

**UNIVERSITY OF KERALA**  
**THIRUVANANTHAPURAM**



**COURSE STRUCTURE AND SYLLABUS**

*For*

**FIRST DEGREE PROGRAMME**

*In*

**BOTANY**

*Under*

**CHOICE BASED CREDIT- SEMESTER  
SYSTEM**

(w.e.f. 2022 admission)



*Signature*  
HEAD OF THE DEPARTMENT  
Department of Botany  
N.S.S. College



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## **OBJECTIVES OF THE PROGRAMME**

- ❖ To impart knowledge of Science is the basic objective of education.
- ❖ To develop scientific attitude is the major objective to make the students open minded, critical, curious.
- ❖ To develop skill in practical work, experiments and laboratory materials and equipments along with the collection and interpretation of scientific data to contribute to science.
- ❖ To understand scientific terms, concepts, facts, phenomenon and their relationships.
- ❖ To make the students aware of natural resources and environment.
- ❖ To provide practical experience to the students as a part of the course to develop scientific ability to work in the field of research and other fields of their own interest and to make them fit for society.
- ❖ The students are expected to acquire knowledge of plant and related subjects so as to understand natural phenomenon, manipulation of nature and environment for the benefit of human beings.
- ❖ To develop ability for the application of the acquired knowledge to improve agriculture and other related fields to make the country self reliant and sufficient.
- ❖ Understand and appreciate the role of biology in societal issues, such as the environment and biological resources, biodiversity, ethics and human health and diseases.
- ❖ To enrich the students with the latest developments in the field of Information technology, Biotechnology, Bioinformatics and other related fields of research and development
- ❖ To create enthusiasm to understand more about the beautiful planet Earth and to give awareness to the public the need to protect the planet from all kinds of exploitation.
- ❖ To keep the scientific temper which the student acquired from school level and to develop a research culture
- ❖ To introduce the students to industrial activities related to Botany and to get an industry orientation and skills

**Table 1. General Structure of the First Degree Programme in Botany**

Sem No.	Course Code	Course Title	Instructional hours/week		Credits	Uty Exam Duration	Evaluation		Total credits
			T	P			Internal	University exam	
I	EN1111	English Language I	5	-	4	3hrs	20%	80%	16
	1111	Additional Language I	4	-	3	„			
	EN1121	Foundation Course I	4	-	2	„			
	BO1141	Core Course I	2	2	3	„			
	CH/BC1131	Compl. courseI(CH/BC)	2	2	2	„			
	ZO1131	Complementary Course II(ZO)	2	2	2	„			
II	EN1211	English Language II	5	-	4	„	20%	80%	20
	EN1212	English Language III	4	-	3	„			
	1211	Additional Language II	4	-	3	„			
	BO1221	Foundation Course II	2	2	3	„			
	CH/BC1231	Compl. Course III(CH/BC)	2	2	2	„			
	ZO1231	Compl. Course IV(ZO)	2	2	2	„			
III	EN1311	English Language IV	5	-	4	„	20%	80%	17
	1311	Additional Language III	5	-	4	„			
	BO1341	Core Course III	3	2	3	„			
	CH/BC1331	Compl. Course V(CH/BC)	3	2	3	„			
	ZO1331	Compl. Course VI(ZO)	3	2	3	„			
	IV	EN1411	English Language V	5	-	4			
1411		Additional Language IV	5	-	4	„			
BO1441		Core Course III	3	2	3	„			
CH/BC1431		Compl. Course VII(CH/BC)	3	2	3	„			
ZO1431		Compl. course VIII(ZO)	3	2	3	„			
CH/BC1432		Compl IX (Practical CH/BC)	-	(8)*	4	„			
ZO1432		Compl X (Practical ZO)	-	(8)*	4	„			
V	BO1442	Core IV (Practical-II - BO1341 & BO1441)		(4)*	4	„	20%	80%	13
	BO1541	Core Course V	4	3	4	„			
	BO1542	Core Course VI	5	2	4	„			
	BO1543	Core Course VII	4	2	3	„			
		<b>Open Course I</b>	3		2	„			
	BO1551.1	Horticulture			-				
	BO1551.2	Mushroom cultivation & Marketing							
	BO1551.3	Forestry							
VI		Project	-	2			20%	80%	25
	BO1641	Core Course IX	5	2	4	„			
	BO1642	Core Course X	4	2	4	„			
	BO1643	Core Course XI	4	2	4	„			
	BO1644	Core (Practical-3)XII	-	(5)*	3	„			
	BO1645	Core (Practical-4)XIII	-	(8)*	4	„			
		<b>Industry based Elective Course</b>	3	-	2	„			
	BO1661.1	Organic Farming							
	BO1661.2	Mushroom Culture Technology							
	BO1661.3	Nursery and garden management							
BO1661.4	Medicinal Botany								
BO1646	Project		3	4					
									120

**L = Lecture P = Practical (\*)Practical hour already distributed in the semester concerned**

**Table 2. SEMESTER – I**

Sem No.	Course Code	Course Title	Instructional hours/week		Credits	Uty Exam Duration	Evaluation		Total credits
			T	P			Internal	University exam	
I	EN1111	English Language I	5	-	4	3hrs	20%	80%	16
	1111	Additional Language I	4	-	3	„			
	EN1121	Foundation Course I	4	-	2	„			
	BO1141	Core Course I -Angiosperm Anatomy Reproductive Botany & Palynology	2	2	3	„			
	CH/BC1131	Compl. CourseI(CH/BC)	2	2	2	„			
	ZO1131	Compl.CourseII(ZO)	2	2	2	„			

**Table 3. SEMESTER – II**

Sem No.	Course Code	Course Title	Instructional hours/week		Credits	Uty Exam Duration	Evaluation		Total credits
			T	P			Internal	University exam	
II	EN1211	English Language II	5		4	3hrs	20%	80%	17
	EN1212	English Language III	4		3	„			
	1211	Additional Language II	4		3	„			
	BO1221	Foundation Course II- Methodology & Perspectives in Plant Science	2	2	3	„			
	CH/BC1231	Compl. Course III (CH/BC)	2	2	2	„			
	ZO1231	Compl. Course IV(ZO)	2	2	2	„			
	BO1222	Core II (Practical-I - BO1141, BO1221)		(4)*	3	„			

L = Lecture P = Practical \*Practical hour already distributed in the semester concerned

**Table 4. SEMESTER – III**

Sem No.	Course Code	Course Title	Instructional hours/week		Credits	Uty Exam Duration	Evaluation		Total credits
			T	P			Internal	University exam	
III	EN1311	English Language IV	5	-	4	3 hrs	20%	80%	17
	1311	Additional Language III Core	5	-	4	„			
	BO1341	Core Course III- Microbiology, Phycology, Mycology, Lichenology & Plant Pathology	3	2	3	„			
	CH/BC1331	Compl. Course V(CH/BC)	3	2	3	„			
	ZO1331	Compl. Course VI(ZO)	3	2	3	„			

L = Lecture P = Practical

**Table 5. SEMESTER –IV**

Sem No.	Course Code	Course Title	Instructional hours/week		Credits	Uty Exam Duration	Evaluation		Total credit
			T	P			Internal	University exam	
IV	EN1411	English Language V Additional	5	-	4	3hrs	20%	80%	29
	1411	Language IV	5	-	4	„			
	BO1441	Core Course IV- Bryology, Pteridology, Gymnosperms &Paleobotany	3	2	3	„			
	CH/BC1431	Compl.CourseVII(CH/BC)	3	2	3	„			
	ZO1431	Complementary CourseVIII(ZO)	3	2	3	„			
	CH/BC1432	Compl IX (PracticalCH/BC)	-	(8)*	4	„			
	ZO1432	Compl X (Practical ZO)	-	(8)*	4	„			
BO1442	Core V (Practical-II BO1341 & BO1441)		(4)*	4					

L = Lecture P = Practical \*Practical hour already distributed in the semester concerned

**Table 6. SEMESTER - V**

Sem No.	Course Code	Course Title	Instructional hours/week		Credits	Uty Exam Duration	Evaluation		Total credits
			T	P			Internal	University exam	
V	BO1541	Core Course VI - Angiosperm Morphology, Systematic botany, Economic botany, Ethno botany & Pharmacognosy	4	3	4	3hrs	20%	80%	20
	BO1542	Core Course VII Environmental Studies, Phytogeography & Research Methodology	5	2	4	„			
	BO1543	Core Course VIII- Cell Biology, Genetics & Evolutionary Biology	4	2	3	„			
	BO1551.1 BO1551.2 BO1551.3	Open Course Horticulture Mushroom cultivation & Marketing Forestry	3	-	2	„			
		Project		2					

L = Lecture P = Practical \*Practical hour already distributed in the semester concerned

**Table 7. SEMESTER – VI**

Sem No.	Course Code	Course Title	Instructional hours/week		Credits	Uty Exam Duration	Evaluation		Total credits
			T	P			Internal	University exam	
VI	BO1641	Core Course IX Plant physiology & Biochemistry	5	2	4	3hrs	20%	80%	25
	BO1642	Core Course X- Molecular Biology, General informatics and Bioinformatics	4	2	4	„			
	BO1643	Core Course XI- Biotechnology, Nano- biotechnology, Horticulture & Plant breeding,	4	2	4	“			
	BO1644	Core (Practical-3)XII (BO1541 & BO1542)	-	(5)*	3	„			
	BO1645	Core (Practical-4)XIII IV (BO1543, BO1641,BO1642, 1643)	-	(8)*	4	„			
	BO1661.1 BO1661.2 BO1641.3 BO1641.4	Industry based Elective course Organic Farming Mushroom Culture Technology Nursery and garden management Medicinal Botany	3	-	2	„			
	BO1646	Project	-	3	4				

L = Lecture P = Practical \*Practical hour already distributed in the semester concerned

**Table 8. Distribution of Contact Hours and Credits**

(CORE, FOUNDATION & OPEN COURSES, PROJECT/DISSERTATION)

Course Code	Course Title	Semester I		Semester II		Semester III		Semester IV		Semester V		Semester VI		Total		
		Contact hours	P	credit	Contact hours	P	credit	Contact hours	P	credit	Contact hours	P	credit	Contact hours	P	Credit
BO1141	Angiosperm anatomy Reproductive Botany & Palynology	2	2	3											4	3
BO1221	Methodology & Perspectives in Plant Science				2	2	3								4	3
BO1222	Practical-I ( BO1141, BO1221)		2*			*	2								4	3
BO1341	Microbiology, Phycology, Mycology Lichenology & Plant Pathology						3	2	3						5	3
BO1441	Bryology, Pteridology, Gymnosperms & Paleobotany								3	2	3				5	3
BO1442	Practical-II (BO1341 & BO1441)						*	2		*	2				4	4
BO1541	Angiosperm Morphology Systematic botany, Economic botany Ethno botany & Pharmacognosy										4	3	4		7	4
BO1542	Environmental Studies Phytogeography & Research methodology										5	2	4		7	4
BO1543	Cell Biology, Genetics & Evolutionary Biology										4	2	3		6	3
BO1551.1 BO1551.2 BO1551.3	Horticulture Mushroom cultivation & Marketing Forestry										3				3	2
BO1641	Plant Physiology & Biochemistry												5	2	4	7
BO1642	Molecular Biology, General informatics and Bioinformatics												4	2	4	6
BO1643	Biotechnology, Nano biotechnology, Horticulture & Plant breeding,												4	2	4	6
BO1644	Practical-III (BO1541 & BO1542)										5*					3
BO1645	Practical-IV (BO1543, BO1641, BO1642, 1643)													8*		4
BO1661.1 BO1661.2 BO1661.3 BO1661.4	Organic Farming, Mushroom Culture Technology, Nursery and garden management, Medicinal Botany												3		3	2
BO1646	Project report, Tour Diary, Viva-Voce										2			3	5	4
	<b>Total</b>															<b>57</b>

L = Lecture P = Practical \*Practical hour already distributed in the semester concerned



**Table 9. Scheme of Evaluation of Foundation Course II, Core Courses,  
Open Courses & Project**

Semester	Course Code	Course Title	Marks		Duration of University Exam.
			CE	ESE	
I	BO1141	Angiosperm anatomy Reproductive Botany & Palynology	20	80	3 hrs
II	BO1221	Methodology & Perspectives in Plant Science	20	80	3 hrs
	BO1222	Practical-I ( BO1141, BO1221)	20	80	3 hrs
III	BO1341	Microbiology, Phycology, Mycology Lichenology & Plant Pathology	20	80	3 hrs
IV	BO1441	Bryology, Pteridology, Gymnosperms &Paleobotany	20	80	3 hrs
	BO1442	Practical-II (BO1341 & BO1441)	20	80	3 hrs
V	BO1541	Angiosperm Morphology Systematic botany, Economic otany Ethnobotany & Pharmacognosy	20	80	3 hrs
	BO1542	Environmental Studies , Phytogeography & Research Methodology	20	80	3 hrs
	BO1543	Cell biology, Genetics & Evolutionary Biology	20	80	3 hrs
	BO1551.1 BO1551.2 BO1551.3	Horticulture Mushroom cultivation & Marketing Forestry	20	80	3 hrs
VI	BO1641	Plant Physiology & Biochemistry	20	80	3 hrs
	BO1642	Molecular Biology, General informatics and Bioinformatics	20	80	3 hrs
	BO1643	Biotechnology, Nano biotechnology, Horticulture and Plant breeding	20	80	3 hrs
	BO1644	Practical-III (BO1541 & BO1542)	20	80	3 hrs
	BO1645	Practical-IV (BO1543, BO1641,BO1642, 1643)	20	80	3 hrs
	BO1661.1 BO1661.2 BO1661.3 BO1661.4	Organic Farming Mushroom Culture Technology Nursery and garden management Medicinal Botany	20	80	3 hrs
	BO1646	Project report, Tour Diary, Viva-Voce	20	80	-

## **END SEMESTER ASSESSMENT (ESA)**

The University shall conduct the external examinations for all semesters. There will not be any supplementary exams. The practical examinations for **Core courses** shall be conducted after 2<sup>nd</sup>, 4<sup>th</sup> and 6<sup>th</sup> semesters and **Complementary** courses at the end of 4<sup>th</sup> semester according to the common calendar and questions set up by the University. The Board of Examiners constituted by the University will have the right to make necessary changes in the pattern of practical examination as and when needed with the prior sanction of the Chairman, Board of Studies Botany (Pass). The practicals mentioned in the syllabus under various branches of Botany Core and Complementary Courses should be incorporated in the Practical record.

## **ELIGIBILITY TO APPEAR FOR PRACTICAL EXAMINATION**

Submission of the following

- Certified and bonafide practical record
- Certified herbarium sheets
- Certified field Book
- Certified Tour Report
- Project report/Dissertation (certified and bonafide)

## **PROJECT**

Project work/Dissertation is compulsory. Students have to begin the project in the 5<sup>th</sup> Semester and submit the project report for valuation at the end of 6<sup>th</sup> Semester. Viva-Voce may be conducted for each student at the time of Project evaluation. Project can be carried out either individually or by a group not exceeding 15 students ensuring direct and active participation of each student in the group. The topics shall either be allotted by the supervising teacher or be selected by the student in consultation with the supervising teacher. The project report/dissertation duly attested by the Supervising teacher and Certified by the Head of the Department, has to be submitted on the day of examination of **Practical - III (Core)**. The project shall be evaluated by an external examiner. The project report/ Dissertation (not less than 30 pages) shall be prepared in Times New Roman font size 12 with 1.5 spacing as per the format given below.

1. Title page /Front page (Certified by the **HOD**)
2. Declaration by the candidate
3. Certificate attested by the Supervising Teacher
4. Acknowledgement, if any
5. Table of contents
6. Abbreviation, if any
7. Introduction & Review of Literature
8. Material and Methods
9. Results and Discussion (Not less than 10pages)
10. Summary and Conclusion

## 11. References

Tables, Graphs, Photographs etc. can be used to present the data. Topics selected once should not be repeated and plagiarism should be avoided.

### STUDY TOUR

- Field trip to a place of plant diversity within or outside Kerala with a minimum duration of 3 days is compulsory. (Field trips are to be conducted for three days either as continuous or one daytrips).
- A brief report of the trip has to be submitted at the time of Practical Examination

### CORE COURSES

Semester	Course Code	Course Title	Contact hrs/week		Credits
			L	P	
I	BO1141	Angiosperm anatomy Reproductive Botany & Palynology	2	2	3
II	BO1221	Methodology & Perspectives in Plant Science	2	2	3
	BO1222	Practical-I ( BO1141, BO1221)		4	3
III	BO1341	Microbiology, Phycology, Mycology Lichenology & Plant Pathology	3	2	3
IV	BO1441	Bryology, Pteridology, Gymnosperms &Paleobotany	3	2	3
	BO1442	Practical-II (BO1341 & BO1441)		4	4
V	BO1541	Angiosperm Morphology Systematic botany, Economic botany Ethno botany & Pharmacognosy	4	3	4
	BO1542	Environmental Studies , Phytogeography & Research Methodology	5	2	4
	BO1543	Cell Biology, Genetics & Evolutionary Biology	4	2	3
VI	BO1641	Plant Physiology &Biochemistry	5	2	4
	BO1642	Molecular Biology, General informatics and Bioinformatics	4	2	4
	BO1643	Biotechnology, Nanobiotechnology, Horticulture and Plant breeding	4	2	4
		Industry based elective course	<b>3</b>	<b>0</b>	<b>2</b>
	BO1661.1	Organic Farming			
	BO1661.2	Mushroom Culture Technology			
	BO1641.3	Nursery and garden management			
	BO1641.4	Medicinal Botany			
	BO1644	Practical-III (BO1541 & BO1542)		5	3
BO1645	Practical-IV (BO 1543, BO1642, BO1642 & BO1643)		8	4	

## SEMESTER-I

### ANGIOSPERM ANATOMY, REPRODUCTIVE BOTANY AND PALYNOLOGY

Course code BO 1141 Number of credits: 3

Number of contact hours: Lecture: 36 hrs; Practical: 36 hrs; Total: 72 hrs

Distribution of Hours	Theory	Practical
Introduction to Botany	02 hrs	
Angiosperm Anatomy	25 hrs	27 hrs
Reproductive Botany & Palynology	09 hrs	09 hrs
<b>Total</b>	<b>36 hrs</b>	<b>36 hrs</b>

**Aim of the course:** To generate awareness about anatomical features of Angiosperms & Reproductive biology.

#### Objectives:

- To develop skills for identification of microscopic structures
- To distinguish various tissue systems and internal structure
- To acquire basic knowledge about embryo development and pollen grains

#### Expected Outcome

- Students are able to understand the complexities of cell wall organization, microscopic and sub microscopic structures.
- Students can distinguish various anatomical features of monocots and dicots (stem and root) with respect to permanent tissues and tissue systems.
- Identify and differentiate male and female gametophyte development in angiosperms.
- Distinguish monocot and dicot embryo and the basic features of pollen grains.

#### MODULE – I

**02 hrs**

Scope of Botany. Importance of plants. An overview of plant Diversity (Brief Account)  
(Introductory - No questions for theory examinations from this module)

#### Angiosperm Anatomy

#### MODULE – II

**04 hrs**

1. Objective and scope of plant anatomy
2. Cell wall organisation – Gross structure- Primary and secondary wall, pits-plasmodesmata-microscopic and submicroscopic structures- Extra cell wall material (lignin, suberin), Non living inclusions of the cell [Reserve food (carbohydrates,

proteins, fats and oil), secretory products (colouring matter, enzymes, nectar), excretory products (nitrogenous and non nitrogenous including resins, tannins, organic acids, latex, essential oils, glycosides, gums and mineral crystals)].

### MODULE - III

09 hrs

3. Tissues-Meristems: Definition, Classification based on origin, position, growth patterns, functions
4. Apical meristem. Theories on apical organization of shoot apex- Apical cell theory, Histogen theory, Tunica-Corpus theory. Organisation of shoot apex in dicots and monocots. Theories of organization of root apex- Apical cell theory, Histogen theory and Korper Kappe theory. Organization of root apex in dicots and monocots.
5. Permanent tissues – Definition, classification – simple, complex and secretory tissues (glandular tissue, laticifers).
6. Tissue systems- Epidermal tissue system, Ground tissue system and vascular tissue systems. Stomata – structure and functions, types- anomocytic, anisocytic, paracytic, diacytic, graminaceous. Different types of vascular arrangements.

### MODULE- IV

12 hrs

7. Primary structure – Root, stem and leaf (Dicot & Monocot)
8. Secondary growth- Root and stem- cambium (structure and function), annual rings, heart wood and sap wood, hard wood and soft wood, tyloses, ring porous wood and diffuse porous wood, periderm formation – phellum, phellogen and phelloderm; lenticels
9. Anomalous secondary growth – *Bignonia*, *Boerhaavia*, *Dracaena*.

### Practicals

27 hrs

1. Non-living inclusions – Cystolith, Raphide, Sphaero- raphide (Druses), Aleurone grains
2. Starch grains (Eccentric, Concentric, compound)
3. Simple permanent tissue- Parenchyma, Chlorenchyma, Aerenchyma, Collenchyma, Sclerenchyma
4. Primary structure- Dicot stem- *Centella*, *Chromolaena*
5. Monocot stem- Grass and *Asparagus*
6. Dicot root- Pea/ *Limnanthemum*
7. Monocot root- Colocasia or any other monocot root
8. Secondary structure – Stem (Normal type) – *Vernonia*
9. Secondary structure – Root (Normal type)- *Carica papaya*, Aerial root- *Tinospora and Ficus*
10. Epidermal structures- Stomata (Anomocytic, anisocytic, paracytic, diacytic)
11. Anomalous secondary thickening – *Bignonia*, *Boerhaavia*, *Dracaena*

### MODULE – V

09 hrs

#### Reproductive Botany and Palynology

1. Introduction to angiosperm embryology, Contribution of P. Maheswary.
2. Microsporogenesis- Structure and functions of wall layers
3. Development of male gametophyte- Dehiscence of anther

4. Megasporogenesis – Development of female gametophyte – Embryo sac- Development and types – Monosporic – *Polygonum* type, Bisporic – *Allium* type, Tetrasporic – *Adoxa* type
5. Pollination- Germination of pollen grains, Fertilization, double fertilization, Barriers of fertilization
6. Structure of embryo – Dicot (*Capsella*). Monocot (*Sagittaria*), Endosperm types (Cellular, nuclear and helobial – Brief account only)
7. Palynology: Pollen structure, aperture morphology, pollen allergy. Economic and taxonomic importance (Brief account only)

### Practical

09 hrs

1. Pollen morphoforms (Colpate, porate and colpate- Photographs/permanent slides. SEM images not needed)
2. Students should be familiar with different types of ovules
3. Students should be familiar with the structure of anther and embryo ( Permanent slides can be used)

### REFERENCES

1. Bhattacharya K and Majumdar M R.(2011) A text book of palynology, New Central Book Agency, Calcutta
2. Bhojwani S S, Dantu P K & Bhatnagar S P (2014) The embryology of Angiosperms, Vikas Publishing
3. Coutler E. G. (1969) Plant Anatomy – Part I Cells and Tissues – Edward Arnold, London
4. David F. Cutler, Ted Botha and Dennis W M. Stevenson (2008) Plant Anatomy : An Applied Approach, John Wiley and Sons Ltd
5. Esau K (1965) Plant Anatomy- Wiley Eastern, New York
6. Esau K (2006) Anatomy of seed plants 2<sup>nd</sup> edition Wiley Eastern, New York
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9. Kashinath Bhattacharya, Manas Ranjan Majumdar, Swati Gupta Bhattacharya (2011) A Text Book of Palynology, New Central Book Agency; 3<sup>rd</sup> Revised edition
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17. Vashista P C (1984) – Plant Anatomy, Pradeep Publications, Jalandhar

## SEMESTER-II

### FOUNDATION COURSE

#### METHODOLOGY AND PERSPECTIVES IN PLANT SCIENCES

Course code : BO 1221 Number of credits : 3

Number of contact hours: 36 hrs (Lecture); 36hrs (Practical)

Total= 72 hours

Distribution of Hours	Theory	Practical
Scientific Studies	08 hrs	0 hrs
Data handling in science	12 hrs	16 hrs
Microtechnique	06 hrs	08 hrs
Biophysics	10 hrs	12 hrs
<b>Total</b>	<b>36 hrs</b>	<b>36 hrs</b>

**Aim of the course:** To introduce the methodology and perspectives of Science in general also as to enable the students to systematically pursue his particular discipline in science in relation to other disciplines that come under the rubric of sciences.

