotany. The Renaissance of Traditional Herbal Medicine – INA – SHREE Publishers. Jaipur.

**GENERIC ELECTIVE  
(for Non-BOTANY main)**

**GENERIC ELECTIVE- I(for Non-BOTANY main)**

**Intellectual Property Rights**

**(Credits: Theory- 3)  
THEORY**

**Course Code: UBOT 357**

**Lectures: 45**

**Max. Marks =100 (ICA = 25 + ESE = 75)**

**Unit 1: Introduction and Patents**

**(9 lectures)**

Concept and kinds. Economic importance. IPR in India and world: Genesis and scope, some important examples. IPR and WTO (TRIPS, WIPO).

Objectives, Rights, Patent Act 1970 and its amendments. Procedure of obtaining patents, Working of patents. Infringement.

**Unit 2 :Copyrights, Trademarks and Geographical Indications(9 Lectures)**

Introduction, Works protected under copyright law, Rights, Transfer of Copyright, Infringement.

Objectives, Types, Rights, Protection of goodwill, Infringement, Passing off, Defences, Domain name.

Objectives, Justification, International Position, Multilateral Treaties, National Level, Indian Position.

**Unit 3:Protection of Traditional Knowledge and Industrial Designs (9 Lectures)**

Objective, Concept of Traditional Knowledge, Holders, Issues concerning Bio-Propecting and Bio-Piracy, Alternative ways, Protectability, need for a Sui-Generis regime, Traditional Knowledge on the International Arena, at WTO, at National level, Traditional Knowledge Digital Library.

Objectives, Rights, Assignments, Infringements, Defences of Design Infringement

**Unit 4: Protection of Plant Varieties**

**(9 Lectures)**

Plant Varieties Protection-Objectives, Justification, International Position, Plant varieties protection in India. Rights of farmers, Breeders and Researchers. National gene bank, Benefit sharing. Protection of Plant Varieties and Farmers' Rights Act, 2001.

**Unit 5: Biotechnology and Intellectual Property Rights**

**(9 Lectures)**

Patenting Biotech Inventions: Objective, Applications, Concept of Novelty, Concept of inventive step, Microorganisms, Moral Issues in Patenting Biotechnological inventions.

**Suggested Readings**

1. Acharya N.K. 2001. Textbook on intellectual property rights, Asia Law House.
2. Guru M. and Rao M.B. 2003. Understanding Trips: Managing Knowledge in Developing Countries, Sage Publications. New Delhi.
3. Ganguli P. 2001. Intellectual Property Rights: Unleashing the Knowledge Economy. Tata McGraw-Hill.
4. Miller A.P. and Davis M.H. 2000. Intellectual Property: Patents, Trademarks and Copyright in a Nutshell, West Group Publishers. London.
5. Watal J. 2001. Intellectual property rights in the WTO and developing countries. Oxford University Press. Oxford.

**GENERIC ELECTIVE- II (for Non-BOTANY main)**

**Greenhouse Technology**

**(Credits: Theory-3)  
THEORY**

**Course Code: UBOT 367**

**Lectures: 45**

**Max. Marks =100 (ICA = 25 + ESE = 75)**

**Unit 1: Fundamentals of Greenhouse Technology (9 Lectures)**

Introduction; scope – classification of greenhouses - construction of greenhouse- heating unit - cooling unit - environmental control (light and temperature). Net- poly houses- low cost green houses.

**Unit 2: Fertilizer Application (9 Lectures)**

Root media for greenhouses - fertilizers – organic and inorganic – liquid fertilizers – application of fertilizers - nutrient deficiencies and toxicities.

**Unit 3: Water in the Greenhouses (9 Lectures)**

Irrigation system in green houses – misting. drip irrigation – micro irrigation - water quality, water sanitation.

**Unit 4: Plant Protection in Greenhouses (9 Lectures)**

Diseases of greenhouse plants (bacterial, fungal, nematodes and viral diseases) – management of pest and diseases – integrated pest management.

**Unit 5: Applications of Greenhouse Technology (9 Lectures)**

Importance of greenhouse technology. Micropropagation and greenhouse planting of tissue culture transplants – advantages and disadvantages of greenhouse technology. Seed production, cut flower gardening.