#### Objectives:

- To familiarize the students with the fundamental characteristics of science and significance of scientific studies
- To apply scientific methods independently and familiarize instruments in biological labs
- To interpret scientific data using basic statistical methods
- To develop skills for microscopic specimen preparation.

#### Expected outcome

- Students will be familiarized with the fundamental characteristics of Science.
- Develops an idea about involvement of science in improvement of human life.
- Create awareness of scientific approach towards life and learns the values of ethics in science.
- Develops skills to interpret scientific data using basic statistical methods.
- Create skills to prepare specimens for microscopic and gross anatomical studies and familiarize with different microscopic methods for sample analysis.
- Students become able to prepare buffers, measure pH, separate plant pigments and construct absorption spectrum of a sample

#### MODULE-I

##### Scientific Studies

08 hrs

1. Science and pseudoscience. (Definition of Science, Eg. germ theory vs spontaneous generation,
2. Methods of science: Inductive and deductive Methods, (Explain with an example suggestion – Ref. 22 - Page 1-23, or any suitable example).

- Approaches to develop Knowledge: steps involved – 1) defining the problem 2) making observations, 3) forming a hypothesis, 4) conducting an experiment and 5) drawing conclusions.
- Botany as a discipline of science. Allied branches of Botany :- (brief account of Plant Tissue culture, Plant Biotechnology, Floriculture. Pharmacognosy, Organic farming, Ethnobotany, Astrobotany)
- Major Revolutions in Biology (Brief description about Green revolution, blue revolution and white revolution.)
- Model organisms in Biology – Significance - brief account on *E.coli*, *Neurospora* and *Arabidopsis*.
- Contributions of Indian Botanists (MS. Swaminathan , E.K. Janakiammal, K.S Manilal)

## MODULE- II

### Data handling in science

12hrs

- Nature and types of data - Typical examples, Data collection, Data presentation- Classification and tabulation, diagrammatic presentation (bar & pie diagrams) and graphic presentation (Histogram, frequency polygon, frequency curve & Ogives).
- Samples and sampling techniques – simple random sampling, systematic sampling and stratified sampling.
- Statistical treatment of data: Statistical terms and symbols. Measures of central tendencies (mean, median, mode), Measures of dispersion (range, mean deviation, variance, standard deviation, standard error), Significance tests (chi-square test).

### Practicals

16hrs

- Workout problems on frequency distribution
- Represent data using bar diagram and histogram
- Measures of central tendencies (Mean, Median, Mode)
- Workout problems on measures of dispersion (range, mean deviation, variance, standard deviation, standard error)
- Workout problems on chi-square test.

## MODULE-III

### Microtechnique

06hrs

- Introduction - microscopy - simple and compound – phase contrast; dark field illumination and electron microscopes (SEM and TEM).
- Micrometry, Camera lucida
- Sectioning - hand and microtome– rotary and sledge
- Killing and fixation agents – Carnoy's formula, Farmer's formula, F.A.A
- Dehydration – reagents – Ethyl Alcohol, Isopropyl Alcohol, Tertiary Butyl Alcohol
- Stains and staining techniques - Stains: safranin, haematoxylin, acetocarmine, Fast green, eosin. Progressive and regressive, Double staining – Safranin & Fast green



7. Mounting media - D. P. X and Canada balsam
8. Whole mounts - cytological methods: maceration, smear and squash preparation.

### **Practical**

**08hrs**

1. Students should be familiar with the use microscope and its parts
2. Familiarize stains, fixatives and mounting media
3. General awareness of Micro technique - maceration, smears & squash
4. Demonstration of microtome sectioning and hand sectioning
5. Measurement of specimens using micrometer (Demonstration only).
6. Photomicrography and Camera lucida drawings (Demonstration only).

## **MODULE-IV**

### **Biophysics**

**10hrs**

1. Principles and applications of Colorimeter, Spectrophotometer (UV-Visible) and Centrifuge- centrifugation, types of rotors (swinging bucket, fixed angle), Density gradient and Differential centrifugation.
2. Basic knowledge of the separation methods: - Chromatography (Column chromatography, paper chromatography and TLC), Electrophoresis (PAGE and AGE).
3. Buffers -their functions in biological systems -Uses of buffers in biological research,
4. pH meter.
5. Cryobiology – cryopreservation, freeze drying (lyophilisation) and its applications.

### **Practical**

**12hrs**

1. Separation of plant pigments by paper chromatography/TLC.
2. Preparation of buffer
3. Measurement of pH
4. Construct the absorption spectrum of any sample.
5. Familiarise students to equipments like Centrifuge, Spectrophotometer, pH meter, Electrophoresis.

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## SEMESTER-III

### MICROBIOLOGY, PHYCOLOGY, MYCOLOGY, LICHENOLOGY AND PLANT PATHOLOGY

Course code : BO 1341 Number of credits : 3

Number of contact hours: Lecture: 54 hrs; Practical: 36 hrs; Total: 90 hrs

Distribution of Hours	Theory	Practical
Microbiology	09 hrs	08 hrs
Phycology	20hrs	10 hrs
Mycology&Lichenology	20 hrs	15 hrs
Plant Pathology	05 hrs	03 hrs
<b>Total</b>	<b>54 hrs</b>	<b>36 hrs</b>

**Aim of the course:** To create awareness about the world of microbes and lower groups of plants.

#### Objectives:

- To familiarize characteristic features of microbes and their significance
- To create awareness about importance of microbes in environment
- To generate idea about types of algae, fungi, lichen and their economic as well as evolutionary significance

#### Expected outcome

- The student can prepare micropreparations and identify the thallus and reproductive structures of lower plant groups like algae, fungi and lichen
- An awareness created among students about various microbes, structure and economic importance
- Students can use effectively the methodology to isolate and identify bacteria present in curd and root nodules
- Can identify various plant diseases, etiology of pathogens and control measures
- Able to prepare fungicides like tobacco decoction and Bordeaux mixture

#### MODULE-I

##### Microbiology

08hrs

1. History & scope of microbiology.
2. Bacterial classification: Morphological classification, classification based on staining reaction: Ultra structure of bacteria, Reproduction, Economic importance.
3. Mycoplasma & Actinomycetes –General account.
4. Virus-General characteristics, Nomenclature, classification, structure, Chemical composition, properties and reproduction of bacteriophages and T. M. V., Economic importance of viruses.
5. Soil microbiology – Soil microorganisms, the rhizosphere
6. Aquatic microbiology - Microbiology of sewage or waste water. Methods of waste water treatment (Brief account only)

7. Food microbiology - Food spoilage and preservation methods [General account].
8. Agricultural microbiology - Role of microbes in soil fertility, Nitrogen fixation, Biofertilizers

**Practical**

**07hrs**

1. Gram staining of bacteria.
2. Test for the Coliform bacteria in contaminated water.
3. Isolation of *Rhizobium* from root nodules of leguminous plants (Demonstration)
4. Examination of different forms of bacteria (Demonstration)

**MODULE - II**

**Phycology**

**20hrs**

1. Introduction – Range of thallus structure – Phylogenic trends – Pigments –Reproduction
2. Life cycle – Classification proposed by F .EFritsch
3. Salient features of the following major groups with reference to the structure, reproduction and life cycle of the types given below (**Excluding the developmental details**)
  - a) Cyanophyceae –*Nostoc*
  - b) Chlorophyceae - *Chlorella*, *Volvox*, *Oedogonium* and *Chara*
  - c) Xanthophyceae –*Vaucheria*
  - d) Bacillariophyceae –*Pinnularia*
  - e) Phaeophyceae –*Sargassum*
  - f) Rhodophyceae –*Polysiphonia*

**Economic importance of algae**

- a) Commercial products of algae – Agar, Alginates, Carrageenin, Diatomaceous earth, biofuels
- b) Algae - medicinal aspects, algal blooms and red tide

**Practical**

**15hrs**

1. Make micro preparations of vegetative and reproductive structures of the types mentioned in the syllabus.
2. Identify the algal specimens up to the generic level and make labeled sketches of the specimens observed.

**MODULE-III**

**Mycology & Lichenology**

**20hrs**

1. Introduction, structure, reproduction, life cycle, evolutionary trends.
2. Classification of Fungi proposed by G.C. Ainsworth (1973)
3. Distinguishing characters of different classes of fungi representing the following genera (Excluding Developmental details)
  - a. Myxomycota –General characters.
  - b. Mastigomycotina - *Pythium*
  - c. Zygomycotina -*Rhizopus*
  - d. Ascomycotina
    - Hemiascomycetes -*Saccharomyces*
    - Plectomycetes -*Penicillium*
    - Pyrenomycetes -*Xylaria*
    - Discomycetes –*Peziza*

- e. Basidiomycotina
    - Teliomycetes - *Puccinia*
    - Hymenomycetes -*Agaricus*
  - f. Deuteromycotina -*Cercospora*.
4. Economic importance of Fungi

**Lichenology:** General account and economic importance;  
Morphology and anatomy of *Usnea*

**Practicals** **10hrs**

A detailed study of structure and reproductive structures of types given in the syllabus and submission of record

*Phythium, Rhizopus, Saccharomyces, Penicillium, Xylaria, Peziza. Puccinia. Agaricus, Cercospora* and *Usnea*.

#### MODULE-IV

**PlantPathology** **06hrs**

1. Classification of plant diseases on the basis of causative organisms and symptoms – Host-parasite interaction, phytoalexins.
2. Study of the following diseases with emphasis on symptoms, disease cycle and control measures - Leaf mosaic of Tapioca, Citrus Canker, Blast disease of Paddy, Root wilt of Coconut
3. Brief account of the following fungicides- Bordeaux mixture, Lime sulphur, Tobacco decoction, Neem cake & oil.

**Practical** **04hrs**

1. Identify the Diseases mentioned with respect to causal organism and symptoms- Leaf mosaic of Tapioca, Citrus Canker, Blast disease of Paddy.
2. Students should be trained to prepare the fungicide Bordeaux mixture & Tobacco decoction.

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## SEMESTER-IV

### BRYOLOGY, PTERIDOLOGY, GYMNOSPERMS AND PALAEOBOTANY

Course code : BO 1441 Number of credits : 3

Number of Contact Hours: Lecture- 54 Hours; Practicals-36 Hours Total- 90 Hrs

Distribution of Hours	Theory	Practical
Bryology	18 hrs	09 hrs
Pteridology	18 hrs	14 hrs
Gymnosperms	14 hrs	12 hrs
Paleobotany	04 hrs	01 hr
<b>Total</b>	<b>54 hrs</b>	<b>36 hrs</b>

**Aim of the course:** To create awareness about non flowering plant groups like Bryophytes, Pteridophytes and Gymnosperms.

#### Objectives:

- To familiarize the students characteristic features and evolutionary significance of Bryophytes, Pteridophytes and Gymnosperms.
- To generate awareness about lifecycle of Bryophytes, Pteridophytes and Gymnosperms.
- To impart knowledge about fossil formation and its significance

#### Expected outcome

- Students are able to make micropreparations of thallus and reproductive structures of as well as better understanding of the life cycle of selected members of Bryophytes, Pteridophytes and Gymnosperms
- Can understand the economic and ecologic importance of lower groups of plant kingdom
- Better understanding of fossilization and importance of Palaeobotany
- Identify various parts of fossil plants through micro slides

#### MODULE-1

##### Bryology

18hrs

1. Introduction and general characters, classification- Proskauer (1957)
2. Study of habit, thallus organization, vegetative and sexual reproduction and alternation of generation of the following types (Developmental details are not required)

*Riccia, Marchantia, Anthoceros, Funaria*

3. Economic importance of Bryophytes

**Practical** **09Hrs**

1. *Riccia*- Habit- Internal structure of thallus- V.S.of thallus through archegonia, antheridia and sporophyte
2. *Marchantia*- Habit- thallus with Archegonial receptacle, Male receptacle V.S, Female receptacle V.S. T.S of thallus through gemma, Sporophyte V.S
3. *Anthoceros* – Habit with sporophyte, Sporophyte V S
4. *Funaria*- Habit V.S. of archegonial cluster, V.S of Antheridial cluster, Sporophyte V.S

**MODULE -11**

**Pteridology** **18hrs**

1. Introduction: General characters. Classification as proposed by Smith (1955).
2. Study of the habitat habit, internal structure, reproduction and life cycle of the following types (Developmental details not required). *Psilotum*, *Selaginella*, *Equisetum* and *Pteris*
3. General topics- Stellar evolution in Pteridophytes - Economic importance of Pteridophytes

**Practical** **14hrs**

1. *Psilotum* -External features, Stem T.S., Synangium T.S
2. *Selaginella* - Habit , stem and rhizophore , T.S, V.S of strobilus, Megasporophyll and Microsporophylls
3. *Equisetum* – Habit, Stem-T.S., L.S. of strobilus, Sporangium, Spore with elators
4. *Pteris* - Habit , Rachis T.S Sporophyll T.S, Prothallus

**MODULE-III**

**Gymnosperms** **14hrs**

1. Introduction –General characters and classification of Gymnosperms (Sporne, 1965)
2. Study of the habit, anatomy, reproduction and life cycle of the following types (Developmental details are not required) *Cycas*, *Pinus* and *Gnetum*
3. Evolutionary trends in gymnosperms, Economic importance of Gymnosperms

**Practical** **12hrs**

1. *Cycas*- T.S of leaf, T.S. of coralloid root. Micro and megasporophyll, V S of ovule
2. *Pinus*- T.S. of stem, T.S. of needle, male and female cone, V.S.
3. *Gnetum*-Habit, stem T.S (young and mature), leaf T.S, male and female strobilus, V.S of male and female cone, ovule V.S and seed.



## MODULE –IV

### Palaeobotany

04hrs

1. Geological time scale, Fossil formation, types of fossils.
2. Fossil Pteridophytes- *Rhynia*, *Lepidodendron*, *Lepidocarpon*. Fossil gymnosperms- *Lyginopteris*.

### Practical

01hr

1. Fossil Pteridophytes- *Rhynia* stem, *Lepidodendron*, *Lepidocarpon*.
2. Gymnosperm-*Lyginopteris*

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## SEMESTER-V

### ANGIOSPERM MORPHOLOGY, SYSTEMATIC BOTANY, ECONOMIC BOTANY, ETHNO BOTANY AND PHARMACOGNOSY

Course Code :BO1541Number of Credits :4

Number of contact hours : Lecture: 72 hrs; Practical: 54 hrs; Total: 126 hrs

Distribution of Hours	Theory	Practical
Morphology	14 hr	9 hr
Systematic Botany	40 hr	36 hr
Economic Botany	12 hr	06 hr
Ethnobotany & Pharmacognosy	06 hr	03 hr
<b>Total</b>	<b>72 hr</b>	<b>54 hr</b>

**Aim of the course:** To understand classification, identification and preservation of angiosperms along with ethnobotanical importance.

#### Objectives:

- To introduce importance of morphological characters in classification and plant identification.
- To develop skill for herbarium preparation.
- To acquire knowledge about economic, ethnobotanical significance and pharmacognosy of plants

#### Expected outcome

- Ability to identify different types of inflorescences, flowers and fruits, their arrangement and relative position.
- Familiarization of basic rules of Angiosperm classification and different types of classification.
- Preparation and maintenance of Herbarium.
- Identification of plants to their respective families.
- Understanding of ethnobotanical and pharmacological significance of plants.

#### MODULE-I

##### Morphology

14hrs

1. Morphological description of a flowering plant: Plant habit, Stem (brief account), Leaf – morphotypes, phyllotaxy, Venation (reticulate and parallel).
2. Various types of inflorescence including special types (Cyathium, Verticillaster, Hypanthodium, Coenanthium and Thyrsus) with examples;
3. Floral morphology- Flower-as a modified shoot, Flower parts, their arrangements, relative position, merosity, cohesion, adhesion, symmetry of flower, aestivation types, placentation types. Description of a plant in technical terms, Floral diagram and floral formula
4. Fruit types: simple, aggregate and multiple. Seeds: albuminous and exalbuminous.

#### MODULE-II

##### Systematic Botany

05hrs

Definition, scope and significance of Taxonomy, Historical development of the systems of classification:

1. Artificial- sexual system of Linnaeus
2. Natural - Bentham and Hooker (detailed account)
3. Phylogenetic- Engler and Prantl (Brief account only)
4. APG-IV system- Brief account only

### MODULE-III

04hrs

1. Basic rules of Binomial Nomenclature and International Code of Nomenclature for algae, fungi, and plants (ICN)
2. Importance of herbarium, Herbarium techniques and Botanical gardens. Brief account on the Modern trends in taxonomy; Chemotaxonomy and Molecular taxonomy

### MODULE-IV

31 hr

A study of the following families with emphasis on the morphological peculiarities and economic importance of its members (based on Bentham & Hooker's system)

- |                  |                    |                   |
|------------------|--------------------|-------------------|
| 1) Annonaceae    | 10) Apiaceae       | 19) Lamiaceae     |
| 2) Nymphaeaceae  | 11) Rubiaceae      | 20) Nyctaginaceae |
| 3) Malvaceae     | 12) Asteraceae     | 21) Euphorbiaceae |
| 4) Rutaceae      | 13) Sapotaceae     | 22) Orchidaceae   |
| 5) Anacardiaceae | 14) Apocynaceae    | 23) Scitaminae    |
| 6) Leguminosae   | 15) Asclepiadaceae | 24) Liliaceae     |
| 7) Combretaceae  | 16) Solanaceae     | 25) Arecaceae     |
| 8) Myrtaceae     | 17) Acanthaceae    | 26) Poaceae       |
| 9) Cucurbitaceae | 18) Verbenaceae    |                   |

### Practical

45hrs

1. Study on various types of inflorescences, Flowers and fruits with vivid record of practical work.
2. Students must be able to identify the angiosperm members included in the syllabus up to the level of families. Draw labeled diagram of the habit, floral parts, L S of flower, T S of ovary, floral diagram, floral formula and describe the salient features of the member in technical terms. (Minimum two plants from each dicot family and one from monocot family).
3. Students must submit practical records, Herbarium sheets (25 Nos: representing one sheet from each family) and Field book at the time of practical examination.
4. Field trips are to be conducted for three days either as continuous or one daytrips.

### MODULE-V

#### a) Economic Botany

10hrs

1. Study of the major crops in Kerala - Coconut & Paddy with special reference to their method of cultivation. Botanical description, morphology of the useful part and economic importance—
  - (i) Cereals– Wheat & Maize
  - (ii) Millets- Ragi & Fox tail millet

- (iii) Pulses – Black gram, Green gram, Bengal gram
- (iv) Sugar yielding plants – Sugar Cane
- (v) Spices- pepper, cloves, cardamom
- (vi) Beverages – Coffee, Tea
- (vii) Fibre yielding plants – Cotton
- (viii) Dye Yielding plants - Henna and *Bixa Orellana*
- (ix) Resins- Asafoetida
- (x) Tuber crops – Tapioca, Potato
- (xi) Oil yielding plants- Sesame, ground nut
- (xii) Latex yielding plants- Rubber
- (xiii) Medicinal plants - *Sida*, *Zingiber officinale*, *Aloe vera* and *Vinca rosea*
- (xiv) Insecticide- Neem

**Practical** **06hrs**  
Identify the economic products obtained from the plants mentioned under Economic Botany

**b) Ethnobotany** **05hrs**

1. Definition — importance, scope, categories and significance.
2. Study of various methods to collect Ethno botanical data.
3. Major tribes of Kerala –Kanikkar, Muthuvan, Kurichiar, Ulladar (brief account only)
4. Plant parts used by tribes in their daily life as food, clothing, shelter, agriculture and medicine.
5. Study of common plants used by tribes. *Aegle marmelos*, *Ficus religiosa*, *Cynodon dactylon*, *Ocimum sanctum* and *Trichopon zeylanicus*

**Practical** **03hrs**

1. Visit to a tribal area and collection of information on their traditional method of treatment using crude drugs
2. Observe the plants of ethno botanical importance

**c) Pharmacognosy** **03hrs**

1. Definition and scope of Pharmacognosy
2. Sources of crude drugs – roots, rhizome, bulb, corm, leaves, stems, flowers, fruits and seeds

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## SEMESTER-V

### ENVIRONMENTAL STUDIES , DISASTER MANAGEMENT, PHYTOGEOGRAPHY & RESEARCH METHODOLOGY

Course code: BO 1542 Number of Credits : 4  
Number of contact hours : Lecture: 90 hrs; Practical: 36 hrs; Total: 126 hrs

Distribution of Hours	Theory	Practical
Environmental Studies	58 hrs	36 hrs
Disaster Management	07 hrs	00 hrs
Phytogeography	09 hrs	00 hrs
Research Methodology	16 hrs	00 hrs
<b>Total</b>	<b>90 hrs</b>	<b>36 hrs</b>

**Aim of the course:** To inculcate environmental awareness among students for protecting the Nature.

#### Objectives:

1. To create awareness about ecosystem and Natural resources.
2. To generate knowledge about importance of Biodiversity conservation
3. To understand the need to mitigate pollution and strategies for disaster management
4. To impart knowledge about phytogeographical regions
5. To impart knowledge about the methodology of research and preparation of report

#### Expected outcome

- Develops awareness about natural resources, its conservation and importance of sustainable lifestyles.
- Understands and identify different ecosystems and ecosystem processes.
- Develops deep understanding about biodiversity and importance of its conservation
- Develops skills to identify polluted sites, its major pollutants and recognize the need to mitigate environmental pollution
- Awareness about different types of disasters and to adopt strategies to overcome and reduce the impact
- Identify the importance of phytogeographical sites in India
- Can devise an experimental design and carry out a project
- Students trained about various steps for the conduct of a research project and write a project report

## **MODULE-I**

### **Natural resources and its conservation**

**10 hrs**

1. Natural Resources - Renewable and Non-renewable - Land & Soil, Water, Energy, Minerals, Food and agriculture, Forests, Plants & Wild life resources. Degradation of natural resources - Land degradation, degradation of water resources, Loss of flora and fauna; Causes – population explosion, over exploitation, deforestation, agriculture mismanagement, desertification, overgrazing, soil erosion, mining, urbanization and industrialization- change in land use, depletion of water resources .
2. Conservation of Natural resources and sustainable life styles. - Afforestation, regeneration of wasteland, Rain water harvesting, ground water dams, Promoting use of renewable resources-solar, tidal and wind; biodiesel, biofuels. Reforestation, Community forestry programmes

## **MODULE- II**

### **Ecosystems**

**18 hr**

1. Ecosystems - Concept, definition, structure and function; components- biotic and abiotic; energy flow
2. Food chains -Food web & ecological Pyramids, biogeochemical cycles - Carbon and Phosphorus cycle
3. Ecological succession-Definition, primary and secondary succession, climax concept, hydrosere and xerosere.
4. Plant adaptations- Morphological, anatomical & physiological adaptations of – Hydrophytes, Xerophytes, Halophytes, Epiphytes, Parasites
5. Introduction- types, characteristic features, structure and functions of the following ecosystems.
6. Forest ecosystem, 2. Grassland ecosystem, 3. Desert ecosystem, 4. Aquatic ecosystems- Ponds, Rivers, Oceans, Estuaries (brief account only)

## **MODULE-III**

### **Biodiversity and its conservation**

**16 hrs**

1. Introduction, Definition- genetic, species and ecosystem diversity; biodiversity index (Shannon index)
2. Hot-spots of biodiversity; India as mega-diversity nation.
3. Threats to biodiversity: land use changes & habitat destruction, poaching of wild life- hunting & export, Overuse of pesticides, invasive species.
4. IUCN, Red data Book; Extinct and Threatened species- endangered & Rare; Endemic species of Western Ghats.
5. Conservation of biodiversity: In-situ (National parks and Wild life sanctuaries) and Ex-situ conservation (botanical gardens); Biosphere Reserves & World Heritage Sites in India- Ramsar sites, Chilka lake.
6. Global initiatives in biodiversity conservation- Stockholm Conference, Montreal Protocol, Convention on Biological diversity Regional initiatives- Chipko movement, National Biodiversity Authority (NBA), Access and Benefit sharing (ABS), A brief account on conservation efforts in Kerala- Kerala State Biodiversity Board (KSBB), People Biodiversity Register.

## **MODULE-IV**

### **Environmental pollution**

**14 hrs**

1. Definition, causes, effects and control measures of – 1. Air pollution, 2. Water pollution, 3.

- Soil pollution, 4. Noise pollution, 5. Thermal pollution.
2. Solid Waste Management- waste minimization, Recycling and Reuse, Consuming environment friendly products. E-waste management.
  3. Environmental Organisations –UNEP, IPCC, WWF, Central Pollution Control Board

## **MODULE-V**

### **Disaster management**

**07 hrs**

1. Introduction, Definition and terminologies; scope and concept of disaster management.
2. Natural and Environmental disasters-a brief description of the following disasters- earth quake, flood, coastal disasters, landslides, tsunami (role of mangroves in controlling tsunami disaster), cyclone, dam collapse, nuclear disaster, chemical disaster, biological disaster.
3. Environmental Issues - Global warming and sea level rise, Acid rain, Ozone layer depletion- causes and effects.
4. Disaster management – four phases – mitigation, preparedness, responses, recovery. Emergency procedures and warning systems, application of GIS (brief account only).

## **MODULE-VI**

### **Phytogeography**

**9 hrs**

1. Concept & definition, species distribution- continental drift, continuous and discontinuous distribution.
2. Vegetation in India – Forests- tropical, temperate, sholas, sub alpine, alpine, mangroves & Grass lands.
3. Phytogeographical regions of India (Chatterjee 1962) - Western Himalayas, Eastern Himalayas, Indus plain, Gangetic Plain, Central India, Deccan, Western coasts of Malabar, Assam and Bay Islands of Andamna and Nicobar.

### **Practical**

**36hrs**

1. Visit a local polluted site and report major pollutants.
2. Visit a mangrove vegetation and report diversity
3. Study of ecological and anatomical modifications of Xerophytes, Hydrophytes, Halophytes, Epiphytes and Parasites.
4. Observation and study of different ecosystems mentioned in the syllabus.
5. Phytogeographical regions of India- Photos/Diagrams

## **MODULE-IV**

**16 hrs**

### **Research Methodology**

1. Introduction; Need for research; Stages of Research – Definition of problem, execution of the problem, interpretation of results
2. Characteristics of Research, Types of research- Qualitative & quantitative.
3. Experimental design, components of experimental designs- Randomized blocks, completely randomized designs.
4. Preparation of a project report : Data analysis and consolidation of photographs, illustrations, tables and graphs, Title, introduction, review of literature, materials and methods, results, discussions, summary, references, acknowledgements; Bibliography – Method of citing and arrangement of references; Brief account of Reference management softwares - EndNote, Mendeley.



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## SEMESTER-V

### CELL BIOLOGY, GENETICS AND EVOLUTIONARY BIOLOGY

Course Code : BO 1543

Number of credits : 3

Number of contact hours : Lecture: 72 hrs; Practical: 36 hrs; Total: 108 hrs

Distribution of Hours	Theory	Practical
Cell biology	25 hrs	12 hrs
Genetics	36 hrs	24 hrs
Evolutionary biology	11 hrs	00 hrs
<b>Total</b>	<b>72 hrs</b>	<b>36 hrs</b>

**Aim of the course:** To familiarize cellular organelles, Classical Genetics and importance of Evolution.

#### Objectives:

- To create awareness about cellular organelles.
- To develop skills to identify cell stages and workout problems in classical genetics.
- To introduce different theories of evolution

#### Expected outcome

- Students have a better understanding of cell structure and cell organelles
- Prepare microslides of cell divisions and identify various stages of mitosis and meiosis
- Able to workout problems in classical genetics, modified mendelian ratios and population genetics
- Able to understand genetic diseases and their inheritance
- Understand evolutionary principles, theories and methods of speciation

#### MODULE-I

##### Cell Biology

25hrs

1. History and progress of cell biology
2. Ultra structure and functions of the cell components and organelles Cell wall; The cell membrane, Endoplasmic reticulum, Ribosomes, Golgi apparatus, Lysosomes, Peroxisomes, Vacuole, Mitochondria, Chloroplast & Nucleus.
3. The chromosomes- Chromosome morphology- Eukaryotic chromosomes and its organization. Chromatin - composition and structure; hetero chromatin and euchromatin; Chemical organization. Nucleoproteins – histones and non –histones. Nucleosome model of DNA organization.
4. Special types of chromosomes- Salivary gland, Lamp brush and B chromosomes
5. Variation in Chromosome number (Numerical aberrations)- aneuploidy and Euploidy- haploidy, polyploidy- significance
6. Variation in Chromosome structure (Structural aberrations) - deletion, duplication,

inversion and translocation;significance

7. Mitosis and Meiosis. cell cycle : Significance of mitosis and meiosis

### **Practical**

**12hrs**

1. Make acetocarmine squash preparation of onion root tip and to identify different stages of mitosis.
2. Make squash preparation of the flower buds of any of the following plants.  
*Rhoeo, Capsicum* (To identify Meiosis) Demonstration only

### **MODULE-II**

#### **Classical Genetics**

**36hrs**

1. Mendelian Genetics- Mendel and his experiments, Mendel's success, Mendelian principles, Mendelian ratios, monohybrid and dihybrid crosses, back cross and testcross
2. Genetics after Mendel- Modified Mendelian ratios; Incomplete dominance –Flower color in *Mirabilis* ; Interaction of genes- Comb pattern in poultry. 9:3:3:1. Epistasis - Recessive. Coat color in mice. 9:3:4; Dominant epistasis. Fruit colour in summer squash. 12:3:1; Complementary genes. Flower color in *Lathyrus* 9:7; Duplicate gene with cumulative effect. Fruit shape in summer squash. 9:6:1; Duplicate dominant genes in shepherd's purse. 15:1; Inhibitory factor. Leaf color in Paddy.13:3
3. Multiple alleles-General account. ABO blood group in man. Rhfactor.
4. Quantitative characters- General characters of quantitative inheritance, polygenic inheritance; Skin color in man, ear size in Maize.
5. Linkage and crossing over- Linkage and its importance, linkage and independent assortment. Complete and incomplete linkage. Crossing over – a general account, two point, three point cross. Determination of gene sequence. Interference and coincidence. Mapping of chromosomes.
6. Sex determination- Sex chromosomes, chromosomal basis of sex determination XX-XY, XX-XO mechanism. Sex determination in higher plants (*Melandrium album*) Sex chromosomal abnormalities in man. Klinefelter's syndrome, Turner's syndrome. Sex linked inheritance. Eye colour in *Drosophila*, Hemophilia in man.
7. Extra nuclear inheritance General account, maternal influence. Plastid inheritance in *Mirabilis*. Shell coiling in snails, kappa particle in *Paramecium*.

### **Practical**

**24hrs**

#### **Work out problems in**

1. Monohybrid cross (Dominance and incomplete dominance)
2. Dihybrid cross (Dominance and incomplete dominance)
3. Gene interactions (All types of gene interactions mentioned in the syllabus)
  - a. Recessive epistasis 9: 3: 4.
  - b. Dominant epistasis 12: 3:1
  - c. Complementary genes 9:7
  - d. Duplicate genes with cumulative effect 9: 6:1
  - e. Inhibitory genes 13:3
  - f. Duplicate dominant gene 15: 1
  - g. Comb pattern in poultry 9:3:3:1
  - h. Multiple alleles

4. Linkage and crossing over
5. Two point and three point crosses
6. Construction of genetic map.

### **MODULE-III**

#### **Evolutionary Biology**

**11hrs**

1. Progressive and Retrogressive evolution.
2. Parallel and Convergent evolution.
3. Micro and Macro evolution.
4. Theory of Lamarck, Wismann and De Vries, Darwinism, Neo-Darwinism
5. Isolation, Mutation, Genetic drift, Speciation
6. Variation and Evolution – Hybridization and Evolution – Polyploidy and evolution– Mutation and Evolution.

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## SEMESTER-VI

### PLANT PHYSIOLOGY AND BIOCHEMISTRY

Course code : BO 1641 Number of Credits : 4

Number of contact hours: Lecture: 90 hrs; Practical: 36 hrs; Total: 126 hrs

Distribution of Hours	Theory	Practical
Plant Physiology	60 hrs	20 hrs
Biochemistry	30 hrs	16 hrs
Total	90 hrs	36 hrs

**Aim of the course:** To create awareness about physiological and biochemical aspects of growth & metabolism

#### Objectives:

- To understand physiology of absorption, photosynthesis and respiration.
- To study physiological responses in growth, movements and flowering of plants
- To generate awareness about biomolecules.
- To develop skill for testing of biomolecules

#### Expected outcome of the Course

- Students get a clear understanding of the basic concepts of Physiology and Biochemistry.
- Understands photosynthesis, respiration, plant growth regulators, nitrogen metabolism, and stress physiology
- Familiarization of basic physiological practical procedures.
- Students get the basic knowledge about the macromolecules and their overall role in cell metabolism; and secondary plant products.
- Identification of protein, reducing and non reducing sugar by qualitative tests.

#### MODULE-I

20hrs

1. General introduction: physiological processes, their significance and applications.
2. Water relations of plants: Importance of water to plant life.
  - a. Absorption of water- organs of absorption, root and root hair. Physical aspects of absorption- imbibition, diffusion and osmosis. Plant cell as an osmotic system; water potential and osmotic potential. Plasmolysis and its significance, practical applications. Mechanism of water absorption – active and passive absorption, Pathway of water across root cells.
  - b. Ascent of sap- vital theory, root pressure and physical theories (transpiration pull)
  - c. Loss of water from plants:transpiration-cuticular,lenticular and stomatal mechanism

- Theories – starch sugar hypothesis, potassium - ion theory. Significance of transpiration - guttation, anti-transpirants, factors affecting transpiration.
3. Mineral nutrition: Gross chemical analysis of the plant body, ash analysis, criteria for essentiality of elements, macro and micro elements, role of essential elements and their deficiency symptoms. Culture methods - hydroponics and aeroponics. Mechanism of mineral absorption (a) passive absorption- ion exchange and Donnan equilibrium (b) active absorption- carrier concept, Lundegardh hypothesis.

## **MODULE-II**

**20hrs**

1. Photosynthesis: Introduction, significance and general equation; Photosynthetic apparatus, structure and function of chloroplast, quantasomes - solar spectrum and its importance - Fluorescence and phosphorescence; Red drop, Emerson effect; Two pigment systems; raw material for photosynthesis; Mechanism of photosynthesis- Light reaction - cyclic and non cyclic photophosphorylation; Hill reaction - Dark reaction: Calvin cycle; Comparative study of C<sub>3</sub>, C<sub>4</sub> and CAM plants; Photorespiration, Bacterial photosynthesis and chemosynthesis (Brief account only)
2. Factors affecting photosynthesis - Law of limiting factor.
3. Respiration: Introduction, definition and significance and general equation. Respiratory substrate, types of respiration- aerobic and anaerobic. Aerobic respiration - glycolysis, Krebs's cycle, terminal oxidation. Anaerobic respiration – fermentation: alcoholic and lactic acid fermentation. Energy relation of respiration - R .Q and its significance - Factors affecting respiration.

## **MODULE-III**

**20hrs**

1. Translocation of solutes: Path way of movement, phloem transport, mechanism of transport - Munch hypothesis, protoplasmic streaming theory - activated diffusion hypothesis, electro osmotic theory.
2. Nitrogen metabolism: Source of nitrogen - Biological nitrogen fixation – symbiotic and asymbiotic. Nitrogen fixation by blue green algae - rotation of crops. Nif genes - Leghaemoglobin.
3. Growth: Phases of growth - vegetative and reproductive growth - growth curve - plant growth regulators - Auxins, Gibberellins, Cytokinins, Ethylene, Abscissic acid - synthetic plant hormones - practical applications. Senescence and abscission, Photoperiodism, Photoreceptors – Phytochrome and Cryptochrome
4. Vernalization - Physiology of bud and seed dormancy, germination.
5. Plant movements: Tropic and nastic movements. Circadian rhythm and biological clock.
6. Stress physiology: water stress, salt stress.

## **Practical**

**20hrs**

1. Water potential of onion peel / *Rhoeo* peel by plasmolytic method.
2. Imbibition of water by different types of seeds.
3. Effect of temperature on permeability.
4. Papaya petiole osmoscope.
5. Determination of stomatal index.
6. Determination of water absorption and transpiration ratio.

7. Measurement of rate of transpiration using Ganong's potometer or Farmer's potometer.
8. Evolution of oxygen during photosynthesis.
9. Light screen experiment
10. Measurement of photosynthesis by Wilmott's bubbler.
11. Evolution of CO<sub>2</sub> during respiration.
12. Ganong's respirometer and measurement of R.Q
13. Alcoholic fermentation using Kuhn's fermentation vessel
14. Geotropism using clinostat
15. Measurement of growth using Arc auxanometer.

## **MODULE-IV**

### **Biochemistry**

**15hrs**

1. Molecules and life.
2. Carbohydrates - Classification, occurrence, structure and functions of monosaccharides (glucose and fructose), oligosaccharides (sucrose and maltose), polysaccharides (starch and cellulose), synthesis of glycosidic bonds – Enzymatic hydrolysis of glycosidic bonds – amylases and invertases.
3. Amino acids- classification based on polarity, structure - Amphoteric property of Aminoacids, Peptide formation; Amino acid metabolism- reductive amination and transamination
4. Proteins – Structure, classification, properties and function; Role of bonds in stabilizing protein structure - hydrolysis of proteins.

## **MODULE-V**

**15hrs**

1. Lipids- classification – Simple lipids- fats & oils, waxes; Compound lipids- phospholipids, sphingolipids and glycolipids; Derived lipids- Cholesterol and terpenes; Fatty acids – Alpha- oxidation and Beta-oxidation; Synthesis of ester bonds.
2. Enzymes - general account - structure, classification and nomenclature (recommended by Commission on Enzymes); Mechanism of enzyme action - inhibition of enzymes - regulation of enzymes - allosteric inhibition - Isoenzymes, coenzymes and cofactors
3. Secondary Plant Products – Introduction – classification and function [General account], Phytochemicals- Alkaloids, terpenoids, phenolics, flavonoids

### **Practical**

**16hrs**

1. Qualitative test for carbohydrates - Molisch's test, Benedict's test (for reducing sugar)
2. Iodine test for starch
3. Test for proteins – Biuret test

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## SEMESTER-VI

### MOLECULAR BIOLOGY, GENERAL INFORMATICS & BIOINFORMATICS

Course code : BO 1642 Number of credits : 4

Number of contact hours: Lecture: 72 hrs; Practical: 36 hrs; Total: 108 hrs

Distribution of Hours	Theory	Practical
Molecular Biology	36 hrs	9 hrs
General informatics	18 hrs	9 hrs
Bioinformatics	18 hrs	18 hrs
<b>Total</b>	<b>72 hrs</b>	<b>36 hrs</b>

**Aim of the course:** To develop knowledge about molecular biology of genetic material and gene expression along with information technology and biological databases

#### Objectives:

- To generate awareness of genetic material and gene expression.
- To get an overview of information technology
- To develop skill for using internet, biological databases and molecular visualization tools

#### Expected outcome

- Understands DNA as genetic material, develops awareness about chemical composition and different types of DNA including their replication method.
- Students understand various molecular aspects of gene expression and regulation of genes
- Develops awareness about various academic services applied for their studies
- Awareness about features of a computer, different application and system software.
- Recognizes the need for safe use of internet and also become aware about health issues related to over usage of computers and mobile phones as well as cyber crimes and cyber laws.
- Students will be familiarized to molecular phylogeny, Biological Databases, Sequence analysis, Genomics, Proteomics & Comparative genomics

#### MODULE-I

##### Molecular Biology

36hrs

1. DNA as genetic material- experimental evidence- Griffith's experiment on Bacterial transformation, Avery's experiment, Hershey-Chase Experiment.
2. DNA- Chemical Composition, Chargaff's rules, molecular structure of DNA-Watson & Crick's Double Helical Model of DNA, Salient features of double helix, Biological Significance of Double Helical Model of DNA; Forms of DNA - A, B and Z forms; Satellite and repetitive DNA
3. Replication of DNA in prokaryotes- An overview, General principles and features, Semi conservative model- Meselson and Stahl experiment; Leading strand and lagging strand synthesis, Okazaki fragments, replication fork and origin of replication; Unidirectional and Bidirectional replication; Replisome. Enzymology of replication: topoisomerase, helicase, primase, polymerase and ligase; DNA repairing mechanism-photoreactivation.

Replication of DNA in eukaryotes (brief account only).

4. RNA structure- Structure, Properties and functions of tRNA, mRNA and rRNA; Genetic code.
5. Synthesis of protein: Transcription in prokaryotes; Transcription in Eukaryotes and post transcriptional modification of mRNA - introns, exons, removal of introns, spliceosome; Capping and Tailing;
6. Translation in prokaryotes; Translation in Eukaryotes (Brief account only); Central dogma-reverse transcription
7. Concept of gene-Units of a gene, cistron, recon, muton – Modern concept of gene; Types of genes- House keeping genes (constitutive genes), Luxury genes (non constitutive genes), overlapping genes.
8. Regulation of gene expression in prokaryotes and eukaryotes- lac operon; transcriptional gene regulation in eukaryotes-promoters, enhancers, transcription factors; RNA interference, epigenetics-DNA methylation (brief account only).
9. Transposable genetic elements- General account, Characteristic, Transposons (jumping genes), Cellular oncogenes and tumour suppressor genes (general account only).

### **Practical**

**9hrs**

1. Study of semi-conservative replication of DNA through micrographs/ schematic representations.
2. Practice problems in molecular biology based on DNA structure and replication

## **Module-II**

### **General Informatics**

**18hrs**

1. Knowledge skill for Higher Education: Data information and knowledge, knowledge management- Internet as a knowledge repository, academic search techniques, creating your cyber presence, open access initiatives, open access publishing models, basic concepts of IPR, copy rights and patents, plagiarism, introduction to use of IT in teaching and learning, educational software (MS Excel), brief account of educational platforms (MOODLE, Google Classroom, SWAYAM), Academic services-INFLIBNET, NICNET and BRNET.
2. Social Informatics: IT and Society- issues and concerns- digital divide, IT and development, new opportunities and new threats, Cyber ethics, Cyber crime, Security, privacy issues, cyber addictions, Information overload, Health issues, guidelines for proper usage of computers, internet and mobile phones. Localization issues-IT and Regional languages-IT for the disabled, the free software debate. IT for Biodiversity Documentation - iNaturalist.