**Suggested Readings**

1. Dubey R.C. 2006. A text book of Biotechnology. S.Chand and Company. New Delhi.
2. Sheela V.L. 2011. Horticulture. MJP Publishers. Chennai,
3. Prasad S., Kumar U. 2012. Green House Management for Horticultural Crops. Agrobios India.
4. Pant V. and Nelson. 1991. Green House Operation and Management. Bali Publication. New Delhi.
5. Introduction to soil science: <http://www.agrimoon.com/wpcontent/uploads/Introduction-to-soil-science.pdf>
6. Greenhouse applications: [http://www.lindegas.com/en/products\\_and\\_supply/fumigants/carbon\\_dioxide\\_in\\_agriculture/greenhouse\\_applications/index.html](http://www.lindegas.com/en/products_and_supply/fumigants/carbon_dioxide_in_agriculture/greenhouse_applications/index.html)
7. Role of greenhouse technology in agricultural engineering: <http://scialert.net/fulltext/?doi=ijar.2006.364.372&org=104>.

**BLUE PRINT OF QUESTION PAPERS**

**PONDICHERRY UNIVERSITY**

**BLUE PRINT OF THEORY QUESTION PAPER FOR B.Sc. BOTANY**

(Choice Based Credit System)

(Effective from the academic year 2017-2018)

**Course Code:**

**Time: 3 hrs**

**Maximum Marks: 75**

**Section- A**

Answer ALL the questions.

Each answer should not exceed 15 words.

(10 x 1 = 10 marks)

1. Unit I
2. Unit I
3. Unit II
4. Unit II
5. Unit III
6. Unit III
7. Unit IV
8. Unit IV
9. Unit V
10. Unit V

**Section- B**

Answer any FIVE questions.

Each answer should not exceed 200 words.

(5 x 5 = 25 marks)

11. Unit I
12. Unit II
13. Unit III
14. Unit IV
15. Unit V
16. Any unit
17. Any unit

**Section- C**

Answer any FOUR questions.

Each answer should not exceed 600 words.

(4 x 10 = 40 marks)

18. Unit I
19. Unit II
20. Unit III
21. Unit IV
22. Unit V

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(Effective from the academic year 2017-2018)

Semester I

**Thallophytes, Microbes and Plant Pathology**

**Course Code: UBOT 111(P)**

**Time: 3 hrs**

**Max. Marks: 50**  
**(ICA= 13+ESE=37= 50)**

1. Make suitable micropreparations of **A & B**. Leave the slide for valuation. Identify with reasons.  
(Preparation-2, Identification-1, Reasons-2 marks) (2 x 05 = 10 marks)
  
2. 1Stain the preparation **C**with Gram stain. Identify and draw. Write the staining procedure. Leave the slide for valuation.  
(Preparation-2, Identification-1, Procedure-2, marks) (1 x 05 = 05 marks)
  
2. Draw labeled sketches and identify giving reasons **D, E, &F**.  
(Identification-1, Diagram-1, Reasons-1 marks) (3 x 03 = 09 marks)
  
3. Identify **G** giving reasons. (1 x 03 = 03 marks)  
(Identification-1, Diagram-1, Reasons-1 marks)

**Total for Practical = 27 marks**  
**Record Marks = 10 marks**

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**Total for ESE = 37 marks**  
**CIA= 13 marks**

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**Grand Total (ICA+ESE) = 50 marks**

**KEY**

A = Algae	(Section)	
B = Fungi	(Section)	
C = Bacteria	(Gram staining)	
D = Algae/ Fungi	(Specimen/ Slide/ Photograph)	
E = Pathology	(Specimen/ Slide/ Photograph)	
F = Virus	(Specimen/ Slide/ Photograph)	
G = Lichen	(Specimen/ Slide/ Photograph)	



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Semester I

**Botany Supportive Paper I**  
(Bacteria, Algae, Fungi, Archegoniatae, Angiosperms and Economic Botany)

**Course Code: UBOT 112(P)**

**Time: 3 hrs**

**Max. Marks: 50**  
**(ICA= 13+ESE=37= 50)**

1. Make suitable micropreparation of the given specimen **A**. Leave the slide for valuation. Identify with reasons.  
(Preparation- 2, Identification – 1, Diagram– 2, Reasons – 2 marks) (1x07 = 07 marks)
2. Identify, draw and write notes on **B & C**.  
(Identification – 1, Diagram – 2, Notes – 2 marks) (2x05 = 10 marks)
3. Assign the given specimen **D** to its family. Describe in technical terms and draw diagrams.  
(Family – 1, Technical description – 2, Diagram – 2 marks) (1x05 = 05 marks)
4. Identify the binomial, family, morphology of the useful part and its uses of the given specimen **E**.  
(Binomial – 1, Family – 1, Useful part – 2, Uses- 1 marks) (1x05 = 05 marks)

**Total for Practical = 27 marks**  
**Record = 10 marks**

-----  
**Total for ESE = 37 marks**  
**ICA= 13 marks**

-----  
**Grand Total (ICA+ESE) = 50 marks**

**KEY**

A = Bryophyte/ Pteridophyte/ Gymnosperms	(Section)	
B = Algae/ Bacteria	(Specimen/ Slide/ Photographs)	
C = Algae/ Fungi	(Specimen/ Slide/ Photographs)	
D = Taxonomy	(Specimen)	
E= Economic Botany	(Specimen)	

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(Choice Based Credit System)  
(Effective from the academic year 2017-2018)

Semester II

**Archegoniatae(Bryophytes, Pteridophytes, Gymnosperms and Paleobotany)**

**Course Code: UBOT 121(P)**

**Time: 3 hrs**

**Max. Marks: 50**  
**(ICA= 13+ESE=37= 50)**

1. Make suitable micropreparations of **A & B**. Leave the slide for valuation. Identify with reasons.  
(Preparation-2, Identification-1, Diagram- 1, Reasons-2 marks) (2 x05 = 10 marks)
2. Make suitable micropreparations of **C**. Leave the slide for valuation. Identify with reasons.  
(Preparation-2, Identification-1, Diagram- 1, Reasons-1 marks) (2 x05 = 05 marks)
3. Draw labeled sketches and identify giving reasons **D**.  
(Identification-1, Diagram-2, Reasons-2 marks) (1 x05 = 05 marks)
3. Identify **E** giving reasons.  
(Identification-1, Diagram-1, Reasons-1 marks) (1 x03 = 03 marks)
4. Write critical notes on **F**. (1 x02 = 04 marks)

**Total for Practical = 27 marks**

**Record Marks = 10 marks**

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**Total for ESE = 37 marks**

**CIA= 13 marks**

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**Grand Total (ICA+ESE) = 50 marks**

**KEY**

A = Bryophytes	(Section)	
B = Pteridophyte	(Section)	
C = Gymnosperm	(Section)	
D = Paleobotany	(Specimen/ Slide/ Photograph)	
E = Bryophyte/ Pteridophyte	(Specimen/ Slide/ Photograph)	
F = Gymnosperm	(Specimen/ Slide/ Photograph)	

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(Choice Based Credit System)  
(Effective from the academic year 2017-2018)

Semester II

**Botany Supportive Paper II**  
(Cytology, Anatomy, Plant Physiology, Microbiology and Plant Ecology)

**Course Code: UBOT 122(P)**

**Time: 3 hrs**

**Max. Marks: 50**  
**(ICA= 13+ESE=37= 50)**

1. Make suitable micropreparation of the given specimen **A**. Leave the slide for valuation. Identify with reasons.  
(Preparation- 2, Identification – 1, Diagram– 2, Reasons – 2 marks) (1x07 = 07 marks)
2. Identify, draw and write notes on **B&C**.  
(Identification – 1, Diagram – 1, Notes – 2 marks) (2x04 = 08 marks)
3. Comment on the physiological importance of **D**.  
(Notes – 2,Diagram – 2 marks) (1x04 = 04 marks)
4. Comment on the microbiological importance of **E**.  
(Notes – 2,Diagram – 2 marks) (1x04 = 04 marks)
5. Comment on the ecological importance of **F**.  
(Notes – 2,Diagram – 2 marks) (1x04 = 04 marks)