### **Practical**

**9hrs**

1. Prepare a table of the mark list of students in a class using MS Excel
2. Prepare a line diagram and bar diagram using MS Excel
3. Calculate Mean and Standard deviation of a given data using statistical functions of MS Excel
4. Students should be familiar to MOODLE, SWAYAM, INFLIBNET, NICNET and BRNET

### **Module-III**

#### **Bioinformatics**

**18hrs**

1. Introduction: Definition, Origin of concept of Bioinformatics; Brief history, Importance of bioinformatics, Wet lab and Weblab.
2. Basics of Genomics, Proteomics & Comparative genomics
3. Biological databases:
  - Nucleic acid databases (Eg: EMBL, Gen Bank, DDBJ)
  - Protein sequence databases. Eg: PIR, SWISS PROT, UNIPROT
  - Brief account on Model/organism databases, Biodiversity data bases
  - Protein structure databank- PDB
4. Gene sequence, Sequence analysis and alignment (brief account only), Pair wise sequence alignment, multiple sequence alignment, Sequence Alignment Tools: BLAST, CLUSTAL X
5. Bioinformatics in relation to Biomolecular structure.
6. Molecular visualization- use of Rasmol
7. Molecular Phylogeny and Phylogenetic trees- Advantages of Molecular phylogeny and phylogenetic analysis- PHYLIP

#### **Practical**

**18 hrs**

1. Molecular visualization using Rasmol
2. Blast Search
3. Students should access Gene databases, download and take a print out of any one of gene sequences
4. Students are expected to work with at least any one of the commercial / scientific packages, to explore the WEB and able to find, recognize, download, install and use software in various areas useful to the research in Biology.
5. Students should be familiar with various databases (Nucleic acid and protein sequence and structure data bases)

#### **REFERENCE**

1. Baxevanis, A.D. and Ouellette B.F.F. (2001) Bioinformatics - A Practical Guide to the Analysis of Genes and Proteins. 2<sup>nd</sup> Edition John Wiley & Sons, Inc.
2. Becker W.M., Hardin J. and Bertoni G. (2018) Becker's World of the Cell, 9<sup>th</sup> Edition, Pearson Education Limited.
3. David L. Nelson and Michael M. Cox (2017) Lehninger Principles of Biochemistry 7<sup>th</sup> Edition W. H. Freeman and Company.
4. David Mount (2004) Bioinformatics: Sequence and Genome Analysis, 2<sup>nd</sup> Edition Cold spring harbor press
5. De Robertis, E.D.P and Robertis, E.M.P (1991) Cell and molecular biology. Scientific Americanbooks.
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7. Ethan Cerami, (2005). XML for Bioinformatics. Springer International Edition
8. Harvey Lodish, Berk A. , Kaiser, Krieger, Scott, Bretscher, Ploegh and Matsudaira (2016) Molecular Cell Biology (8th edition) Wh Freeman & Co
9. Higgs, (2005). Bioinformatics and Molecular evolution. Ane Books India Pvt.Ltd
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Wiley India Edition

11. Janet Iwasa and Wallace Marshall. (2016). Karp's Cell and Molecular Biology: Concepts and Experiments. 8<sup>th</sup> Edition. John Wiley & Sons. Inc.
12. Jin Xiong, (2007). Essential Bioinformatics. Cambridge University Press India Pvt.Ltd
13. Joseph Seckback and Eitan Rubin, (2007). Springer, Kluwer Academic publishers
14. Mukerjee DP, (2000). Fundamentals of Computer Graphics and Multimedia. Prentice Hall of India Pvt. Ltd.
15. Niel C Jones and Pavela Pevzner, (2009). An introduction to Bioinformatics Algorithms. Ane Books India Pvt.Ltd
16. Robert Tamarin (2010) Principles of Genetics. Tata Mc Graw Hill
17. Selzer P.M., Marhöfer R.J. and Rohwer A. (2008). Applied Bioinformatics: An Introduction, Springer
18. Selzer PM, Marhofer RJ, Rohwer A (2009) Applied Bioinformatics. Springer- Verlag Berlin Heidelberg, Germany
19. Teresa Attwood and David Parry-Smith (1999) Introduction to Bioinformatics Prentice Hall
20. Twymann, R.M. (1998) Advanced molecular biology, Viva books NewDelhi.
21. Berg JM, Tymoczko JL, Gatto Jr. GJ, Stryer L (2019) Biochemistry. W.H Freeman

#### WEB RESOURCES

- ✓ [www.fgcu.edu/support/office2000](http://www.fgcu.edu/support/office2000)
- ✓ [www.openoffice.org](http://www.openoffice.org) *Open office officialwebsite*
- ✓ [www.microsoft.com/office](http://www.microsoft.com/office) *MS Officewebsite*
- ✓ [www.lgta.org](http://www.lgta.org) *Office onlinelessons*
- ✓ [www.learntheneth.com](http://www.learntheneth.com) *WebPrimer*
- ✓ [www.computer.org/history/timeline](http://www.computer.org/history/timeline)
- ✓ [www.computerhistory.org](http://www.computerhistory.org)
- ✓ <http://computer.howstuffworks.com>
- ✓ <http://vmoc.museophile.org> *Computerhistory*
- ✓ [www.dell.com](http://www.dell.com) *DellComputers*
- ✓ [www.intel.com](http://www.intel.com) *Intel*
- ✓ [www.ibm.com](http://www.ibm.com) *IBM*
- ✓ [www.keralaitmission.org](http://www.keralaitmission.org) *Kerala Govt. ITDept.*
- ✓ [www.technopark.org](http://www.technopark.org)
- ✓ [www.studentworkzone.com/question.php?ID=139](http://www.studentworkzone.com/question.php?ID=139)

## SEMESTER-VI

### BIOTECHNOLOGY, NANOBIO TECHNOLOGY, HORTICULTURE & PLANT BREEDING

Course code : BO 1643 Number of credits : 4

Number of contact hours: Lecture: 72 hrs; Practical: 36 hrs; Total: 108 hrs

Distribution of Hours	Theory	Practical
Biotechnology	27 hrs	18 hrs
Nanobiotechnology	07 hrs	00 hrs
Horticulture	18 hrs	09 hrs
Plant breeding	18 hrs	09 hrs
	72 hrs	36 hrs

**Aim of the course:** To introduce horticultural techniques and plant breeding along with awareness in research methodology

#### Objectives:

- To introduce plant biotechnology, tissue culture and rDNA technology
- To give insight into applications in industrial biotechnology and nano biotechnology
- To get an awareness in principles and methods of gardening
- To understand plant breeding techniques and develop skill for hybridization.
- To get knowledge about research methodology and preparation of projects

#### Expected Outcome

- Students are familiarized in preparation of culture solutions, sterilization, inoculation of explants, induction of callus and morphogenesis
- They are familiarized in biotechnological tools like RFLP, RAPD and PCR techniques
- Appreciate the application of equipments and tools in biotechnology
- Understanding of ethical and legal issues in biotechnology and basic knowledge about IPR
- Better understanding of nanosystems, and applications of nanomaterials
- Students able to identify and use various horticultural implements
- Can propagate plants through grafting, budding and layering & can prepare manures, fungicides etc
- Can effectively do plant breeding methods and understands their practical application in betterment of food crops

#### MODULE-I

##### Biotechnology

08 hours

1. Introduction – History- major achievements-Biotechnology in India.
2. Plant Tissue culture – Totipotency- definition and importance – dedifferentiation, redifferentiation and Cytodifferentiation.
3. Equipments and other requirements in tissue culture laboratory – instruments, tools, glass wares
4. Sterilization- Explants, equipments and medium

5. Culture media-MS Medium, composition and preparation
6. Micropropagation – steps -Innoculation – Subculture, Callus and suspension culture, meristem culture
7. Somaclonal variation- Somatic embryogenesis and organogenesis.
8. Production of haploids – pollen culture, anther culture – protoplast culture – somatic hybrids – cybrids - Synthetic seeds

## **MODULE-II**

**07 hours**

Recombinant DNA technology:

1. General account of cloning vehicles – plasmid (PBR 322), bacteriophages ( $\lambda$  phage), Brief account of cosmids and phagemids. Cutting and joining of DNA molecules – restriction endonucleases, ligases – Gene library.
2. Brief account of gene transfer techniques – Direct DNA uptake by protoplast –vector method *Agrobacterium* mediated, physical method- electroporation- shot gun method – microinjection.

## **MODULE- III**

**08 hours**

1. Methods in Biotechnology.
  - a. Isolation and purification of DNA from plant cells.
  - b. Agarose gel electrophoresis
  - c. PCR, DNA sequencing-Sanger's method, Southern blotting, ELISA.
  - d. Molecular markers – RAPD, RFLP
2. Application of biotechnology in
  - a. Medicine – edible vaccines from plants, gene therapy.
  - b. Agriculture – Genetically modified crops – Bt Cotton, Golden Rice, Flavr Savr tomato
  - c. Bioremediation using genetically modified organisms- marine oil spills
3. Biosafety and ethical issues, Intellectual Property Rights (IPR) in recombinant DNA technology.

## **MODULE- IV**

### **Microbial and Industrial Biotechnology**

**06 hours**

1. Microbes in Biotechnology.
2. Bioreactor – Chemostat and Turbidostat
3. Industrial microbiology: Production of alcohol, vinegar, bread, dairy products & single cell protein (brief account only)

## **MODULE- V**

### **Nanobiotechnology**

**07 hours**

1. Introduction-background and definition of nanotechnology
2. Nanosystems in nature - Subcellular components
3. Nanoscaled biomolecules (nucleic acids and proteins)
4. Synthesis of nanomaterials – Physical, Chemical and Green synthesis
5. Technologies for visualization of biological structures at the nano scale-atomic force microscope
6. Nanoparticles- Quantum dots, Paramagnetic iron Oxide Crystals, Dendrimers, Carbon nanotubes.
7. Application of nanotechnology in lifesciences; Biosensors

**Practicals****18 hours**

1. Visit to a well equipped biotechnology laboratory to familiar with the use of equipments and glasswares. Petri dishes, conical flasks, culture tubes, Pasteur pipettes, forceps, scalpels, hot air oven, autoclave, platform shaker, pH meter and laminar air flowsystem.
2. Preparation of media, sterilization, inoculation and callus induction (demonstration only).
3. DNA isolation from plant tissues (Demonstration only)
4. Familiarizing students to equipments like PCR, gel electrophoresis
5. General awareness of Bioreactor
6. Awareness of Genetically modified plants (Bt cotton, Golden rice, Flavr Savr tomato).

**MODULE- VI****Horticulture****10hrs**

1. Introduction - Divisions of horticulture- Importance and scope of horticulture.
2. Principles of garden making- types of pots and containers- Potting mixture and potting media – soil, sand, peat, sphagnum moss, vermiculite- Soil types, Soil preparation- Irrigation methods
3. Propagation methods- Cuttings, Layering – Air layering, Ground layering (Tip, Trench and Compound), Budding – T- budding, Grafting – Approach grafting, Bridge grafting, whip and tongue grafting.
4. Garden tools and implements- Lawn mower, hand trowel, nursery spade, spade fork, garden hoe, weeder, tillers
5. Manures and fertilizers- Farmyard manure, compost, vermicompost and biofertilizers; Chemical fertilizers – NPK; Time and application of manures and fertilizers- Foliar sprays
6. Irrigation Methods–Surface, Drip irrigation, Sprinkler irrigation

**MODULE- VII****8hrs**

1. Components of Garden- Landscaping principles; Lawns, Trees, shrubs and shrubberies, climbers and creepers, Flower beds and borders, ornamental hedges, edges, Drives, roads, walks and paths, Carpet beds, topiary, trophy, rockery, Conservatory or green houses
2. Indoor garden, Roof garden (Brief account only)
3. Bonsai
4. Flower Arrangement- Containers and requirements for flower arrangements- Free style, Shallow and Mass arrangement- Japanese- Ikebana. Dry flower arrangement

**Practical****09 hrs**

1. Familiarise the garden tools and implements mentioned in the syllabus
2. Students must be trained to do Cutting/ layering/ grafting/budding.
3. Visit to a Botanical garden under the guidance of the teacher is recommended

**MODULE-VIII****18 hrs****Plant breeding**

1. Introduction, objectives in plant breeding- - Important national and international plant breeding Institutes
2. Plant introduction. Agencies of plant introduction in India, Procedure of introduction - Acclimatization -Achievements.
3. Selection - mass selection, pure line selection and clonal selection. Genetic basis of selection and methods.



4. Hybridization: Procedure of hybridisation, inter generic, inter specific, inter varietal hybridisation with examples. Composite and synthetic varieties.
5. Heterosis and inbreeding depression- genetic basis; male sterility
6. Mutation breeding – method – achievements in India.
7. Polyploidy breeding
8. Breeding techniques and achievements with reference to the following crops in India:
  - (a). Rice (b). Wheat (c).Potato (d).Coconut

### Practical

09 hrs

1. Techniques of emasculation and hybridization of any bisexual flower.

### REFERENCES

1. Abhilasha S Muthuriya (2009) Industrial Biotechnology. Ane Books Pvt.Ltd
2. Benjamin Lewin (2004). Gene VIII Pearson Education International
3. Bharat Bhushan (2004) Hand book of nanotechnology. Springer- verlag, Berlin
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5. Jayaraman (2007), Concepts in Biotechnology, Universities Press
6. Channarayappa (2008), Molecular Biotechnology, Universities Press
7. Colin Ratledge (2006) Basic Biotechnology, Cambridge University Press India Pvt.Ltd
8. Gayathri M C (2015), Plant Tissue Culture: Protocols in Plant Biotechnology, Narosa Publishers Pvt Ltd
9. Gupta P. K. (2010). Elements of Biotechnology, Rastogi Publications.
10. Ignacimuthu S. J. (1996) Applied Plant Biotechnology, Tata Mc Graw Hill
11. Janardhanan S and Vincent S (2007) Practical Biotechnology, Universities Press
12. Kesavachandran K and KV Peter (2008), Plant Biotechnology, Universities Press
13. Kumar H .D. (1983) . Molecular Biology & Biotechnology, Vikas publishing
14. Misra SP (2009) Plant Tissue Culture. Ane Books Pvt.Ltd
15. Pamela Peters (1993). Biotechnology: A guide to genetic engineering, WC Brown Publishers
16. Ramawat K. G. (2011). Plant Biotechnology, S. Chand & Company
17. Razdan M. K. (2016) An introduction to Plant Tissue Culture ,Oxford and I B H publishers
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22. Timir Baran Jha and Biswajit Ghosh (2007), Plant Tissue Culture, Universities Press
23. Victoriano Valpuesta 2004, Fruit and Vegetable Biotechnology, CRC Press. New York. Ane Books Pvt. Ltd
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26. Arora J.S (1990). Introductory Ornamental Horticulture, Kalyani Publications
27. Bailey L.H (1901). The Standard Cyclopaedia of Horticulture Volume 1,2 and 3, Macmillan Publications.

28. Bose T.K and Mukerjee D (1987). Gardening in India, Oxford Book House
29. Chauhan V.S (1972). Vegetable Production in India, Ram Prasad & Sons
30. Gupta S N (2010) Instant Horticulture, Jain Brothers publishing
31. Kumar N (1989). Introduction to Horticulture, Rajalakshmi Publications
32. Manibhushan Rao K (2005). Text Book of Horticulture, Macmillan Publications
33. Shujnrrnoto, (1982). The Essentials of Bonsai, David & Charles ,Newton
34. Singh B D (2015). Plant Breeding, Kalyni publishers

## OPEN COURSES

Offered to the students of other disciplines choosing Botany open course

Semester	Course Code	Title of the Course	Contact hrs/week	Credits
V	BO1551.1	Horticulture	3	2
	BO1551.2	Mushroom Cultivation and Marketing		
	BO1551.3	Forestry		

## INDUSTRY BASED ELECTIVE COURSES

Offered to the students of Botany

Semester	Course Code	Title of the Course	Contact hrs/week	Credits
VI	BO 1661.1	ORGANIC FARMING	3	2
	BO 1661.2	MUSHROOM CULTURE TECHNOLOGY	3	2
	BO 1661.3	NURSERY AND GARDEN MANAGEMENT	3	2
	BO 1661.4	MEDICINAL BOTANY	3	2

## **OPEN COURSE –I (a)**

### **HORTICULTURE**

**Course code : BO1551.1**

**Number of credits : 2**

**Number of contact hours : Lecture: 54 hrs**

**Aim of the course:** To develop knowledge about principles of gardening, propagation and flower arrangement

**Objectives:**

- To introduce horticultural methods
- To familiarize propagation methods in plants.
- To study types of gardens and flower arrangements

**Expected outcome**

- Students are familiarized in horticulture implements and methods of gardening
- Better understanding of commercial horticulture, flower arrangement, cut flowers
- Can understand about land scaping, fertilizers and Plant protection

**MODULE–I**

**10hrs**

1. Introduction
2. Divisions of horticulture
3. Importance and scope of horticulture.
4. Principles of garden making
5. Types of pots and containers
6. Potting mixture and potting media – soil, sand, peat, sphagnum moss, vermiculite
7. Soil types, Soil preparation
8. Irrigation methods- drip irrigation and sprinkler irrigation
9. Hydroponics

**MODULE–II**

**12hrs**

1. Propagation methods
  - a. Cuttings- root, stem, leaf
  - b. Layering – Air layering, Ground layering (Tip, Trench and Compound)
  - c. Budding – T-budding
  - d. Grafting – Approach grafting, Bridge grafting, whip and tongue grafting.
2. Garden tools and implements
3. Manures and fertilizers
4. Farmyard manure, compost, vermicompost and biofertilizers.
5. Chemical fertilizers –NPK.
6. Time and application of manures and fertilizers.
7. Foliar sprays

**MODULE- III**

**12hrs**

1. Components of Garden
2. Lawns and landscaping Trees, shrubs and shrubberies, climbers and creepers
3. Flower beds and borders, ornamental hedges, edges, Drives, roads, walks and

- paths , Carpet beds, topiary, trophy,rockery
4. Conservatory or green houses, Indoor garden, Roof garden
  5. Bonsai

#### **MODULE- IV**

**12hrs**

1. Flower Arrangement -Containers and requirements for flower arrangements Free style, Shallow and Mass arrangement, Japanese –Ikebana
2. Bouquet and garland making
3. Dry flower arrangement
4. Harvesting Methods- Anthurium and Orchid &Storage
5. Marketing of Fruits, vegetables and flowers
6. Preservation and processing of fruits and vegetables

#### **MODULE- V**

**8hrs**

1. Growth regulators in horticulture
2. Rooting hormones , Growth promoters , Flower induction ,Parthenocarpy
3. Common diseases of Mango and Tomato
4. Plant protection- Weedicides, Fungicides, Pesticides

**Field Study:** Visit to a Botanical garden under the guidance of the teacher is encouraged.

#### **REFERENCES**

1. Arora J.S (1990). Introductory Ornamental Horticulture, KalyaniPublications
2. Bailey L.H (1901). The Standard Cyclopaedia of Horticulture Volume 1,2 and 3, Macmillan Publications.
3. Bose T.K and Mukerjee D (1987). Gardening in India, Oxford Book House
4. Chauhan V.S, (1972). Vegetable Production in India, RamPrasad & Sons
5. Gupta S N (2010) Instant Horticulture, Jain Brothers publishing
6. Kumar N (1989). Introduction to Horticulture, RajalakshmiPublications
7. Manibhushan Rao K (1991). Text Book of Horticulture, Macmillan Publications
8. Shujnrnoto, (1982). The Essentials of Bonsai, David & Charles, Newton
9. Rajesh Kumar, Kaushal Kumar Misra, (2014) Fundamentals of Horticulture, Biotech publishers
- 10.Singh J (2017) Fundamentals of Horticulture, Kalyani publishers

## OPEN COURSE -I (b)

### MUSHROOM CULTIVATION AND MARKETING

Course code : BO1551.2 Number of credits : 2

Number of contact hours : Lecture: 54 hrs

**Aim of the course:** To create awareness about cultivation methods for mushroom and its economic aspects

#### Objectives:

- To get knowledge about nutritional and medicinal values of mushrooms
- To understand methods of mushroom cultivation.
- To give insight into the economic significance of mushroom cultivation

#### Expected outcome

- **Identify mushrooms, structure and mode of propagation**
- **Understand commercial mushroom cultivation, marketing and their nutritional value**
- **Better understanding of methods of processing and storage of mushrooms**

#### MODULE- I

12hrs

- History and introduction: Edible mushrooms and Poisonous mushrooms.
- Systematic position, morphology, distribution, structure of *Agaricus* and *Pleurotus*.

#### MODULE- II

08hrs

Nutritional value, medicinal value and advantages- types- milky, straw, button and poisonous mushrooms

#### MODULE- III

12hrs

1. Cultivation: Paddy straw mushroom – substrate, spawn making. Methods – bed method, polythene bag method, field cultivation.
2. Oyster mushroom cultivation –Substrate, spawning, pre-treatment of substrate. Maintenance of mushroom.
3. Cultivation of white button mushroom – Spawn, composting, spawning, harvesting.

#### MODULE- IV

12hrs

1. Diseases- Common pests, disease prevention and control measures- *Agaricus*, *Pleurotus* and *Volverilla*.
2. Processing - Blanching, steeping, sun drying, canning, pickling, freeze drying.
3. Storage – short term and long term storage.

#### MODULE-V

10hrs

1. Common Indian mushrooms.
2. Production level, economic return, Foreign exchange from Mushroom cultivating countries and international trade.

**Field Study:** Visit to a Laboratory engaged in mushroom cultivation

**REFERENCES**

1. Harander Singh. (1991). Mushrooms- The Art of Cultivation- SterlingPublishers.
2. Indian Journal of Mushrooms. Published by I.M.G.A. Mushroom ResearchLaboratory. College Agriculture,Solan
3. Kaul T N (2001). Biology and conservation of mushrooms. Oxford and IBH publishing companyN.Delhi
4. Pandey B P (1996). A textbook of fungi. Chand and Company NDelhi.
5. Pavel Kalc (2016) Edible mushrooms, Chemical composition and nutritional value, Elseveir book aid international

## OPEN COURSE -I (c)

### FORESTRY

Course code : BO1551.3

Number of credits : 2

Number of contact hours : Lecture; 54 hrs

**Aim of the course:** To enlighten students about forest types and forest produce

#### Objectives:

- To get a knowledge about types of forest and silviculture
- To get knowledge about forest produce
- To understand agroforestry

#### Expected outcome

- Identification of forest types, Forest products and their utilisation and common forest trees of Kerala
- Understanding timber yielding plants and methods of identification of timber
- Understanding of germination of seeds of forest trees, methods to break dormancy of seeds, forest act and methods of preserving forests
- Get knowledge about silviculture and Social forestry
- 

#### MODULE - I

10hrs

1. General introduction to forests- Types of Forest- Natural and Manmade; Tropical, temperate, evergreen semi- evergreen, deciduous; Monoculture, multipurpose, social and industrial. Forest and gene conservation.

#### MODULE - II

16hrs

1. Silviculture- concept and scope of study of natural and artificial regeneration of forests. Clear felling, uniform shelter, wood selection, coppice and conservation systems. Silviculture of some of the economically important species in India such as *Azadirachta indica*, *Tectona grandis*, *Eucalyptus indica*, *Swietenia mahagoni*, *Dalbergia sisso* and *Santalum album*, *Artocarpus heterophyllus*, *Hevea brasiliensis*.
2. Wood: Homogenous and heterogenous- spring and autumn wood- Porous and non porous wood- Heart and sap wood.
3. Relevance of wood anatomical studies in Kerala- Identification of wood- preparation of key and their uses

#### MODULE - III

10hrs

1. Social and agro forestry. Selection of species and role of multipurpose trees. Food, fodder and energy.
2. Social forest- Avenue plantation. Sacred plants- definition, importance of sacred trees like *Ficus religiosa*, *Emblica officinalis*, *Aegle marmelos*.

#### MODULE - IV

09hrs

1. Seed orchards, seed dormancy- Types of dormancy, physical and chemical methods to overcome seed dormancy.



2. Forest laws- necessity, General principles, Indian forest act 1927 and their amendment.

### **MODULE - V**

**09hrs**

1. Forest resources and utilization. Forest products- timber, pulp wood, secondary timbers, non timber forest products (NTFPs).
2. Definition and scope (brief outline) - Gums, resins, fibers, oil seeds, nuts, rubber, canes and bamboos, medicinal plants, charcoal. Lac collection and marketing.

### **Field Study**

1. Identification of wood using key: Teak, Jack wood, Mahogany, Rubber, *Azadirachta*, Eucalyptus.
2. Visit to a plywood factory to have knowledge of wood based industry.

### **REFERENCES**

1. A Hand book of Kerala Timbers- KFRI, Trichur.
2. Anil Kumar Dhiman. (2003). Sacred plants and their medicinal uses. Daya publishing house, NewDelhi
3. B.S. Chundawat and S.K.Gautham. (1996). Text book of Agroforestry. Oxford and IBH Publishing House , NewDelhi
4. Kollmann and Cote (1988). Wood science and Technology. Vol.I& II Springer verlag.
5. Parthiban K T (2016) Forestry, Competition Tutor publishers
6. Praveen Dhar T .(2018). Introduction to Forestry Narendra Publishing House, New Delhi
7. Sagreiya, K.P. (1994). Forests and Forestry (Revised by S.S. Negi). National book trust. NewDelhi.
8. Sharma P.D. (2004). Ecology and Environment. Rastogi publications, Meerut
9. Singh M.P. and Vinita Vishwakarma.(1997) .Forest environment and Biodiversity. Daya publishing house, NewDelhi.
10. Tiwari K.M. (1983). Social forestry inIndia.
11. Tribhawan Mehta, (1981). A handbook of forest utilization. Periodical Expert Book Agency, NewDelhi.