**Total for Practical = 27 marks**  
**Record = 10 marks**

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**Total for ESE = 37 marks**  
**ICA= 13 marks**

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**Grand Total (ICA+ESE) = 50 marks**

**KEY**

A = Anatomy	(Section)	
B = Cell Biology	(Specimen/ Slide/ Photographs)	
C = Anatomy	(Specimen/ Slide/ Photographs)	
D = Physiology	(Specimen/ Apparatus/ Photograph)	
E= Microbiology	(Slide/ Photographs)	
F= Ecology	(Specimen/ Photographs)	

**PONDICHERRY UNIVERSITY**  
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(Choice Based Credit System)  
(Effective from the academic year 2017-2018)

Semester III

**Developmental Botany (Cell Biology, Angiosperm Anatomy and Embryology)**

**Course Code: UBOT 231(P)**

**Time: 3 hrs**

**Max. Marks: 50**  
**(ICA= 13+ESE=37= 50)**

1. Prepare squash/ smear of the material **A**. Identify any two stages giving reasons.  
Leave the slide for valuation.  
(Preparation-2,Diagram-1,Reasons-1 marks) (1x04= 04 marks)
  
2. Make suitable micropreparations of **B&C**. Leave the slide for valuation.  
Identify with reasons.  
(Preparation-1, Identification-1, Diagram-1, Reasons-1marks) (2x04= 08 marks)
  
3. Dissect and mount the embryo/endosperm of the specimen **D**. Leave the slide for valuation.  
(1x03= 03 marks)
  
4. Draw labeled sketches and identify giving reasons **E, F, G&H**.  
(Identification-1, Diagram-1, Reasons-1 marks) (4x03= 12 marks)

**Total for Practical = 27 marks**

**Record = 10 marks**

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**Total for ESE = 37 marks**

**ICA= 13 marks**

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**Grand Total (ICA+ESE) = 50 marks**

**KEY**

A = Cell Biology	(Preparation)	
B = Anatomy	(Section)	
C = Embryology	(Section)	
D = Embryology	(Dissection)	
E = Anatomy	(Specimen/ Slide/ Photograph)	
F = Anatomy	(Specimen/ Slide/ Photograph)	
G = Embryology	(Specimen/ Slide/ Photograph)	
H= Cell Biology	(Specimen/ Slide/ Photograph)	

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Semester III

**Medicinal Botany**

**Course Code: UBOT 232(P)**

**Time: 3 hrs**

**Max. Marks: 50**  
**(ICA= 13+ESE=37= 50)**

1. Identify the given material **A & B** using micropreparation/ histochemical/ phytochemical methods.  
(Preparation-3, Identification-1, Procedure-3, Diagram-2 marks) (2x09 = 18 marks)
2. Identify and draw specimen **C** giving reasons.  
(Identification-1, diagram-2, reasons-2marks) (1x05 = 05 marks)
3. Write medicinal uses of specimen **D&E** (2 x02= 04 marks)

**Total for Practical = 27 marks**

**Record Marks = 10 marks**

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**Total for ESE = 37 marks**

**ICA= 13 marks**

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**Grand Total (ICA+ESE) = 50 marks**

**KEY**

A = from Unit 3	(Section)	
B = from Unit 3	(Section)	
C = from Unit 5	(Specimen/ Slide/ Photograph)	
D = from Unit 2	(Specimen/ Slide/ Photograph)	
E = from Unit 3	(Specimen/ Slide/ Photograph)	

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Semester IV

**Field Botany (Ecology and Angiosperm Taxonomy)**

**Course Code: UBOT 241(P)**

**Time: 3 hrs**

**Max. Marks: 50**  
**(ICA= 13+ESE=37= 50)**

1. Describe the given specimen **A** in technical terms. Draw L.S. and Floral Diagram of the Flower. Write the Floral Formula. Assign to its Family giving reasons.

(Identification-1, Description-2, Flower.L.S-2, Floral Diagram-1, Reasons-1 marks)

(1x07 = 07 marks)

2. Identify the given specimen **B** to its family giving reasons. Write its Taxonomic hierarchy.

(Identification-1, Reasons-2, Taxonomic hierarchy-2 marks)

(1x05 = 05 marks)

3. Estimate the Importance Value Index (IVI) from the given values in **C**. (1x05 = 05 marks)

4. Make a suitable micropreparation of given specimen **D**. Leave the slide for valuation.

Identify with reasons.

(Preparation-2, identification-1, diagram-1, Reasons-2 marks)

(1x06 = 06 marks)

**Total for Practical = 23 marks**

**Record = 10 marks**

**Herbarium = 4 marks**

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**Total for ESE = 37 marks**

**ICA= 13 marks**

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**Grand Total (ICA+ESE) = 50 marks**

**KEY**

A = Taxonomy	(Specimen)	
B = Taxonomy	(Specimen)	
C = Ecology	(Problem)	
D = Ecology	(Section)	

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Semester IV

**Economic Botany**

**Course Code: UBOT 242(P)**

**Time: 3 hrs**

**Max. Marks: 50**  
**(ICA= 13+ESE=37= 50)**

1. Identify the given material **A** using micropreparation.  
(Preparation-3, Identification-1, Reasons/ Procedure-3, Diagram-2 marks) (1x09= 09 marks)
2. Localise the starch by Histochemical method of the given material **B**.  
(Preparation-3, Identification-1, Reasons/ Procedure-3, Diagram-2 marks) (1x09= 09 marks)
3. Identify, write the binomial and economic uses of **C, D & E**.  
(Identification-1, binomial-1, uses-1 marks) (3x03= 09 marks)

**Total for Practical = 27 marks**

**Record = 10 marks**

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**Total for ESE = 37 marks**

**ICA= 13 marks**

-----  
**Grand Total (ICA+ESE) = 50 marks**

**KEY**

A =	(Micropreparation)	
B =	(Histochemical localization)	
C =	(Specimen/ Slides/ Photographs)	
D =	(Specimen/ Slides/ Photographs)	
E =	(Specimen/ Slides/ Photographs)	

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Semester V

**Molecular Biology**

**Course Code: UBOT 352(P)**

**Time: 3 hrs**

**Max. Marks: 50**  
**(ICA= 13+ESE=37= 50)**

1. Isolate/Estimate the materials from the given specimen **A**. List the materials required. Evaluate and record the results. Leave the preparation for valuation.  
(Preparation-3, Procedure-3, List of materials-1, Sketch-1, Results-2 marks)  
(1x10= 10 marks)
  
2. Stain the materials from the given specimen **B**. List the materials required. Evaluate and record the results. Leave the preparation for valuation.  
(Preparation-2, Procedure-2, List of materials-1, Sketch-1, Results-1marks)  
(1x07= 07 marks)
  
3. Identify and write notes on **C** and **D**.  
(Identification-1, Diagram-2, Notes-2 marks)  
(2x05= 10 marks)

**Total for Practical = 27 marks**

**Record = 10 marks**

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**Total for ESE = 37 marks**

**ICA= 13 marks**

-----

**Grand Total (ICA+ESE) = 50 marks**

**KEY**

A =	(DNA isolation/estimation)	
B =	(Giemsa staining)	
C =	(Specimen/ Slides/ Photographs)	
D =	(Specimen/ Slides/ Photographs)	



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Semester V

**Plant Physiology and Biochemistry**

**Course Code: UBOT 353(P)**

**Time: 3 hrs**

**Max. Marks: 50**  
**(ICA= 13+ESE=37= 50)**

1. Outline the procedure for the given experiment **A**. List the materials required. Set up the experiment and draw. Tabulate the data recorded. Report the results and leave the setup for valuation.

(Set up-2, Procedure-2, List of materials-1, Sketch/Graph-1, Tabulation-2 and Results-2 marks) (1x10=10 marks)

2. Outline the procedure for the given experiment **B**. List the materials required. Set up the experiment and draw. Tabulate the data recorded. Report the results and leave the setup for valuation.