## SEMESTER-VI

### INDUSTRY BASED ELECTIVE COURSE (a) ORGANIC FARMING

**Course code : BO1661.1**

**Number of credits : 2**

**Number of contact hours : Lecture - 36 hrs and Practice - 18 hrs**

**Aim of the course:** To introduce students to agriculture industry and familiarize students to the potential of Organic farming

Sector / Industry - Agriculture, Companies dealing with production of Biofertilizer/Biopesticide/organic manure

Placement opportunities – Students can start organic farming initiatives, can lead export of organic farm produce, can get inducted in Biofertilizer/Biopesticide/organic manure preparation and marketing companies

Unique Skills – Learn the basic principles of organic farming, preparation of organic manures, biopesticides and biofertilizers

#### **Course outcome –**

1. Students will understand the ancient agricultural practices and protect the environment from the recent indiscriminate, avaricious anthropogenic onslaughts that the extent of damage done is at least be mitigated.
2. Students can assess the advantages of organic farming with as an alternative to use of anthropogenic chemicals that biofertilizers and natural means of crop protection including the advocacy of IPM can ensure profitable farming.
3. Students can analyse the various forms of microbes as suppliers of organic nutrients, including nitrates, phosphates enriching the soil that would eventually have a bearing on the methods of cultivation with enhanced nitrogen supply.
4. Students apply the knowledge of using biopesticides without harming the co- living microbiota and life forms in the ecosystem and understand that the use crop protection chemicals can be avoided to safe guard environment.
5. Students will use the acquired knowledge needed to prepare eco friendly commercial formulations meeting national and international standards and regulations and float newer entrepreneurial ventures

#### **Module I.**

**8 hr**

1. Organic farming definition, Principles and practices of organic farming. Need of organic farming. Types. (Integrated organic farming, Pure organic farming,). Zero Budget Natural Farming (ZBNF), advantages and disadvantages of organic farming
2. Introduction to Agriculture: Domestication of plants – early agricultural practices– inter cropping and crop rotation, major cultivated crops and vegetables in India ( Brief description about Rice, wheat, Maize, Brinjal, Ladies finger, Vigna, and Tomato )

## Module II.

10 hrs

1. Organic matter management in agricultural fields , – plant health – sustainable agriculture– supplementation of NPK as bioresource – vermicomposting –mulching, green manure – terrace and kitchen garden
2. Soil: Definition; Soil formation; Composition and characteristics; Types of soil according to composition; Acidic, Alkaline and Saline soils; Effect of soil types on Agriculture; Method of reclamation;
3. Soil productivity: Meaning and Concept. Difference between Soil Fertility and Productivity; Method of Increasing productivity and fertility, importance of microbes in the enrichment of soil fertility. Role of VAM as growth regulator. Drip irrigation, Mulching, Relationship between soil fertility and soil pH
4. Organic Agri-Horticulture in Urban and rural areas , Value addition in organic products – government policies

## Module III.

18 hrs

1. Biofertilizers: Scope, application, types – mass cultivation of Biological nitrogen fixers – Blue green algae – Rhizobium, Azolla – Phosphate solubilizing bacteria , – Mycorrhiza – cost-benefit analysis.and Protection Measures: Integrate pest and disease managements.
2. Organic pesticides, bio-pesticides- Types and benefits. Microbial biopesticides, and its advantages (*Trichoderma*, *Pseudomonas fluorescense*, *Bacillus thuringiensis*) Inorganic pesticides, disadvantages of their use.
3. Seed, seedling and soil Treatment measures. Feasibility of complete dependence on organic sources.
4. Biogas slurry- Organic content. Status of Biogas Usage, benefits and significance. Pipe compost- installation and benefits
5. Economics of organic products- cost of production and financial benefits to cultivator. Good Harvesting Practices; Storage; Transportation; Supply Chain. Need of certification and quality assessment of organic produce.

## Modules IV.Practices or field knowledge.

18 hr

1. Preparation of two organic manure using locally available sources. (cow dung, cow urine , leaves, coir pith, bone dust , etc ) .prepare a report with its methodology.
2. Preparation of one biopesticide and study its effect on pest .
3. Internship : Visit to the fields where the organic farming practice takes place and work in association with farmers and get a certificate from the farmer (report the activities with photographs ).
4. Local survey to find out cost benefit ratio of organic products- small project based on local organic farming and marketing.

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9. Organic fertilizers 2019, Sonia Soloneski, Intech open
10. Biogas fundamentals 2018, Meisam Tabatabaei, Springer
11. Agriculture Research Data Book 2019, ICAR—Indian Agriculture . Statistics Research Institute, Pusa, New Delhi.
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13. S.K. Biswas et al 2015, " Effect of drip irrigation and mulching on yield, water-use efficiency and economics of tomato" Plant Soil Environ. Vol. 61, No. 3: 97–102.
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## SEMESTER-VI

### INDUSTRY BASED ELECTIVE COURSE (b)

#### MUSHROOM CULTURE TECHNOLOGY

Course code : BO1661.2

Number of credits : 2

Number of contact hours : Lecture - 36 hrs and Practice - 18 hrs

**Aim of the course:** To introduce students to Mushroom cultivation, post harvest storage, value addition and marketing

Sector / Industry - Mushroom cultivation and marketing industry

Placement opportunities – Students may get absorbed in Mushroom production and processing industries. Also the students may become entrepreneurs to start their own small scale mushroom cultivation units.

Unique Skills – Students will learn the technicalities of cultivation, Harvesting, Value addition, packaging and marketing of mushroom.

#### Expected Course outcome

- At the end of the course, the students will be able to
- Developing skills in identifying locally available common mushrooms, distinguish between edible and non-edible mushrooms.
- Analyze the pest and growth limiting factors affecting growth of mushroom.
- Develop new skills and technologies of growing mushroom among college students.
- Developing skills in making value added products from mushrooms.
- Raise linkages to increase employment opportunities and generating income.

#### Module I. (10hrs)

##### Introduction

Definition of a Mushroom – Introduction-History and Scope of mushroom cultivation - Nutritional value of mushrooms, Economic value of various mushrooms - Edible and Poisonous Mushrooms- Popular mushrooms - Edible, poisonous, medicinal, hallucinogenic mushrooms – SMEs cultivating mushroom.

#### Module II (10 hrs)

##### Cultivation of Mushroom:

Common cultivated varieties of Mushrooms- Morphological characters and taxonomical position of *Agaricus*, *Calocybe*, *Pleurotus*, *Volveriella* and *Lentinula*, Life cycle of *Agaricus*- Tray method for large cultivation – Packet method for small scale cultivation-Mushroom Pure culture Development - Production of mother spawn and multiplication of spawn - composting technology - Different cultivation substrates -Beds preparation - compost making – casing of soil, Pest and environmental control.

### **Module III**

**(16 hrs)**

#### **Cultivation Units**

Spawn production Units-structure and requirements, Structure and construction of mushroom house - Budget for mushroom cultivation unit - maintenance of sanitation in mushroom house – common contaminants, Waste management and recycling in mushroom cultivation Harvesting method - Asepsis- Preservation of mushrooms - Blanching, steeping, sun drying, canning, pickling, freeze drying; Storage - short term and long term storage; Grading, packaging- quality assurance of mushrooms- Labelling, Developing value added products- Dried mushroom – Mushroom Pickle- Mushroom soup powder – Mushroom candy – Mushroom powder etc. Marketing Cost benefit ratio-- Marketing in India and abroad, Export value

### **Module IV**

**(18 hrs)**

#### **Practice Session**

- Visit to a Mushroom Cultivation Industry
- Demonstration of pure culture development, Mother spawn preparation, Bedding and Bagging
- Establishment of a Mushroom cultivation shed/unit in College Campus

### **REFERENCES**

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**SEMESTER-VI**  
**INDUSTRY BASED ELECTIVE COURSE (c)**

**NURSERY AND GARDEN MANAGEMENT**

**Course code : BO1661.3**

**Number of credits : 2**

**Number of contact hours : Lecture - 36 hrs and Practice - 18 hrs**

**Aim of the course:** To introduce students to techniques involved in Nursery and Garden management business

Sector / Industry - Agriculture, Nursery business

Placement opportunities – Students can start Nursery and gardening initiatives, Can get employment in commercial nurseries

Unique Skills – Learn the basic principles of nursery and garden management, Learn the various procedures of plant propagation, Sourcing and marketing of new ornamentals and hybrid varieties of fruit plants.

**Expected Course outcome**

Students would have an understanding of :

- Preparation of quality nursery plants considering the need of farmers
- Root induction from stem cuttings to maximize vegetative propagation
- Methodology of seed storage, identify the ideal conditions for seed sowing and growth
- Possibilities and types of landscaping
- The students are able to carry out best gardening and nursery management practices.
- They become skillful professionals in gardening and managing nurseries as well as in the preparation of nursery beds, soil management, planting procedures, control of seedling density, use of fertilizers, irrigation, and pest control.
- Also Skilled and professional training ensures quality seedling production and their maintenance in nursery.

**Module I**

**(10hrs)**

Nursery: definition, different types, objectives and scope and building up of infrastructure for nursery, planning and seasonal activities - Planting - direct seeding and transplants. Seed: Structure and types -Seed dormancy; Methods of breaking dormancy - Seed storage: factors affecting seed viability, Seed production technology- seed testing and certification. Nursery management: Definition, Key elements, Essential nursery management practices

**Module II**

**(12 hrs)**

Common garden tools- water can, digging fork, shovel, garden rake, hand trowel, secateurs, budding/grafting knife. Methods of Vegetative propagation: Cutting, grafting, budding, layering; rooting medium, potting mixture and planting of cuttings, Media for propagating nursery plants – sphagnum moss, peat moss, vermiculite. Technique of plant tissue culture (Outline only), Rearing & Hardening of micropropagated plants – green house, mist chamber,

Poly tunnel, Poly house, shade house and glass house.

### **Module III**

(14hrs)

Gardening: definition, objectives and scope - different types of gardening and suitable plants used in each -landscape and home gardening, terrace gardening, indoor gardening, vertical gardens, aquatic gardens, Special types- Bonsai, Terrarium, Kokedoma. computer applications in landscaping (brief account only), Gardening operations: Bed preparation, manuring, Fertilizer application- different fertilizers, biofertilizers, vermicomposting, watering, irrigation methods, management of pests and diseases and harvesting.

### **Module IV:**

(18hrs)

Practice session

Practice of the following items and submission of a consolidated report

1. Practice of Bed preparation, Sowing/raising of seeds and seedlings, transplanting of seedlings – Activity in the home or college campus
2. Vermicomposting, preparation of the common fungicides- Bordeaux mixture, Lime sulphur, Tobacco decoction, Neem cake & oil.
3. Field visit to a well-established nursery to study the techniques of gardening. Submission of report
4. Cultivation of any three vegetables either in home garden or campus: Amaranthus, Vigna, momordica, chillies, brinjal, lady's finger, tomato and Submission of report
5. Planting of ornamental plants and their maintenance either in home garden or in campus.

### **Suggested Readings**

1. Ray PK (2012) Plant Nursery Management: How to Start and Operate a Plant Nursery, Scientific Publishers, India
2. Singh DK (2007). Textbook of Plant propagation and Nursery management. Ibdc Publishers, India
3. Vikas Kumar and Anjali Tiwari (2018). Practical Manual of Nursery Management. Agri-Biovet Press, India.
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**SEMESTER-VI**  
**INDUSTRY BASED ELECTIVE COURSE (d)**

**MEDICINAL BOTANY**

**Course code : BO1661.4**

**Number of credits : 2**

**Number of contact hours : Lecture - 36 hrs and Practice - 18 hrs**

**Aim of the course:** To introduce students to opportunities in Medicinal plant cultivation, harvesting, storage and marketing of the medicinal plants with market demand

**Sector / Industry** - Agriculture, Ayurvedic pharma industries

**Placement opportunities** – Students can join Ayurvedic pharma industries as botanists with additional skill in identification of medicinal plants. They can start initiatives to cultivate and process medicinal plants required for the pharmaceutical industries.

**Unique Skills** – An appreciation of the contribution of medicinal plants to traditional and modern medicine and the importance of holistic mode of treatment of the Indian traditional systems of medicine. To develop an understanding of the constraints in promotion and marketing of medicinal plants.

**Expected Course outcome**

The students should be able to

- Identify medicinal plants, describe its morphology, add medicinal knowledge about locally available plant.
- Cultivate medicinal herbs, learn processing, storing and packing of medicinal produce.
- Develop entrepreneurship skills to establish value addition products, botanical extracts and isolation of bioactive compounds.

**MODULE I**

**8 hrs**

1. Introduction to medical practices in India: History – Literatures and physicians of ancient period.
2. Outlines of Ayurvedha, Siddha, Unani and Homeopathic systems of traditional medicine.
3. Role of AYUSH, NMPB, CIMAP and CDRI.
4. Importance and Future prospects of medicinal plants.
5. Conservation and sustainable use of medicinal plants, Gene banks of medicinal plants

**MODULE II**

**10 hrs**

1. Ethnobotany and Folk lore medical practices: Ethnic communities in Kerala and their medicinal plant usage – patented products (Kani Tribe) – popular folklore medicines
2. Role of medicinal plants in traditional and modern system of medicine - methods of documenting the ethnobotanical knowledge – AICRP-MAP.
3. Cultivation and processing of medicinal plants: Propagules (Seed, leaf, stem, root, rhizome and bulbs, micropropagation) – cultivation methods – organic farming practices of medicinal plants - harvesting – processing – Grading -packaging – storage.

4. Medicinal plants in commercial products
5. Adulteration of plant crude drugs and methods of identification - some examples.

### MODULE III

**18 hrs**

An overview of selected medicinal plants: Morphology, family, vernacular, botanical name, useful part, uses active principles and phytotherapeutics.

- Whole plant (*Phyllanthus amarus*, *Bacopa monnieri*, *Scoparia dulcis*)
- Root (*Asparagus racemosus*, *Rauwolfia serpentina* & *Gloriosa superba*)
- Leaf (*Aloe vera*, *Azadirachta indica*)
- Bulb (*Allium cepa*, *Allium sativum*)
- Rhizome (*Zingiber officinale*, *Curcuma longa*)
- Fruit (*Solanum nigrum*, *Solanum xanthocarpum*, *Phyllanthus emblica*)
- Seed (*Trigonella foenum-graceum*, *Cuminum cyminum*)
- Oil seed (*Cocos nucifera*, *Ricinus communis*)

### MODULE IV

**18 hr**

#### Practice/ Activities

1. Collect any five medicinal plants and establishment of medicinal plant germplasm resource center in their campus and submit report.
2. Observe the medicinal plants in their locality and identify the scientific name and vernacular names and submit report.
3. Visit to a home garden/medicinal plant nursery and collect information on the importance of medicinal plant in their garden and submit report.

#### References

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3. Cunningham, A.B., 2001. Applied ethnobotany- people, wild plant use and conservation. Earth scan publications limited, London.
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9. Mathur, N., 2010. Medicinal plants of india. RBSA publishers, New Delhi.
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## **Model Question papers**

**MODEL QUESTION PAPER**  
**FIRST SEMESTER B. SC. DEGREE (CBCSS) EXAMINATION**  
**BOTANY CORE COURSE I**  
**BO1141 :ANGIOSPERM ANATOMY, REPRODUCTIVE BOTANY AND**  
**PALYNOLOGY**  
**(2022 Admission Onwards)**

**Time :3 Hrs**

**Total Marks: 80**

*(Draw diagrams wherever necessary)*

**SECTION A**

**I.** Answer all questions. Each question carries 1 mark

Write short notes on

1. What is Primary wall
2. In which plant Bulliform cells are present?
3. What is Endodermis
4. Define Endarch condition
5. What is a Conjunctive tissue
6. Define Raphides
7. What are Tyloses
8. Amoeboid Tapetum
9. Comment on Anatropous ovule
10. Define Porogamy

**(10 x 1 =10 marks)**

**SECTION B**

**II.** Answer any **Eight** questions. Each question carries 2 mark

11. Write a note on Bordered pits
12. Comment on periderm and its function.
13. Mention different types of Stomata
14. Give an account of Laticifers
15. Differentiate Heart wood and sap wood
16. Give an account of Quiscent centre
17. Explain Guttation
18. Write a note on Fibers
19. Explain Polyembryony
20. Draw a neat labeled diagram of Dicot embryo with cellular divisions.
21. Write about Pollen kitt
22. Explain Kopper Kappe theory

**(8 x 2 =16Marks)**

**SECTION C**

**III.** Answer any **six** questions. Each question carries 4 marks

23. Write an account on Meristems and its classification
24. Enumerate Different types of vascular arrangement seen in Angiosperms

25. Differentiate dicot stem with that of monocot Stem.
26. With the help of diagram describe the internal structure of young anther
27. Explain different types of Endosperm formation found among Angiosperm
28. Differentiate dicot and monocot root.
29. Briefly describe the theories on apical organization of stem apex.
30. Describe the structure and function of Cambium.
31. Explain about the Non living inclusions of a cell. **(6 x4 =24 Marks)**

#### **SECTION D**

**IV.** Answer any **two** questions. Each carries 15 marks.

32. What are permanent tissues? Explain different types.
33. With suitable diagrams describe normal secondary growth in Dicot stem.
34. Write an account on the process of secondary growth in Bignonia stem with diagrams
35. Explain Megasporogenesis and the *Allium* type of Embryosac development with the help of diagrams. **(2x 15=30 Marks)**

**MODEL QUESTION PAPER**  
**SECOND SEMESTER B. SC. DEGREE (CBCSS) EXAMINATION**  
**BOTANY :FOUNDATION COURSE II**  
**BO1221: METHODOLOGY AND PERSPECTIVE IN PLANT SCIENCES**  
**(2022 Admission Onwards)**

Time: 3 Hours

Max. Marks: 80

*(Draw diagrams wherever necessary)*

**SECTION - A**

I. Answer all questions in **one** or **two** sentences. Each question carries **1** mark.

Write short notes on

- 1) Primary data
- 2) Empirical knowledge
- 3) Range
- 4) Pictogram
- 5) Buffer
- 6) Median
- 7) Null hypothesis
- 8) PAGE
- 9) DPX
- 10) A killing agent

**(10x1=10 marks)**

**SECTION - B**

II. Answer **any 8** of the following. Each question carries **2** marks.

- 11) Differentiate primary and secondary source of information.
- 12) Comment on transparency and honesty in science.
- 13) Why sharing of knowledge is essential?
- 14) What is standard deviation?
- 15) Differentiate hypothesis and null hypothesis.
- 16) Write notes on Camera Lucida
- 17) Give the principle of Beer Lamberts Law.
- 18) What are the steps involved in maceration?
- 19) Write notes on double staining
- 20) What is range? How it is calculated?
- 21) Write different sources of secondary data
- 22) Describe parts of a table

**(8x2=16mark)**

### SECTION - C

III. Answer **any six** of the following. Each question carries **4** marks.

- 23) What is the significance of ethics in science?
- 24) Differentiate inductive and deductive reasoning.
- 25) Briefly describe about the working of a phase contrast microscope.
- 26) What are the applications of SEM and TEM
- 27) Write brief notes on different types of stains
- 28) Differentiate PAGE and AGE.
- 29) Write brief notes on Chi square test.
- 30) Briefly explain the uses and applications of cryobiology.
- 31) Write notes on centrifugation and different types of rotors. **(6x4=24marks)**

### SECTION - D

IV. Write essay on **anytwo** of the following. Each question carries **15** marks.

- 32) Write notes on the process of killing and fixing and briefly describe the process of microtome sectioning.
- 33) Explain the methods of data collection and possible ways of its representation.
- 34) Explain different separation methods for biological molecules.
- 35) Discuss science as a human activity. Add notes on major revolutions in science and technology. **(2x15=30 marks)**

**MODEL QUESTION PAPER**  
**THIRD SEMESTER B. SC. DEGREE (CBCSS) EXAMINATION**  
**BOTANY :CORECOURSE II**  
**BO1341 MICROBIOLOGY, PHYCOLOGY, MYCOLOGY, LICHENOLOGY &**  
**PLANT PATHOLOGY**  
**(2022 Admission Onwards)**

**Time. 3 Hrs**

**Total Marks: 80**

*(Draw diagrams wherever necessary)*

**SECTION –A**

I. Answer **all** questions in one word or two sentences. Each question carries **one** mark.

- 1) Name the causative organism of Citrus canker
- 2) Write down the male and female sex organs in the fungal partner of *Usnea*
- 3) What are aflatoxins?
- 4) Define rhizosphere
- 5) What is annulus
- 6) Define coprophilous fungi.
- 7) Comment on synzoospore
- 8) What are prions?
- 9) Which algae is known as stone wort?
- 10) Name the algal source of carageenin (**10x1 = 10 marks**)

**SECTION –B**

II. Answer **any eight** questions in a paragraph : Each question carries **two** marks

11. Write down four characteristic features of retroviruses.
12. Describe Hormogonia as a method of reproduction.
13. What is the plakea stage in *Volvox*?
14. Differentiate auxospore and autospore.
15. Explain asexual reproduction in *Pythium*?
16. Explain the thallus structure of *Polysiphonia*.
17. Describe the asexual reproduction in *Rhizopus*.
18. Briefly explain the asexual reproduction in yeast.
19. Explain the cleistothecium type of ascocarp in *Penicillium*.
20. Comment on ectomycorrhiza.
21. Differentiate fruticose and foliose lichen with examples.
22. Write a short note on preparation of lime sulphur (**8x2 = 16 marks**)

**SECTION –C**

III. Answer **any six** questions; not to exceed **120** words. **Each** question carries **four** marks.

23. Write the causative organism, symptoms and control measures of following diseases
  - a) Blast disease of paddy
  - b) Leaf mosaic disease of tapioca
24. Explain the fruiting body and sexual reproduction of *Agaricus*
25. Briefly explain the economic importance of Fungi



26. Describe the asexual and sexual reproduction in *Vaucheria*
27. Give a detailed account on classification of algae by F.E Fritsch.
28. Detail the gene transfer methods in bacteria.
29. With suitable diagrams explain the multiplication cycle of a bacteriophage.
30. Explain the thallus structure and reproduction of *Nostoc*.
31. Describe the apothecium of *Peziza* with a neat labeled diagram(6x4 = 24 marks)

#### SECTION –D

- IV. Write an essay on **any two** of the following( not more than three pages)  
**Each** question carries **15** marks.
32. With the help of neat and labeled diagrams describe the lifecycle of *Puccinia*
  33. What is diplontic life cycle? Explain the thallus structure, and sexual reproduction of *Sargassum*
  34. Compare the nannandrous and macrandrous life cycle of *Oedogonium*
  35. Describe the asexual and sexual reproductive methods in *Volvox*.  
(2x15 = 30 marks)

**MODEL QUESTION PAPER**  
**FOURTH SEMESTER B. SC. DEGREE (CBCSS) EXAMINATION**  
**BOTANY: CORE COURSE III**  
**BO1441: BRYOLOGY, PTERIDOLOGY, GYMNOSPERMS &**  
**PALAEOBOTANY**  
**(2022 Admission Onwards)**

**Time. 3 Hrs**

**Total Marks: 80**

*(Draw diagrams wherever necessary)*

**SECTION –A**

I. Answer **all** questions in one word or two sentences; Each question carries **one** mark.

- 1) What is carbon dating?
- 2) What are amphibious plants?
- 3) What are elators?
- 4) Who is the father of palaeobotany?
- 5) What is a ligule?
- 6) What is gemma?
- 7) Name two types of rhizoids in Riccia.
- 8) What is ramenta?
- 9) Name a genus with winged pollen.
- 10) What is parthenocarpy?