(Set up-2, Procedure-2, List of materials-1, Sketch/Graph-1, Tabulation-2 and Results-1 marks) (1x09= 09 marks)

3. Identify, draw and write notes on **C & D**.

(Identification- 1, Diagram-1, Notes-2 marks) (2x04= 08 marks)

**Total for Practical = 27 marks**  
**Record = 10 marks**

-----  
**Total for ESE = 37 marks**  
**ICA= 13 marks**

-----  
**Grand Total (ICA+ESE) = 50 marks**

**KEY**

A = Plant Physiology	(Experiment)	
B = Biochemistry	(Experiment)	
C = Plant Physiology	(Specimen/ Slides/ Photographs)	
D = Biochemistry	(Specimen/ Slides/ Photographs)	

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Semester V

**Mushroom Culture**

**Course Code: UBOT 354(P)**

**Time: 3 hrs**

**Max. Marks: 50**  
**(ICA= 13+ESE=37= 50)**

1. Write the procedure and prepare the bed with the given material **A** inside the polythene bags for mushroom culture.

(Preparation-3, Diagram-2, Procedure-3, Reasons-2 marks) (1x10=10 marks)

2. Prepare spawn of the given mushroom **B** and write the procedure.

(Preparation-3, Diagram-1, Procedure-3, Reasons-2 marks) (1x09=09 marks)

3. Identify, draw and write critical notes on the given specimen **C&D**.

(Identificaiton-1, Diagram-1, Notes-2 marks) (2x04= 08 marks)

**Total for Practical = 27 marks**  
**Record = 10 marks**

-----  
**Total for ESE = 37 marks**  
**ICA= 13 marks**

-----  
**Grand Total (ICA+ESE) = 50 marks**

**KEY**

A =	(Preparation)	
B =	(Preparation)	
C =	(Specimen/ Slides/ Photographs)	
D =	(Specimen/ Slides/ Photographs)	

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Semester V

**Biofertilizers and Organic Farming**

**Course Code: UBOT 355(P)**

**Time: 3 hrs**

**Max. Marks: 50**  
**(ICA= 13+ESE=37= 50)**

1. Write the procedure and isolate *Rhizobium* from the given material **A**.  
(Preparation-3, Diagram-2, Procedure-3, Reasons-2 marks) (1x10= 10 marks)
2. Make suitable micropreparation of the given specimen **B**. Leave the slide for valuation.  
Identify with reasons.  
(Preparation-2, Identification-1, Diagram-2, Reasons-2 marks) (1x07= 07 marks)
3. Identify, draw and write critical notes on the given specimen **C&D**.  
(Identification-1, Diagram-2, Notes-2marks) (2x05= 10 marks)

**Total for Practical = 27 marks**

**Record = 10 marks**

-----  
**Total for ESE = 37 marks**

**ICA= 13 marks**

-----  
**Grand Total (ICA+ESE) = 50 marks**

**KEY**

A = Bacteria	(Preparation)	
B = Algae	(Micropreparation)	
C =	(Specimen/ Slides/ Photographs)	
D =	(Specimen/ Slides/ Photographs)	

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Semester V

**Biostatistics and Computer Applications in Biology**

**Course Code: UBOT 356(P)**

**Time: 3 hrs**

**Max. Marks: 50**  
**(ICA= 13+ESE=37= 50)**

1. Solve the given problem **A**. (1x10= 10 marks)
2. Solve the given Problem **B** using computer software. (1x10= 09 marks)
3. Identify, draw and write notes on **C & D**.  
(Identificaiton-1, Diagram-1, Notes-2marks) (2x4= 08 marks)

**Total for Practical = 27 marks**

**Record = 10 marks**

-----

**Total for ESE = 37 marks**

**ICA= 13 marks**

-----

**Grand Total (ICA+ESE) = 50 marks**

**KEY**

A = Biostatistics	(Problem)	
B = Computer Applications	(Problem)	
C = Biostatistics	(Specimen/ Photographs)	
D = Computer Applications	(Specimen/ Photographs)	

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Semester VI

**Plant Biotechnology**

**Course Code: UBOT 362(P)**

**Time: 3 hrs**

**Max. Marks: 50**

**(ICA= 13+ESE=37= 50)**

1. Perform the experiment **A**. Prepare the tissue culture medium and write the procedure.  
(Preparation-3, Procedure-3, List of materials-1, Diagram-2, Results-1marks)

(1x10= 10 marks)