**(10x1=10 Marks)**

**SECTION B**

II. Answer **any eight** of the following; Each question carries **two** marks

8. Write a short note on Peristome teeth.
9. Comment on Geological timescale
10. What are xerophytic characters of *Equisetum*?
11. What is alternation of generation?
12. Enumerate the salient features of coralloid root.
13. Differentiate homospority and heterospority with examples.
14. What are the angiosperm characters of *Gnetum*?
15. Write a short note on Rhizophore of *Selaginella*.
16. Briefly explain the thallus structure of *Anthoceros*
17. Write a note on Eusporangiate ferns.
18. Explain circinate vernation with example.
19. Write a short note on transfusion tissue.

**(8x2=16 marks)**

### SECTION C

III. Answer **any six** of the following; Each question carries **four**marks

20. What is the role of Palaeobotany in relation to the exploration of fossil fuels?
21. With a labelled diagram, explain the internal structure of Pinus needle.
22. Narrate the economic importance of Gymnosperms.
23. Draw the L. S. of *Cycas* ovule and discuss.
24. Enumerate the dissimilarities of bryophytes with pteridophytes.
25. Explain the structure of rachis of *Cycas*.
26. What are the economic importances of bryophytes?
27. Write down the structure of *Lepidodendron*.
28. Discuss the spore dispersal mechanism in *Pteris*. **(6x4=24marks)**

### SECTION D

IV. Write an essay on **any two** of the following; Each question carries **fifteen** marks

29. Describe the stellar evolution in Pteridophytes.
30. What are fossils? Discuss various methods of fossilization.
31. Compare the sporophytes of bryophytes that you have studied.
32. Give an account of sexual reproduction in *Gnetum*. Mention the advanced characters.

**(2x15=30 Marks)**

**MODEL QUESTION PAPER**  
**FIFTH SEMESTER B. SC. DEGREE (CBCSS) EXAMINATION**  
**BOTANY : CORE COURSE IV**  
**BO 1541- ANGIOSPERM MORPHOLOGY, SYSTEMATIC BOTANY, ECONOMIC**  
**BOTANY, ETHNOBOTANY & PHARMACOGNOSY**  
**(2022 Admission Onwards)**

**Time. 3 Hrs**  
**Marks: 80**

**Total**

*(Draw diagrams wherever necessary)*

**SECTION – A**

I. Answer **all** questions in one word or two sentences. Each question carries **one** mark.

1. What is Regma ?
2. Name the inflorescence mostly found among Euphorbiaceae members.
3. What is a Legume?
4. Define Phyllotaxy.
5. What is a Floral diagram ?
6. Name the fruit of Asteraceae.
7. Define epigyny
8. Which is the source of Quinine ?
9. Morphology of cotton
10. Name two plant derived drugs used in tribal medicine **(10x1= 10 marks)**

**SECTION – B**

II. Answer **any eight** questions. **Each** question carries **2** marks. (Answer **not** to exceed **one** paragraph).

11. What is aestivation? Mention different types.
12. Differentiate between actinomorphic and zygomorphic flowers.
13. Give an account of different types of Schizocarpic fruits.
14. Write a note on Binomial nomenclature.
15. Distinguish between syngenesious and synandrous condition
16. Give the binomial and family of two dye yielding plants.
17. Explain the role of BSI in taxonomy.
18. Name an Indian ethnobotanist and mention his/her major contributions
19. Narrate the salient features of Malvaceae.
20. What are the advanced features of Lamiaceae ?
21. Enlist diagnostic characters of Verbenaceae
22. Explain the morphology of tendrils in Cucurbitaceae

**(8x2 = 16 marks)**

**SECTION – C**

III. Answer **any six** questions. Each question carries **4** marks. (Answer should **not** exceed **120** words).

23. What is placentation? Explain different types with examples.
24. Compare the salient features of Apocynaceae and Asclepiadaceae.
25. Explain the Principles of ICBN.

26. Write an account of Herbarium techniques.
27. "Flower is a modified shoot". Comment on the statement.
28. Give an account of cereals and millets you have studied.
29. Give a brief account on APG.
30. What is Chemotaxonomy? Write down its applications
31. Explain the advanced characters of Orchidaceae?

**(6x4 = 24 marks)**

#### **SECTION - D**

IV. Answer **any two** questions. **Each** question carries **15** marks. (Answer **not** to exceed **three** pages).

32. Describe Bentham and Hooker's system of classification. Comment on its merits and demerits.
33. Discuss the floral variations in Leguminosae
34. Discuss the advanced features of Asteraceae. Add a note on the reason for the wide distribution of Asteraceae members.
35. Give an account of different types of inflorescences you have studied.

**(2x15= 30 marks)**

**MODEL QUESTION PAPER**  
**FIFTH SEMESTER B.Sc. DEGREE (CBCSS) EXAMINATION**  
**BOTANY: CORE COURSE V**  
**BO 1542 : ENVIRONMENTAL STUDIES, PHYTOGEOGRAPHY AND RESEARCH**  
**METHODOLOGY**  
**(2022 Admission Onwards)**

**Time-3 Hours**

**Total marks: 80**

*(Draw diagrams wherever necessary)*

**SECTION-A**

**I Answer all questions** in a word or sentence, each question carries **1** mark

Write short notes on

- 1) A Natural Hazard
- 2) Halophyte
- 3) Food web
- 4) Red data book
- 5) Acid rain
- 6) Edaphic factors
- 7) Deforestation
- 8) Mitigation
- 9) Plagiarism
- 10) Basic Research

**(10x1=10 marks)**

**SECTION-B**

**II. Answer any 8** of the following in a paragraph. Each question carries **2** marks.

- 11) What are ecological pyramids?
- 12) Define succession
- 13) Briefly describe energy flow in an ecosystem
- 14) Write note on Ramsar sites
- 15) Write about impact of land slides
- 16) Explain 'Hot spots'
- 17) Enlist effects of earthquakes
- 18) Explain randomization in research design
- 19) What is null hypothesis?
- 20) What is Green house effect?
- 21) Define Synecology
- 22) How Mendeley software is useful for research?

**(8x2=16 marks)**

**SECTION-C**

**III. Answer any 6** of the following. Each question carries **4** marks each

- 23) Explain different components of an ecosystem.
- 24) Write about anatomical, morphological and physiological adaptations of hydrophytes
- 25) Explain nuclear hazards
- 26) Explain different stages of succession in a hydrosere
- 27) Give an account on adaptations of mangroves

- 28) Explain the process of waste water treatment
- 29) Explain the causes of soil degradation.
- 30) Distinguish between CRD and RBD
- 31) Make an account on the structure of project report **(6x4=24marks)**

#### **SECTION-D**

**IV.** Answer **any two** questions. Each question carries **15** marks each

- 32) Explain Phytogeographical regions of India.
- 33) Give an account of natural resources and their conservation.
- 34) Explain various phases of disaster management.
- 35) Explain scientific method in biological research. **(2 x 15= 30 marks)**

**MODEL QUESTION PAPER**  
**FIFTH SEMESTER B.Sc. DEGREE (CBCSS) EXAMINATION**  
**BOTANY CORE COURSE VI**  
**BO1543: CELL BIOLOGY, GENETICS AND EVOLUTIONARY BIOLOGY**  
**(2022 Admission Onwards)**

**Time. 3 Hrs Total Marks: 80**

*(Draw diagrams wherever necessary)*

**SECTION –A**

- I. Answer **all** questions in one word or two sentences; Each question carries **one** mark.
1. What is a test cross?
  2. What is heredity?
  3. What is telomeric chromosome?
  4. Who were the rediscoverers of Mendel's work?
  5. Name one characteristic each in plant and man, which show polygenic inheritance?
  6. Explain genetic drift?
  7. Explain aneuploidy?
  8. What is SAT chromosome?
  9. What is parallel evolution?
  10. According to Mendel how recombinants are formed? **(10x1=10 Marks)**

**SECTION B**

- II. Answer **any eight** of the following; Each question carries **two** marks
11. Briefly describe Ribosome and its major functions?
  12. People with AB blood groups are called 'Universal acceptors'. Why?
  13. Explain holandric genes with suitable examples?
  14. Explain Lamarck's theory of evolution?
  15. Why colour blindness more frequent in males than in females?
  16. Mutation is the basic necessity in the origin of species. Justify the statement?
  17. What are salivary gland chromosomes? Give examples?
  18. What are nucleoproteins? Differentiate histones and non histones?
  19. Explain Neo Darwinism?
  20. Describe the role of polyploidy in evolution?
  21. What do you mean by criss-cross inheritance?
  22. Write notes on Triple X chromosome? **(8X2=16Marks)**

**SECTION C**

III. Answer **any six** of the following; Each question carries **four** marks

23. Differentiate lysosome and peroxisome?
24. How can isolation of a population leads to speciation?
25. Describe the ultra structure of cell membrane?
26. Write an account on XX-XO system of sex determination?
27. Explain the genetic basis of ABO blood group in man ?
28. Describe the different types of structural chromosomal aberrations?
29. What is meant by Evolution? Give three arguments to convince a layman that evolution has takes place
30. State reasons for Mendel's success in formulating the law of heredity?
31. Are acquired characters inherited? Explain. **(6X4=24 Marks)**



### SECTION D

V. Write an essay on any **two** of the following; Each question carries **fifteen** marks

32. What are giant chromosomes? Briefly describe the structure and organization of any two types of giant chromosomes?
33. 'Only the first nuclear division is really meiotic and not the second division'. Explain it with the help of a diagrammatic representation of different stages of meiosis?
34. Explain various sex determination mechanisms in plants?
35. Explain linkage and crossing over? Describe its importance.

**(2x15=30Marks)**

**MODEL QUESTION PAPER**  
**FIFTH SEMESTER B. SC. DEGREE (CBCSS) EXAMINATION**  
**OPEN COURSE I**

**B01551.1 :HORTICULTURE**

**(2022 Admission Onwards)**

**Time. 3 Hrs**

**Total Marks: 80**

*(Draw diagrams wherever necessary)*

**SECTION –A**

I. Answer **all** questions in one word or two sentences. Each question carries **one** mark.

- 1) What is Air layering?
- 2) Define Hydroponics
- 3) What are the uses of Weedicides
- 4) Define Parthenocarpy
- 5) Write two examples for rooting hormone
- 6) What are Fertilizers?
- 7) Write common uses of Vermiculite
- 8) What are foliar sprays?
- 9) Explain NPK?
- 10) Define Pomology

**(10x1=10 Marks)**

**SECTION –B**

II. Answer **any eight** of the following; not to exceed one paragraph. Each question carries **twomarks**

- 11) Write four principles of garden making?
- 12) Explain approach grafting
- 13) Write two examples of garden tools and its uses?
- 14) What are the advantages of Vermicompost
- 15) Explain potting mixture
- 16) What is carpet beds?.
- 17) What is sphagnum moss?
18. Write four uses indoor garden
19. What is Bouquet?
20. What is the purpose of storage of flowers?
21. Write uses and examples of fungicide
22. Briefly explain different types cutting

**(8x2=16 Marks)**

### SECTION –C

**III. Answer any six of the following; not to exceed 120 words; Each question carries fourmarks**

23. Explain flower arrangements
24. What is the relevance of conservatory and green house in a garden?
25. Explain different types of layering
26. Briefly explain different types of soil
27. Describe different types of irrigation methods
28. What are the components of a garden?
29. Write an account on Bonsai
30. Explain T-budding
31. Explain Methods of Dry flower arrangements **(6x4=24 Marks)**

### SECTION –D

**IV. Write an essay on any two of the following; Each question carries fifteenmarks**

32. Write an essay on common diseases of fruits and vegetable crops
33. Explain various types of grafting methods
34. Briefly explain different types processing and preservation of fruits and vegetables
35. Give an account of Manures and fertilizers **(2x15=30 marks)**

**MODEL QUESTION PAPER**  
**FIFTH SEMESTER B. SC. DEGREE (CBCSS) EXAMINATION**  
**OPEN COURSE I**

**BO1551.2: MUSHROOM CULTIVATION AND MARKETING**

**(2022 Admission Onwards)**

**Time. 3 Hrs**

**Total Marks: 80**

*(Draw diagrams wherever necessary)*

**SECTION –A**

I. Answer **all** questions in one word or two sentences. Each question carries **one** mark.

1. Give the name of any two edible mushrooms.
2. What is Spawn?
3. Name any one field mushroom.
4. Give an example of medicinal mushroom.
5. What is blanching?
6. Write the scientific name of white button mushroom.
7. Name any two poisonous mushrooms.
8. What is composting?
9. What is the scientific name of milky mushroom or paddy straw mushroom?
10. What is a substrate? **(10x1=10 Marks)**

**SECTION B**

II. Answer **any eight** of the following; not to exceed one paragraph. Each question carries **twomarks**.

11. What are the advantages of mushroom cultivation?
12. Write a note on common Indian mushrooms.
13. Write a short note on field cultivation of mushroom.
14. Give an account of poisonous mushrooms.
15. Write a note on the nutritional value of mushrooms.
16. Comment on the medicinal value of mushrooms.
17. Which are the bacterial diseases that affect mushrooms?
18. Write a note on freeze drying.
19. Narrate the harvesting of mushrooms.
20. Write a note on pickling.
21. Write the systematic position of *Agaricus*.
22. Write any two binomial of *Pleurotus*. **(8x2=16 Marks)**

**SECTION C**

III. Answer **any six** of the following; not to exceed 120 words. Each question carries **four** marks

23. Explain the Spawn preparation?
24. What are the common diseases and pests found in mushrooms?
25. Describe the various measures and methods adopted to prevent and control diseases in mushrooms.

26. Differentiate edible and poisonous mushrooms.
27. Explain pre-treatment of substrate.
28. Which are the steps involved in bed preparation.
29. Briefly explain the cultivation of white button mushroom.
30. Write a note on foreign exchange from mushroom cultivation.
31. Explain the economic importance of mushrooms.

**(6x4=24 Marks)**

### **SECTION D**

**IV.** Write an essay on **any two** of the following. Each question carries **fifteen** marks

32. Explain the distribution, structure and morphology of *Agaricus*.
33. What is the scientific name of *Oyster* mushroom? Discuss about the various steps in the cultivation of *Oyster* mushroom.
34. How mushrooms are stored? Explain the various steps in the processing of mushrooms.
35. Explain different substratum and their processing methods used in the cultivation of mushrooms.

**(2x15=30 Marks)**

**MODEL QUESTION PAPER**  
**FIFTH SEMESTER B. SC. DEGREE (CBCSS) EXAMINATION**  
**OPEN COURSE I**  
**B01551.3 : FORESTRY**  
**(2022 Admission Onwards)**

**Time. 3 Hrs**  
**Marks: 80**

**Total**

*(Draw diagrams wherever necessary)*

**SECTION –A**

**I.** Answer **all** questions in one word or two sentences. Each question carries **one** mark.

- 1) What are Multipurpose trees?
- 2) What is Shellac?
- 3) Define Silviculture.
- 4) What are Tropical Forests?
- 5) Define Sacred plants.
- 6) Differentiate Homogenous and Heterogenous wood
- 7) Explain Avenue plantation.
- 8) What is NTFPs?
- 9) Define Seed dormancy
- 10) Describe Dendrochronology.

**(10x1=10 Marks)**

**SECTION B**

**II.** Answer **any eight** of the following; not to exceed one paragraph. Each question carries **twomarks**.

- 11) What is gene conservation?
- 12) What are Gums and resins?
- 13) What is the sacredness of *Aeglemarmelous*?
- 14) Explain different types of seed dormancy
- 15) What do you mean by regeneration of forests?
- 16) Describe the types of seed dormancy.
- 17) Define Seed Orchard
18. Write uses of Medicinal plants
19. What are Sacred Groves?
20. Explain porous and non-porous wood
21. Write the importance of Charcoal

**(8x2=16 Marks)**

**SECTION C**

**III.** Answer **any six** of the following; not to exceed 120 words.Each question carries **fourmarks**.

22. Briefly explain types of seed dormancy

23. Point out importance of Evergreen and deciduous forest in forest ecosystem
24. What is the relevance of wood anatomical studies in Kerala?
25. Give an account of Timber Forest Products
26. Write about Silviculture of *Azadirachta indica*
27. Explain coppice and conservation systems
28. What are the uses of canes and bamboos?
29. Write an account of Trees in Sacred grove
30. Write about Lac collection and marketing
31. Explain methods to overcome seed Dormancy **(6x4=24 Marks)**

#### **SECTION D**

**IV.** Write an essay on **any two** of the following. Each question carries **fifteen** marks.

32. Write an essay on Silviculture methods
33. Explain various types of Forest in Kerala
34. Briefly explain different types of wood
35. Explain Indian forest act 1927 and their amendment **(2x15=30 Marks)**

**MODEL QUESTION PAPER**  
**SIXTH SEMESTER B. SC. DEGREE (CBCSS) EXAMINATION**  
**BOTANY : CORE COURSE IX**  
**BO 1641 - PLANT PHYSIOLOGY AND BIOCHEMISTRY**  
**(2022 Admission Onwards)**

**Time. 3 Hrs**

**Total Marks: 80**

*(Draw diagrams wherever necessary)*

**SECTION –A**

**I.** Answer **all** questions in one word or two sentences. Each question carries **one** mark

1. What is Kranz anatomy?
2. What are epimers?
3. Why cytochrome  $a_3$  is called terminal oxidase?
4. Represent the overall equation of photosynthesis.
5. What are isoenzymes?
6. What is meant by thigmotropic movement?
7. What is tonicity?
8. Define red drop.
9. What is incipient plasmolysis?
10. How the stomata of CAM plants differ from that of C3 plants?

**(10 x 1 = 10 marks)**

**SECTION – B**

**II** Answer any **8** questions. **Each** question carries **2** marks.

11. Give an account on raw materials of photosynthesis.
12. Briefly describe the physiological role of Abscisic acid in plants.
13. Differentiate apoplast and symplast.
14. How root pressure influences water movement in plants?
15. What are derived lipids? Give examples
16. Explain the physiology of senescence.
17. Discuss the amphoteric nature of aminoacids
18. Briefly describe the relation between OP, TP and WP in plants.
19. Comment on hydroponics.
20. Differentiate absorption spectrum and action spectrum.
21. Why fluorescent radiation has higher wavelength than phosphorescent radiation?
22. Point out the differences between photosynthesis in bacteria and higher plants.

**(8 x 2 = 16 marks)**

**SECTION -C**

**II.** Answer any **six** of the following. Each question carries **4** marks

23. Describe the vital and physical theories explaining ascent of sap.
24. How the principle of Limiting factors apply in photosynthesis?



25. Give an account on coenzymes and cofactors.
26. Explain beta oxidation of fatty acids.
27. Describe the classification and function of secondary plant products.
28. Explain the mechanisms of mineral absorption in plants.
29. How anaerobic respiration differs from aerobic in terms of ATP yield?
30. Discuss the mechanism of photorespiration. Enumerate its advantages and disadvantages
31. Explain biological nitrogen fixation.

**(6 x 4 = 24 marks)**

#### **SECTION - D**

**III.** Answer any 2 questions. Each question carries **15 marks**.

32. Discuss the mechanisms and theories on translocation of organic substances in plants.
33. Explain dark reaction and compare the photosynthetic mechanisms in C<sub>3</sub> and CAM plants.
34. Discuss various types of movements exhibited by plants.
35. What are carbohydrates? How are they classified? Mention its function

**(2x15 = 30 marks)**

**MODEL QUESTION PAPER**  
**SIXTH SEMESTER B. SC. DEGREE (CBCSS) EXAMINATION**  
**BOTANY : CORE COURSE X**  
**BO-1642-MOLECULAR BIOLOGY, GENERAL INFORMATICS AND**  
**BIOINFORMATICS**  
**(2022 Admission Onwards)**

**Time. 3 Hrs**

**Total Marks: 80**

*(Draw diagrams wherever necessary)*

**SECTION –A**

**I.** Answer **all** questions in one word or two sentences. Each question carries **one** mark

- 1) Define cistron.
- 2) How is wet lab different from a web lab?
- 3) Expand NICNET
- 4) Name two operating systems used in computers.
- 5) Mention role of helicases.
- 6) Explain PIR
- 7) What are okazaki fragments?
- 8) Name two nucleic acid databases.
- 9) What are introns?
- 10) Write about importance of Reverse transcriptase

**(10x1=10 marks)**

**SECTION –B**

**II.** Answer **any eight** of the following: Each question carries **two** marks

- 11) Give any four differences between DNA and RNA.
- 12) What is Kornberg enzyme.
- 13) What is plagiarism?
- 14) What are stop codons? Give their sequence
- 15) What are replisomes?
- 16) Describe the health issues faced by regular users of computer.
- 17) What is SWISS-PROT? Mention any two important features.
- 18) What you mean by the statement “the genetic code is degenerate”?
- 19) Write a note on the main objectives of INFLIBNET.
- 20) Differentiate between Global and Local alignment
- 21) What are the parts of a typical rooted phylogenetic tree?
- 22) How CLUSTAL becomes an indispensable tool in Bioinformatics?

**(8x2= 16 marks)**

**SECTION –C**

**III.** Answer **any six** of the following: Each question carries **four** marks

- 23) Give an account on sequence analysis and alignment in bioinformatics.
- 24) Write the salient features of Watson and Crick double helical model of DNA.
- 25) Comment on intellectual property rights.
- 26) Give an account on operon concept with reference to *lac* operon.

- 27) What is a phylogram? Describe the various tools used in phylogenetic analysis.
- 28) Give an account of the different types of RNA
- 29) Practicing good cyber ethics is a present day necessity. Comment.
- 30) Describe the experiment of Meselson and Stahl
- 31) How is Rasmol used in molecular visualization? **(6x4=24 marks)**

**SECTION –D**

IV. Write **essay** on any two of the following. Each question carries **fifteen** marks

- 32) What are the advantages of molecular phylogenetic analysis? Explain the technique
- 33) Describe the various experiments conducted by scientists to prove that DNA is the genetic material in living organisms.
- 34) Give a detailed account on different biological databases.
- 35) What is central dogma in molecular biology? Elucidate the process by which genetic information is transferred from DNA to RNA in a prokaryotic cell. **(2x15 = 30 marks)**

MODEL QUESTION PAPER  
SIXTH SEMESTER B. SC. DEGREE (CBCSS) EXAMINATION  
BOTANY : CORE COURSE XI  
BO1643: BIOTECHNOLOGY, NANOBIO TECHNOLOGY, HORTICULTURE,  
PLANT BREEDING  
(2022 Admission Onwards)

Time. 3 Hrs

Total Marks: 80

*(Draw diagrams wherever necessary)*

**SECTION –A**

**I.** Answer **all** questions in one word or two sentences. Each question carries **one** mark.

1. Define totipotency
2. Define cosmids
3. Define quantum dots
4. Define gene library
5. What are cybrids
6. What are mutagens?
7. Define Pomology.
8. What is floriculture?
9. What is NPK?
10. What is heterosis?.