2. Perform the experiment **B**. Inoculate the given explant in the medium. Write the procedure.  
(Preparation-3, Procedure-3, List of materials-1, Diagram-1, Results-1marks)

(1x09= 09 marks)

3. Identify, draw and write notes on **C & D**.  
(Identification-1, Diagram-1, Notes-2marks)

(2x04= 08 marks)

**Total for Practical = 27 marks**

**Record = 10 marks**

-----

**Total for ESE = 37 marks**

**ICA= 13 marks**

-----

**Grand Total (ICA+ESE) = 50 marks**

**KEY**

A =	(Preparation)	
B =	(Experiment)	
C =	(Specimen/ Photographs)	
D =	(Specimen/ Photographs)	

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Semester VI

**Horticulture**

**Course Code: UBOT 364(P)**

**Time: 3 hrs**

**Max. Marks: 50**  
**(ICA= 13+ESE=37= 50)**

1. Demonstrate pruning of the given plant specimen **A**. Draw diagram and write the procedure. (1x10= 10 marks)

2. Outline the procedure for inoculation of the given experiment **B**. List the materials required. Set up the experiment and draw. Tabulate the data recorded. Report the results and leave the setup for valuation.

(Set up-2, Procedure-2, List of materials-1, Sketch/Graph-1, Tabulation-2 and Results-1 marks) (1x09= 09 marks)

3. Identify, draw and write notes on **C & D**. (Identification- 1, Diagram-1, Notes-2 marks) (2x04= 08 marks)

**Total for Practical = 27 marks**

**Record = 10 marks**

-----  
**Total for ESE = 37 marks**

**ICA= 13 marks**

-----  
**Grand Total (ICA+ESE) = 50 marks**

**KEY**

A =	(Experiment)	
B =	(Experiment)	
C =	(Specimen/ Photographs)	
D =	(Specimen/ Photographs)	

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Semester VI

**Plant Tissue Culture**

**Course Code: UBOT 365(P)**

**Time: 3 hrs**

**Max. Marks: 50**  
**(ICA= 13+ESE=37= 50)**

1. Prepare the plant tissue culture medium, **A**. Write the procedure.

(Preparation-3, Procedure-3, List of materials-1, Diagram -1, Results-1 marks)

(1x09= 09marks)

2. Write the procedure and inoculate the given explant in the given medium.

(Preparation-3, Procedure-3, List of materials-1, Diagram -1, Results-2 marks)

(1x10= 10 marks)

3. Identify, draw and write notes on **C & D**.

(Identification- 1, Diagram-1, Notes-2 marks)

(2x04= 08 marks)

**Total for Practical = 27 marks**

**Record = 10 marks**

-----

**Total for ESE = 37 marks**

**ICA= 13 marks**

-----

**Grand Total (ICA+ESE) = 50 marks**

**KEY**

A = Medium preparation	(Experiment)	
B = Inoculation	(Experiment)	
C =	(Specimen/ Photographs)	
D =	(Specimen/ Photographs)	

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Semester VI

**Ethnobotany**

**Course Code: UBOT 366(P)**

**Time: 3 hrs**

**Max. Marks: 50**  
**(ICA= 13+ESE=37= 50)**

1. Make suitable micropreparation of the given specimen **A**. Leave the slide for valuation. Identify with reasons.  
(Preparation-2, Identification-1, Diagram-2, Reasons-2 marks) (1x07= 07 marks)
2. Identify, draw and write critical notes on ethnobotanical uses of given specimen **B&C**.  
(Identification-1, Diagram -1, Notes-1marks) (2x03= 06 marks)
3. Write the family, botanical name, common name and uses of the given specimen **D&E**.  
(Family- 0.5, Botanical name- 0.5, Common name- 0.5, Uses- 0.5 marks) (2x02= 04 marks)

**Total for Practical = 17 marks**

**Record = 10 marks**

**Herbarium = 05 marks**

**Report = 05 marks**

-----

**Total for ESE = 37 marks**

**ICA= 13 marks**

-----

**Grand Total (ICA+ESE) = 50 marks**

**KEY**

A =	(Micropreparation)	
B =	(Specimen/ Photographs)	
C =	(Specimen/ Photographs)	
D =	(Specimen/ Photographs)	