**(10x1= 10 Marks)**

**SECTION –B**

**II** Answer **any eight** of the following ;Each question carries **two**marks.

11. What are synthetic seed? Mention the uses
12. What are genetically modified crops? Mention any two GMC you have studied
13. What is Ti Plasmid?
14. Explain genomic DNA library
15. What are cybrids?
16. What is Somatic embryogenesis?
17. Give an account on biofertilizers used in horticulture.
18. Write a short note on quarantine.
19. Explain the advantages of organic manures.
20. Explain the term “pureline”.
21. Describe backcross method.
22. What is bonsai?.

**(8x 2= 16 Marks)**

**SECTION –C**

**III** Answer **any six** of the following;Each question carries **four**marks.

23. Give an account on Somatic hybridization
24. Discuss the classification of Nanoparticles in detail
25. Give a brief account on various gene transfer mechanisms in plants
26. Explain the requirements and process of Southern blotting

27. Describe polyploidy breeding.
28. Describe the method of vermi-composting.
29. Explain inter-varietal hybridization.
30. Explain the steps to be taken for weed control.
31. Write an account on types of flower arrangement. **(6x4=24 marks)**

**SECTION –D**

**IV** Answer **any two** of the following; Each question carries **fifteen** marks.

32. Define Micropropagation. Explain the steps involved in micropropagation and its application
33. What is PCR? Explain the basic steps and its application.
34. Explain various grafting techniques in plant propagation.
35. Method and application of mutation breeding. **(2x15 = 30 Marks)**

MODEL QUESTION PAPER  
**SIXTH SEMESTER B. SC. DEGREE (CBCSS) EXAMINATION**  
**INDUSTRY BASED ELECTIVE COURSE -A**  
**BO1661.1 :ORGANIC FARMING**  
**(2022 ADMISSION ONWARDS)**

**Time. 3 Hrs**

**Total Marks: 80**

*(Draw diagrams wherever necessary)*

**SECTION A**

Answer **all** questions. Each Question carries 1 mark

1. Name a Biopesticide
2. ZBNF
3. Mulching
4. Give the names of any two indigenous rice varieties
5. VAM
6. Symbiotic nitrogen fixation
7. Biogas slurry
8. Trychoderma
9. Reclamation
10. What is soil fertility

**(1 x 10 = 10 marks)**

**SECTION B**

Answer **any eight** questions. Each Question carries 2 marks

11. Define organic farming.
12. What are Trap Crops?
13. Write down the agronomic benefits of biofertilizers.
14. Write short note on Vermicomposting.
15. What are botanical insecticides?
16. What are the differences between Soil Fertility and Productivity?
17. Write about any two soil amendments.
18. Explain ‘Natural enemies’ with at least two examples.
19. How does organic farming help in conservation of ecological balance?
20. Brief up on organic seeds.
21. Write about characteristics of good soil.
22. What is drip irrigation?

**(2 x 8 = 16 marks)**

**SECTION C**

Answer **any six** questions. Each Question carries 4 marks

23. Write down the practices to be followed in an organic farming system.
24. What is the role of organic manures in organic farming?
25. Explain about the use of crop residue in organic farming.
26. Write short notes on (a). NPOP. And (b). Organic logo.
27. Briefly explain the cultural methods for disease and pest control.
28. How does organic farming help in conservation of ecological balance?
29. Write down the organic production requirements as per the national standards.
30. Write down the specific requirements for handling and processing of organic food.
31. What are organic amendments? Write down their advantages and disadvantages.

**(6 x 4 = 24 marks)**

### **SECTION D**

Answer **any two** questions. Each Question carries 15 marks

32. Write about the basic concept of economics, demand & supply of an organic farm.
33. Discuss on composting methods and vermi-composting.
34. Write the principles of organic farming and explain the benefits of organic farming.
35. Write about Farm Inspection & Certification

**(2 x 15 = 30 marks)**

MODEL QUESTION PAPER  
Sixth semester B. Sc. Degree (CBCSS) Examination  
Industry based Elective course -a  
BO1661.2 : Mushroom Culture Technology  
(2022 Admission Onwards)

Time. 3 Hrs

Total Marks: 80

*(Draw diagrams wherever necessary)*

**Section – A**

I. Answer **all** questions. Each carries **1** mark.

1. Name a poisonous mushroom
2. What is 'mushroom hunting'?
3. What is Spawn
4. Genus of Oyster mushroom
5. What are 'Puffballs'?
6. Name a disinfectant in mushroom cultivation
7. Name an antidiabetic species of mushroom
8. What is a mushroom bed
9. Example for a contaminant in mushroom cultivation
10. What is canning

**(1x10=10)**

**Section – B**

II. Answer **any eight** of the following. Each carries **2** marks.

11. Blanching
12. Medicinal values of Oyster mushroom
13. Define Pasteurization
14. Draw and label the structure of basidiocarp
15. Difference between mushrooms and toadstools
16. Write down the common cultivated varieties of Pleurotus
17. Name pest control methods used in mushroom cultivation
18. Common medicinal values of mushroom
19. What is casing. Write down its purpose
20. How Sciarids affects mushroom production
21. What is freeze drying process
22. Comment on clamp connection

**(2x8=16)**

**Section – C**

III. Answer **any six** of the following. Each carries **4** marks.

23. History of mushroom cultivation in India – Comment
24. Write an overview of techniques in mushroom cultivation
25. What are thermostats and humidistats
26. What are the chemical and physical properties of materials used in casing
27. What is grading and picking
28. Salient features of Shiitake
29. Explain the steps in mushroom bed preparation
30. Describe any four value added products in mushroom cultivation



31. Discuss any two techniques used in mushroom harvesting (4x6=24)

**Section - D**

IV. Write an essay on **any two** of the following. Each carries **15** marks

32. Write an essay about the structure and construction of a mushroom house
33. Explain the procedures used in compost preparation
34. Describe the life cycle of a mushroom with a neatly labelled diagram
35. Write an essay about pest and environmental control used in mushroom cultivation (2x15=30)

MODEL QUESTION PAPER  
**SIXTH SEMESTER B. SC. DEGREE (CBCSS) EXAMINATION**  
**INDUSTRY BASED ELECTIVE COURSE -C**  
**BO1661.3 :NUSRSERY AND GARDEN MANAGEMENT**  
**(2022 Admission Onwards)**

**Time. 3 Hrs**

**Total Marks: 80**

*(Draw diagrams wherever necessary)*

**SECTION A**

Answer **all** questions. Each Question carries 1 mark

1. Sphagnum moss
2. Scion
3. Certified seed
4. Kokedomo
5. Potting mixture
6. Weedicides
7. Vermiculite
8. Foliar application
9. Name the common name of two hanging plants
10. Common name of two high value ornamentals

**(1 x 10 = 10 marks)**

**SECTION B**

Answer **any eight** questions. Each Question carries 2 marks

11. What are the different types of seeds?
12. Differentiate between shade house and glass house
13. Write an account on potting mixture
14. Discuss the relevance of computer aided landscape designing
15. Write about mist chamber
16. What is rooting? Give examples of any two rooting agents
17. Write an account on terrace gardening
18. Write four principles of garden making?
19. Write two examples of garden tools and its uses.
20. What are the advantages of Vermicompost?
21. Write notes on two ornamentals that are propagated by cutting.

**(2 x 8 = 16 marks)**

**SECTION C**

Answer **any six** questions. Each Question carries 4 marks

22. Define gardening. Give a brief description on different types of gardening
23. Write about the hardening procedure for micropropagated plants. Mention its significance

24. Write brief account on gardening operations and the management of pests and disease in a nursery
25. Give an account on different methods for breaking the seed dormancy
26. Briefly explain different types of soil
27. Describe different types of irrigation methods
28. What are the components of a garden?
29. Write an account on Bonsai
27. What is the relevance of a polyhouse in a garden?
28. Write an account on the general operations during generating and sale of a batch of ornamental plant.
29. Explain the process of seed bed preparation
30. Why some plants are transplanted after germination in seed beds?

**(6 x 4 = 24 marks)**

#### **SECTION D**

Answer **any two** questions. Each Question carries 15 marks

31. Write an essay on different seed types and outline the procedure of seed testing and certification
32. Describe the different methods of vegetative propagation
33. Give an account of Manures and fertilizers
34. Write an essay on the potential of a commercial ornamental plant nursery in Kerala

**(2 x 15 = 30 marks)**

**MODEL QUESTION PAPER**  
**SIXth semester B. Sc. Degree (CBCSS) Examination**  
**Industry based Elective course -d**  
**BO1661.4 : Medicinal Botany**  
**(2022 Admission Onwards)**

**Time :3Hours**

**Max. Marks :80**

**SECTION –A**

**Answer all questions in a word or one or two sentences. Each question carries 1mark. Draw diagrams only if specified in the question.**

1. Mention the binomial of Tulsi.
2. Which plant is used to cure hepatitis?
3. Name two medicinal plants propagated by Bulbs
4. Mention the use Brahmi
5. Expansion of CIMAP.
6. What is Medicina plant Bank.
7. Name a plant that can be used as biopesticide
8. Give the binomial of Sarpagandha
9. What is NMPB?
10. What do you meant by red data book?

**(10 x 1 = 10 marks)**

**SECTION - B**

**Answer any 8 questions. Each question carries 2 marks. Answer not to exceed one paragraph**

11. Name two commercial products having herbals as ingredients and mention its manufacturer.
12. What is micropropagation?.
13. Mention propagation methods of four medicinal plants.
14. What are folkmedicines?
15. Comment on the medicinal value ofAsoka.
16. Mention two ayurvedic products in which Aonla is an ingredient
17. What is the soil conditions in which Aonla grows well?
18. Explain organic farming of medicianal plants?
19. How microbial biofertilizers are beneficial to medicinal plant cultivation?
20. Name two plants whose seeds are medicinally important
21. Which all medical systems comes under AYUSH
22. What is the role of Herbaria in medicinal plant conservation.

**(8x2 = 16 marks)**

**SECTION -C**

**Answer any six of the following. (Answer not to exceed 120words). Each question carries 4 marks**

23. Name four medicinal plants which are having consumption of more than 1000 tonnes per year.
24. Why medicinal plants are considered as part and parcel of culture and rituals of Kerala and India? Explain with sufficient examples.

25. Write a brief account on the product “Jeevani”
26. Write a brief account on the history of Ayurvedic system of medicine
27. Explain the objectives and functioning of ‘AICRP-MAP’
28. What are adulterants in medicinal products? Name two plants used as adulterants
29. Discuss the agencies and their role in cultivation of medicinal plants
30. What are difficulties faced by farmers with growing and marketing of medicinal plants?
31. What is the importance of medicinal plant conservation for Kerala being a state traversed by western Ghats?

**(6x4 = 24 marks)**

#### **SECTION - D**

**Answer any 2 questions. (Not more than three pages). Each question carries 15 marks.**

32. Explain the post harvest processing and marketing of three medicinal plants. Mention the end users of these products.
33. Write a detailed account on the cultivation, harvesting, storage and marketing of two medicinal plants.
34. Write the common propagation methods of medicinal plants citing examples
35. Describe in detail the cultivation of 3 medicinal plants of importance to Ayurveda. Mention their binomial and uses.

**(2X15=30 marks)**

**Model Question Paper**  
**First Degree Programme in Botany (CBCSS) Practical Examination**  
**Botany Core (Practical I) VII-Course Code: BO1222**  
**Angiosperm Anatomy, Reproductive Botany, Palynology,**  
**Methodology and Perspectives in Plant Science**  
**(2022 Admission Onwards)**

**Time: 3 Hours**

**Max. Marks: 80**

- |  |   |                        |
|--|---|------------------------|
| 1.                                     | Make suitable micropreparation of <b>A</b> and <b>B</b> ; identify giving reasons and describe its structure with the help of 10 labeled diagrams. Leave the preparation for valuation.<br>(Preparation-3, Labelled diagram-3, Reasons-3, Identification-1) | <b>10x2 = 20 Marks</b> |
| 2.                                     | Construct a frequency table (Discrete/Continuous) from the given data <b>C</b>  | <b>4 Marks</b>         |
| 3.                                     | Construct histogram/Bar diagram from the data <b>D</b> .  | <b>4 Marks</b>         |
| 4.                                     | Workout the problem <b>E</b><br>(Calculation- 3, Result-1)  | <b>4 Marks</b>         |
| 5.                                     | Identify the instrument <b>F</b> . Comment on its working principle.<br>(Identification-1, Aim-1, Working Principle-2)  | <b>4 Marks</b>         |
| 6.                                     | Identify the separation technique <b>G</b> . Comment on its procedure.<br>(Identification-1, Aim-1, Procedure-2)  | <b>4 Marks</b>         |
| 7.                                     | Comment on <b>H</b><br>(Major group-1, Notes-2)   | <b>3 Marks</b>         |
| 8.                                     | Write critical notes on <b>I</b><br>(Identification -1, Notes-2)  | <b>3 Marks</b>         |
| 10.                                    | Identify the type of stomata in specimen <b>J</b><br>(Identification-1, Labelled Diagram-1, Reasons-1)  | <b>3 Marks</b>         |
| 11.                                    | Identify and describe the type of cellular inclusions in specimen <b>K</b><br>(Identification-1, Description-2, Labelled Diagram-1)   | <b>4 Marks</b>         |
| 12.                                    | Identify <b>L</b> and draw a neat labelled diagram<br>(Identification-1, Labelled Diagram-3)  | <b>4 Marks</b>         |
| 13.                                    | Comment on <b>M</b><br>(Identification-1, Notes-2)  | <b>3 Marks</b>         |
| <b>Record (Content-15, Neatness-5)</b> |   | <b>20 Marks</b>        |

## KEY TO SPECIMENS

- A Primary/Normal Secondary Root/Stem
- B Stem with anomalous secondary structure (*Bignonia*, *Boerhaavia*, *Dracaena*)
- C Numerical data
- D Frequency table data -
- E Frequency table/Numerical Data–Problem from measures of central tendency/ Chi squared test
- F Instruments from Biophysics
- G Biophysics- Chromatography/Electrophoresis
- H Fixatives/ Stains/ Mounting media
- I Dissection/Compound microscope / Part of Microscope/ Microtome / Camera lucida/ Micrometer
- J Stomatal type-
- K Cell inclusions mentioned in the syllabus
- L Anther T. S /Dicot embryo L. S/ Monocot embryo L.S. Embryosac (*Polygonum* type) Ovule (Orthotropous/ Anatropous) (*Permanent slides /diagrams*)
- M Pollen Aperture type mentioned in the syllabus

**First Degree Programme in Botany (CBCSS) Practical Examination**  
**Botany Core (Practical II) VIII-Course Code: BO1442**  
**Microbiology, Phycology, Mycology, Lichenology & Plant Pathology**  
**Bryology, Pteridology, Gymnosperms & Paleobotany**  
**(2022 Admission Onwards)**

**Time: 3 Hours**

**Max. Marks: 80**

1. Make suitable micro preparations to bring out the structure of **A, B, C** and **D**. Draw a cellular diagram of each and label the parts. Identify giving reasons and leave the preparation for valuation.  
(Preparation-2, Labelled diagram-2, Reasons, 2, Identification-1) **4 x 7 = 28 Marks**
  2. Identify any two algal specimens from the mixture **E**, giving reasons  
(Diagram-1, Reasons-1, Identification-1) **2 x 3 = 6 Marks**
  3. Observe **F** under microscope, identify and write down its procedure.  
(Procedure-3, Identification -1) **4 Marks**
  4. Identify the disease in plant specimen **G** and give the name of the causative organism along with important symptoms associated with it.  
(Disease-1, Pathogen-1, Symptoms-2) **4 Marks**
  5. Spot at sight **H, I, J, K, L** and **M**  
(Genus name-1, Part of the plant-1, Major group-1) **6 x 3 = 18 Marks**
- Record (Content-15, Neatness-5) 20 Marks**



## KEY TO SPECIMEN

- A Fungus mentioned in the syllabus
- B Bryophyte mentioned in the syllabus
- C Pteridophyte mentioned in the syllabus
- D Gymnosperm mentioned in the syllabus
- E Algal Mixture (Mixture of different algae (at least four members) mentioned in the syllabus.
- F Bacterial Smear (Gram positive/ Gram negative)
- G Plant disease mentioned in the syllabus
- H Alga (Macroscopic)
- I Fungus/Lichen
- J Bryophyte
- K Pteridophyte
- L Gymnosperm
- M Fossil form mentioned in the syllabus(Permanent slide /Photograph)

**MODEL QUESTION PAPER**  
**First Degree Programme in Botany (CBCSS) Practical Examination**  
**Botany Core (Practical III) XII-Course Code: BO1644**  
**Angiosperm Morphology, Systematic Botany, Economic Botany, Ethnobotany**  
**and Environmental Studies**  
**(2022 Admission Onwards)**

**Time: 3 Hours**

**Max. Marks: 80**

1. Identify and write notes on **A** with a labelled diagram.  
(Notes-2, Labelled diagram-1) **(3 Marks)**
  2. Comment on **B**  
(Notes 2, Diagram-1) **(3 Marks)**
  3. Describe **C** in technical terms. Draw a labelled sketch of the L. S. of the flower **C**. Construct a floral diagram and write the floral formula.  
(Description-2, Labelled sketch-2, Floral diagram-1, Floral formula-1) **(6 Marks)**
  4. Refer **D** and **E** to their respective families, pointing out the class, subclass and series with reasons. (Reasons upto series-2, Description of plant in technical terms- 2, Family characters-2, Identification of family-1) **(7 x 2 = 14 Marks)**
  5. Write the generic name and family of **F** and **G**  
(Generic name-1, Family-1) **(2 x 2 = 4 Marks)**
  6. Spot at sight **H** and **I**  
(Binomial-1, Family-1, Morphology of the useful part-1) **(3 x2 = 6 Marks)**
  7. Identify and write critical notes on **J**  
(Binomial -1, Family-1, Notes-2) **(4 Marks)**
  8. Make a suitable micropreparation of **K**. Write the anatomical adaptations and identify the ecological group.  
(Preparation-1, Adaptations-2, Ecological group-1) **(4 Marks)**
  9. Identify the ecological group **L** and write its morphological adaptations.  
(Ecological group-1, Adaptations-2) **(3 Marks)**
  10. Identify and write notes on **M**  
(Identification-1, Notes-2) **(3 Marks)**
- **Herbarium submission -7; Field Note & Tour Report-3** **(10 Marks)**
  - **Record (Content-15 Marks. Neatness-5 Marks)** **(20 Marks)**

## KEY TO SPECIMEN

- A. Inflorescence (*Mentioned in the syllabus*)
- B. Fruits (*Mentioned in the syllabus*)
- C. Systematic Botany – Flowering twigs (along with floral buds) from **Polypetalae/Gamopetalae**
- D. Any Dicot family mentioned in the syllabus (Flowering twigs from **Polypetalae/Monochlamydeae**)
- E. Any Dicot family mentioned in the syllabus (Flowering twigs from **Gamopetalae**)
- F & G Herbarium sheets
- H & I Economic Botany (*Mentioned in the syllabus*)
- J Ethnobotany (*only plants mentioned in the syllabus*)
- K & L Ecological groups mentioned in the syllabus
- M Ecosystems (*Photographs, Pictures or Diagrams of ecosystems mentioned in the syllabus*)

**MODEL QUESTION PAPER**  
**First Degree Programme in Botany (CBCSS) Practical Examination**  
**Botany Core (Practical IV)XIII-Course Code: BO1645**

**Cell Biology, Genetics, Plant Physiology, Biochemistry, Molecular Biology,  
Bioinformatics, General Informatics, Biotechnology, Plant Breeding & Horticulture  
(2022 Admission onwards)**

**Time: 3 Hours**

**Max. Marks: 80**

1. Make acetocarmine squash preparation of material **A**. Identify metaphase and anaphase stages of cell division and draw labelled sketches of identified stages.  
[Preparation-3, Identification-2 (1x2), Labelled diagram- 4 (2x2)] **9Marks**
2. Work out the problems **B, C &D**  
(B-4 Marks, C-5 Marks, D-3 Marks) **12Marks**
3. With the help of a labelled diagram, explain the working of Experiment **E**.  
(Aim-1, Labelled diagram-2, Working-3, Inference-1) **7 Marks**
4. Detect the presence of proteins/reducing sugar/non reducing sugar/starch in **F**.  
Write down the procedure.  
(Conduct of experiment-2, Procedure-3, Identification-1) **6 Marks**
5. Write down the procedure and demonstrate emasculation using material **G**. Submit for valuation.  
(Demonstration-4, Procedure-2) **6Marks**
7. Write down the procedure and demonstrate T-Budding/Air layering/Grafting (Wedge/Whip) using **H**. Submit for valuation.  
(Demonstration-3, Procedure-2) **5Marks**
8. Identify and write critical notes on **I, J &K**  
(Identification-1, Notes 3) **12 Marks**
- Submission of report (Industry based Elective course)** **3Marks**
- Record (Content- 15, Neatness-5)** **20 Marks**

## MODEL QUESTION PAPER

### KEY TO SPECIMENS

- A. Onion Root tips
  - B. Genetics problem (*Incomplete Dominance / Dihybrid*)
  - C. Genetics problem (*Interaction of Genes*)
  - D. Molecular Biology problem
  - E. Physiology experiments
  - F. Biochemistry (proteins/ reducing sugar/non reducing sugar/starch)
  - G. Plant Breeding: Inflorescence suitable for emasculation
  - H. Horticulture
  - I. Critical note from Biotechnology (PCR, Flavr Savr tomato, Bt cotton, Golden rice, PBR322, Bioreactor, Restriction enzymes, Agarose, Acrylamide)
  - J. Critical note from Bioinformatics (NCBI BLAST, EMBL, SWISSPROT, PDB, Rasmol, Protein 3D structure)
  - K. Prepare a bar diagram / line diagram / do calculation of Mean and standard deviation from a given data using MS Excel
- OR
- Critical note from General informatics (INFLIBNET, BRNET, NICNET, SWAYAM, INaturalist)

### BO1646: PROJECT

## The project work/ Dissertation can be carried out individually or group of students. Project report, duly attested by the Supervising teacher and certified by Head of the Department, has to be submitted on the day of Core Practical III examination. Viva voce has to be conducted individually.

**Project Report - 80 Marks Viva voce - 20 marks**

**Total – 100Marks**

# UNIVERSITY OF KERALA

## THIRUVANANTHAPURAM



COMPLEMENTARY COURSE

# BOTANY

FOR

FIRST DEGREE PROGRAMME IN ZOOLOGY/ HOME SCIENCE/BIOCHEMISTRY

UNDER



CHOICE BASED CREDIT- SEMESTER SYSTEM

*(w.e.f. 2022 admission onwards)*

HEAD OF THE DEPARTMENT  
Department of Botany

Dr. AMPILI M.  
Principal



**UNIVERSITY OF KERALA**  
**THIRUVANANTHAPURAM**



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**SEMESTER-I**

**MICROTECHNIQUE, ANGIOSPERM ANATOMY  
AND REPRODUCTIVE BOTANY**

**SEMESTER-II**

**THALLOPHYTES, ARCHEGONIATAE AND PLANT  
PATHOLOGY**

**SEMESTER-III**

**SYSTEMATIC BOTANY, ECONOMIC BOTANY,  
ETHNO BOTANY AND PLANT BREEDING**

**SEMESTER-IV**

**PLANT PHYSIOLOGY, PLANT ECOLOGY,  
HORTICULTURE AND PLANT  
BIOTECHNOLOGY**



Course code	Course title	Semester I		Semester II		Semester III		Semester IV		Total	
		Contact hours	Credit	Contact hours	Credit	Contact hours	Credit	Contact hours	Credit	Contact hours	Credit
BO1131	Microtechnique, Angiosperm Anatomy and Reproductive Botany	2	2							4	2
BO1231	Thallophytes, Archegoniatae and Plant pathology			2	2					4	2
BO1331	Systematic botany, Economic botany, Ethnobotany and Plant Breeding					3	3			5	3
BO1431	Plant Physiology, Ecology, Plant Biotechnology and Horticulture							3	3	5	3
BO1432	Practical BO1131,BO1231 ,BO1331 &BO1431	2		2		2		2		8	4
											14

## SEMESTER-I

### MICROTECHNIQUE, ANGIOSPERM ANATOMY AND REPRODUCTIVE BOTANY

Course code : BO 1131 Number of credits : 2

Number of contact hours: (Lecture -36 hrs : Practical- 36hrs) Total -72 hrs

Distribution of Hours	Theory	Practical
Microtechnique	06 hrs	02hrs
Angiosperm anatomy	20 hrs	30hrs
Reproductive Botany	10 hrs	04 hrs
Total	36 hrs	36 hrs

**Aim of the course:** To generate awareness about anatomical features of Angiosperms & reproductive biology as well as to learn techniques for micropreparations.

#### Objectives:

- To develop skills for preparation and identification of microscopic structures
- To distinguish various tissue systems and internal structure
- To acquire basic knowledge about embryo development and pollen grains

#### MODULE-I

##### Microtechnique

6hrs

1. Killing and Fixing agents – Carnoy's formula, FAA.
2. Stains and Staining techniques- Double staining. General account; Stains: Saffranin, Haematoxylin, Acetocarmine.

#### MODULE-II

##### Angiosperm Anatomy

10hrs

1. Objective and scope of plant anatomy
2. Tissues – Meristems, Definition, Classification based on origin, position, growth patterns, functions.
3. Apical meristems & theories on apical organization - Apical cell theory, Histogen theory, Tunica -Corpus theory. Organization of root apex in dicots & monocots (Kopper-Kappe theory).
4. Permanent tissues – Definition, classification - simple, complex and secretory.
5. Tissue systems – Epidermal tissue systems, Ground tissue systems & vascular tissue systems. Different types of vascular arrangements

### MODULE-III

10hrs

1. Primary structure – Root, stem and leaf [Dicot & Monocot]. Secondary growth (Stelar and extra stelar)- Root and stem- cambium (structure and function) annual rings, heart wood and sap wood, tyloses, ring porous wood and diffuse porous wood, Periderm formation-Phellum, Phellogen and Phelloderm ; Lenticels
2. Anomalous secondary growth –*Boerhaavia*.

### Practical

32hrs

1. Familiarize Killing and Fixing agents, Stains
2. Simple permanent tissue – Parenchyma, Chlorenchyma, Aerenchyma, Collenchyma and Sclerenchyma
3. Primary structure – Dicot stem: *Centella*.
4. Monocot stem: Grass.
5. Dicot root: Pea or *Limnanthemum*
6. Monocot root: *Colocasia*.
7. Secondary structure - Stem [Normal type]-*Vernonia*.
8. Secondary structure - Root [Normal type]- *Carica papaya*; Aerial root -*Tinospora/ Ficus*.
9. Anomalous secondary thickening – *Boerhaavia*

### MODULE- IV

#### Reproductive Botany

10hrs

1. Micro sporogenesis - structure and functions of wall layers.
2. Development of male gametophyte - Dehiscence of anther.
3. Megasporogenesis - Development of female gametophyte - Embryo sac development and type - Monosporic – *Polygonum* type.
4. Pollination - Fertilization - Double fertilization. Structure of Embryo- Dicot [*Capsella*],

### Practical

4hrs

Students should be familiar with the structure of anther and embryo,

(Permanent slides can be used)

### REFERENCES

1. Bhojwani S S (1974) The Embryology of Angiosperms, 6<sup>th</sup> edition Vikas publishers
2. Coutler E. G. (1969) Plant Anatomy – Part I Cells and Tissues – Edward Arnold, London.
3. Esau K. (1965) Plant Anatomy – Wiley Eastern, New York.
4. Fahn A. (1985) Plant Anatomy – Pergamon Press, Oxford.

5. Maheswari P (1950) An Introduction to the Embryology of Angiosperms – McGraw Hill, New York
6. Pandey, B .P. (1997) Plant Anatomy - S.Chand and co. New Delhi
7. Pijush Roy (2006) Plant Anatomy. New Central Book Agency (P) Ltd
8. Prasad and Prasad (1972) Out lines of Botanical Micro technique, Emkay publishers, New Delhi.
9. Vashista.P. C (1984) Plant Anatomy – Pradeep Publications – Jalandhar

## SEMESTER-II

### Thallophytes, Archegoniatae and Plant pathology

Course code : BO 1231 Number of credits : 2

Number of contact hours : 36 hrs (Lecture); 36 hrs (Practical) Total- 72 hours

Distribution of Hours	Theory	Practical
<b>Thallophytes I - Algae</b>	09 hrs	08 hrs
<b>Thallophytes II – Fungi &amp; Lichens</b>	09 hrs	08 hrs
<b>Plant Pathology</b>	03 hrs	04 hrs
<b>Archegoniatae I - Bryophyta</b>	06 hrs	06 hrs
<b>Archegoniatae II - Pteridophyta</b>	06 hrs	06 hrs
<b>Archegoniatae III - Gymnosperms</b>	03 hrs	04 hrs
<b>Total</b>	<b>36 hrs</b>	<b>36 hrs</b>

**Aim of the course:** To create awareness about the world of microbes and non flowering plants.

#### Objectives:

- To familiarize characteristic features of microbes and their significance in environment
- To generate idea about types of algae, fungi, lichen and their economic as well as evolutionary significance
- To familiarize the students the characteristic features, life cycle and evolutionary significance of Bryophytes, Pteridophytes and Gymnosperms.
- To impart knowledge about diseases in plants

#### MODULE-I

##### Thallophytes I - Algae

**9hrs**

1. Salient features of the following major groups with reference to the structure, reproduction and life cycle of the types given below (Excluding the developmental details)–
  - a) Cyanophyceae -*Nostoc*
  - b) Chlorophyceae - *Chlorella*, *Oedogonium* and *Chara*
  - c) Phaeophyceae -*Sargassum*
  - d) Rhodophyceae –*Polysiphonia*

##### Practical

**8 hrs**

1. Make micro preparations of vegetative and reproductive structures of the types mentioned in the syllabus.
2. Identify the algal specimens up to the generic level and make labeled sketches of the specimens observed

## MODULE-II

### Thallophytes II – Fungi & Lichens

9hrs

1. Characteristic features of the following major groups with reference to the structure, reproduction and life cycle of the types given below (Excluding the developmental details)–

a. Zygomycotina-*Rhizopus*

b. Ascomycotina

i. Discomycetes-*Peziza*

c. Basidiomycotina

i. Teliomycetes –*Puccinia*

2. Economic importance of Fungi

3. General account and economic importance of Lichens; Morphological and anatomical features of *Usnea*

#### Practicals

8 hrs

A detailed study of structure and reproductive structures of types given in the syllabus and submission of record.

*Rhizopus, Peziza. Puccinia. And Usnea.*

## MODULE III - Plant Pathology

3 hrs

1. A brief account on the following plant diseases with reference to the symptoms, causative organism, spread of the disease and effective control measures.

a) Brown spot disease of Paddy

b) Powdery mildew of Rubber

c) Tapioca Mosaic Virus

d) Quick wilt of Pepper

2. Method of preparation and mode of action of the following fungicides- Bordeaux mixture, Tobacco decoction.

#### Practical

4 hrs

Students are expected to observe the symptoms and causal organisms of all plant diseases mentioned above.

## MODULE-IV

6hrs

### Archegoniatae I - Bryophyta

1. Introduction and Classification

2. Study of the habit, thallus organization, vegetative and sexual reproduction and alternation of generation of the following types (Developmental details are not required).

3. *Riccia, Funaria*

4. Economic Importance of Bryophytes.

#### Practical

6 hrs

1. *Riccia*– Habit - Internal structure of thallus – V. S. of thallus through archegonia, antheridia and sporophyte

2. *Funaria*– Habit, V. S. of archegonial cluster, V.S. of antheridial cluster, Sporophyte V.S.

**Archegoniatae II - Pteridophyta** **6 hrs**

1. Introduction: General characters morphological and phylogenetic classification.
2. Study of the habitat, habit, internal structure, reproduction and life cycle of the following types (Developmental details not required). *Selaginella* and *Pteris*

**Practical** **6 hrs**

1. *Selaginella*: Habit, stem and rhizophore T. S., V.S. of strobilus, Megasporophyll and microsporophyll.
2. *Pteris*- Habit, Rhizome and petiole T. S., sporophyll T.S

**MODULE-V**

**Archegoniatae III - Gymnosperms** **3 hrs**

1. Introduction and classification of gymnosperms.
2. Study of the Habit, Anatomy, Reproduction and life cycle of *-Pinus* (Developmental details are not required)

**Practical** **4 hrs**

*Pinus*- Branch of indefinite growth, spur shoot, T. S of old stem and needle, male and female cone, V.S. of male and female cone.

**REFERENCES**

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## SEMESTER-III

### SYSTEMATIC BOTANY, ECONOMIC BOTANY, ETHNO BOTANY, PLANT BREEDING

Course code :BO 1331      Number of credits : 3

Number of contact hours: (Lecture 54& Practical 36) Total-90 hrs

Distribution of Hours	Theory	Practical
Systematic Botany	33hrs	32 hrs
Economic botany	08hrs	04 hrs
Ethnobotany	02hrs	00 hrs
Plant Breeding	11hrs	00 hrs
<b>Total</b>	<b>54 hrs</b>	<b>36 hrs</b>

**Aim of the course:** To understand classification, identification and ethnobotanical importance of angiosperms along with plant breeding techniques.

#### Objectives:

- To introduce importance of morphological characters in classification and plant identification.
- To develop skill in identification of plants.
- To acquire knowledge about economic, ethnobotanical significance and pharmacognosy of plants
- To get knowledge about plant breeding techniques

#### MODULE- I

##### Systematic Botany

11 hrs

1. Floral morphology: Parts of a flower, types of inflorescence – Cymose (Simple, monochasial & Dichasial), Racemose- (Simple raceme, Corymb, Spike, Head), Special type- Cyathium (Brief account only) aestivation and placentation, Types of Fruits - Simple fruits - dry (Pea), Fleshy (Mango), Aggregate fruits (*Polyalthia*), Multiple fruits (Jack fruit) - Floral diagram and Floral formula.

2. Definition, scope and significance of Taxonomy.

3. Systems of classification:

a. Artificial

b. Natural - Bentham and Hooker (detailed account)

c. Phylogenetic

4. Basic rules of Binomial Nomenclature. Definition and importance of Herbarium.



**MODULE-II****22 hrs**

A study of the following families with emphasis on the morphological peculiarities and economic importance of its members. (Based on Bentham and Hooker's System)

- |                |                   |
|----------------|-------------------|
| 1) Annonaceae  | 7) Apocynaceae    |
| 2) Malvaceae   | 8) Solanaceae     |
| 3) Rutaceae    | 9) Verbenaceae    |
| 4) Leguminosae | 10) Euphorbiaceae |
| 5) Rubiaceae   | 11) Liliaceae     |
| 6) Asteraceae  | 12) Poaceae       |

**Practical /fieldwork****32 hrs**

1. Students must be able to identify the angiosperm members included in the syllabus. Draw labeled diagram of the habit, floral parts, L.S of flower, T.S of ovary, floral diagram, floral formula and describe the salient features of the member in technical terms.
2. Students must submit the practical records at the time of practical examination.

**MODULE-III****Economic Botany****8 hrs**

Study of the Botanical name, Family, Morphology of useful parts, and utility of the following;

- Cereals and Millets – Paddy and Ragi
- Legumes - Ground nut, Blackgram.
- Sugar yielding plants -Sugarcane.
- Spices & condiments - Cumin, Clove, Cardamom and Pepper
- Fibre -Cotton
- Dyes -Henna
- Resins -Asafoetida.
- Tuber crops - Tapioca, Colocasia.
- Tropical Fruits - Banana, JackFruit.
- Oil yielding - Sesame oil, Coconut.
- Medicinal plants - *Ocimum* ,*Adhatoda* ,*Sida*,Turmeric.

**Practical****4 hrs**

Identify the economic products obtained from the plants mentioned under Economic Botany.

**MODULE-1V****Ethnobotany****2 hrs**

1. Study of common plants used by tribes-Neem, *Trichopuszeylanicus*

## **MODULE-V**

### **Plant Breeding**

**11 hrs**

1. Introduction, objectives in plant breeding.
2. Plant introduction - Agencies of plant introduction in India, Procedure of introduction - Acclimatization - Achievements.
3. Selection - mass selection, pure line selection and clonal selection.
4. Procedure of hybridization, inter generic, inter specific, inter varietal hybridization with examples. Composite and synthetic varieties.
5. Heterosis and its exploitation in plant breeding.
6. Polyploidy breeding (brief account).
7. Breeding for disease resistance (brief account).
8. Mutation breeding (brief account).

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## SEMESTER-IV

### PLANT PHYSIOLOGY, PLANT ECOLOGY, HORTICULTURE AND PLANT BIOTECHNOLOGY

Course Code : 1431 Number of credits : 3

Number of contact hours: 54 hrs (Lecture); 36 hrs (Practical) Total-90 hrs

Distribution of Hours	Theory	Practical
Plant Physiology	30hrs	15hrs
Plant Ecology	08hrs	13hrs
Horticulture	06hrs	02hrs
Plant Biotechnology	10hrs	06hrs
<b>Total</b>	<b>54 hrs</b>	<b>36 hrs</b>

**Aim of the course:** To create awareness about physiological aspects of growth & metabolism along with knowledge about Ecology, horticulture and Biotechnology

#### Objectives:

- To understand physiology of absorption, photosynthesis and respiration.
- To study ecosystem and ecological modifications
- To generate awareness about horticultural techniques.
- To familiarize plant tissue culture techniques

#### MODULE-I

##### Plant Physiology

10 hrs

1. General introduction :physiological processes, their significance and applications.
2. Water relations of plants: Importance of water to plant life.
  - a. Absorption of water- organs of absorption, root and root hair. Physical aspects of absorption- imbibition, diffusion and osmosis. Plant cell as an osmotic system; water potential and osmotic potential. Plasmolysis and its significance, practical applications. Mechanism of water absorption – active and passive absorption, root pressure. Pathway of water across root cells.
  - b. Ascent of sap- vital and physical theories.
  - c. Loss of water from plants: transpiration - cuticular, lenticular and stomatal mechanism - theories – starch sugar hypothesis, potassium - ion theory. Significance of transpiration - guttation, anti - transpirants, factors affecting transpiration.
3. Mineral nutrition: macro and micro elements, role of essential elements and their deficiency symptoms. Mechanism of mineral absorption (a) passive absorption- ion exchange and Donnan equilibrium (b) active absorption- carrier concept.

**MODULE-II****10 hrs**

1. Photosynthesis: Introduction, significance and general equation. Photosynthetic apparatus, structure and function of chloroplast, quantasomes - solar spectrum and its importance - Fluorescence and Two pigment systems- raw material for photosynthesis- Mechanism of photosynthesis- Light reaction - cyclic and non cyclic photophosphorylation. Hill reaction - Dark reaction: Calvin cycle. Comparative study of C3, C4, and CAM plants. Photorespiration
2. Factors affecting photosynthesis - Law of limiting factors.

**MODULE-III****10 hrs**

1. Respiration: Introduction, definition and significance and general equation. Respiratory substances, types of respiration- aerobic and anaerobic. Aerobic respiration - glycolysis, Krebs's cycle, terminal oxidation. Anaerobic respiration – fermentation: alcoholic and lactic acid fermentation. Energy relation of respiration
2. R .Q and its significance – Factors affecting respiration.
3. Translocation of solutes: Path way of movement, phloem transport, mechanism of transport - Munch hypothesis, protoplasmic streaming theory - activated diffusion hypothesis, electro osmotic theory.
4. Growth: Phases of growth - vegetative and reproductive growth - growth curve – plant growth regulators - Auxins, Gibberellins, Cytokinins, Ethylene, Abscisic acid  
– synthetic plant hormones - practical applications. Senescence and abscission. Photoperiodism.

**Practical****15 hrs**

1. Water potential of onion peel / *Rhoeo* peel by plasmolytic method
2. Papaya petiole osmoscope.
3. Determination of water absorption and transpiration ratio.
4. Measurement of rate of transpiration using Ganong's potometer or Farmer's potometer.
5. Evolution of oxygen during photosynthesis.
6. Evolution of CO<sub>2</sub> during respiration.
7. Ganong's respirometer and measurement of R.Q.
8. Alcoholic fermentation using Kuhne's fermentation vessel.
9. Measurement of growth using Arc auxanometer.

**MODULE-IV****Plant Ecology****8 hrs**

1. Definition-Scope and relevance to society and human environment. Need for public awareness
2. Ecosystems-Concept of an ecosystem- structure and function of an ecosystem-
3. Biotic and abiotic components- Energy flow in an ecosystem.
4. Ecological succession-Definition- primary, secondary- hydrosere.
5. Food chains -Food web & ecological Pyramids.
6. Introduction- types, characteristic features, structure and functions of the following ecosystems.

A . 1. Forest ecosystem 2. Grass land ecosystem 3. Desert ecosystem 4 . Aquatic ecosystems - Ponds, Estuaries.

B. Morphological, anatomical & physiological adaptations of – Hydrophytes, Xerophytes, Halophytes, Epiphytes, Parasites.

**Practical** **13 hrs**

1. Study of ecological and anatomical modifications of Xerophytes, Hydrophytes, Halophytes, Epiphytes and Parasites.
2. Observation and study of different ecosystems mentioned in the syllabus.

## **MODULE-V**

**Horticulture** **6 hrs**

1. Introduction to Horticulture
2. Garden tools and implements - Lawn mower, hand trowel, nursery spade, spade fork, garden hoe, weeder, tillers
3. Methods of vegetative propagation: Cutting, grafting, budding, layering, special methods of propagation,
4. propagation by seeds.
5. Media for propagation of plants — soil, sand, peat, sphagnum moss, vermiculture, soil mixture,
6. Nursery beds
7. Manures – organic and inorganic

**Practical** **2 hrs**

1. Methods of vegetative propagation: Cutting, grafting, budding, layering, special methods of propagation - propagation by seeds.

## **MODULE - VI**

**Biotechnology** **10 hrs**

1. Introduction – History – major achievements – Biotechnology in India
2. Plant Tissue culture - Culture media; composition, preparation and sterilization – Totipotency: definition and importance - Dedifferentiation and redifferentiation – Callus and suspension culture, meristem culture - Somatic embryogenesis, Anther culture and production of haploids.

**Practical** **6 hrs**

1. Preparation of media, sterilization, inoculation and callus induction (Demonstration only).

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**MODEL QUESTION PAPER**

**FIRST SEMESTER B. SC. DEGREE (CBCSS) EXAMINATION**

**Complementary Botany for Zoology, Home Science and Biochemistry**

**BO1131- Microtechnique, Angiosperm Anatomy and Reproductive Botany**

**(2019 Admission Onwards)**

**Time : 3 Hours**

**Max.Marks : 80**

(Draw Diagrams wherever necessary)

**Section- A**

I. Answer **all** Questions, **each** carries **one** mark.

1. Name a killing and Fixing fluid
2. What are Tyloses?
3. What is middle lamella?
4. Define exarch condition
5. What is Dendrochronology?
6. Comment on closed vascular bundle
7. Write a note on Orthotropous ovule
8. What is Coleoptile?
9. What is palynology?
10. Name a complex tissue

**(10x1 = 10 marks)**

**Section –B**

II. Answer any **eight** of the following. **Each** carry **two** marks.

11. Comment on FAA
12. What is Histogen Theory
13. What are Annual rings
14. Explain Lenticels and their function
15. Give an account of laticiferous tissue
16. Write a note on Tapetum
17. Distinguish between endothecium and endothelium
18. Write down the structure of monocot embryo
19. Draw a labelled diagram of a bicollateral vascular bundle
20. Describe mesophyll tissue
21. What is double fertilization?
22. Describe glandular tissue

**(8x2=16 marks)**

**Section –C**

III. Answer any **six** of the following not more than 120 words. **Each** carry **four** marks.

23. Describe with labelled diagram the structure of Dicot leaf
24. Explain the salient features of periderm.
25. Distinguish between monocot and dicot root
26. Describe phloem and its function
27. Describe microsporogenesis
28. Describe different types of endosperm
29. Write an account heartwood and sapwood
30. Describe anomalous secondary thickening in *Boerhaavia* stem
31. Explain Hydathodes and the phenomenon of guttation **(6x4=24 marks)**

#### **Section –D**

IV. Write an essay on **any two** of the following, **each** carry **15** marks.

32. Explain meristematic tissues and various theories of apical organization of stem
33. Give an account of normal secondary thickening in a dicot stem with labelled diagrams
34. Describe megasporogenesis and development and structure of *Polygonum* type of embryo sac
35. Write an essay on permanent tissues with suitable diagrams **(2X15=30)**



**MODEL QUESTION PAPER**  
**SECOND SEMESTER B. SC. DEGREE (CBCSS) EXAMINATION**  
**Complementary Botany for Zoology, Home Science and Biochemistry**  
**BO1231- Thallophytes, Archegoniatae and Plant pathology**  
**(2019 Admission Onwards)**

**Time : 3 Hours**

**Max.Marks : 80**

(Draw Diagrams wherever necessary)

**Section- A**

I. Answer **all** Questions, **each** carries **one** mark.

1. Pigment which give red colour to Rhodophyceae.
2. Name a unicellular algae.
3. Reserve food material of Phaeophyceae.
4. Name the Causative organism of Quick Wilt of Rubber.
5. Name a coprophilous Fungus.
6. What is Peristome?
7. Write a note on Cup Fungi.
8. Give an example for fungicide.
9. What is Yellow Shower?
10. Give an example for heterosporouspteridophyte. **(10x1=10 marks)**

**Section –B**

II. Answer any **eight** of the following.**Each** carry **two** marks.

11. Why the endosperm of *Pinus* is haploid?
12. What are Pyrenoids?
13. Structure of the thallus of *Rhizopus*.
14. Write any two economic importance of Lichens.
15. Write short note on heteroecious fungus.
16. Explain Polyembryony
17. Write about any two root characters shown by Rhizophore of *Selaginella*.
18. Describe the receptacle in *Sagassum*.

19. Describe the mode of reproduction in *Chlorella*.
20. Write the difference between teleutospores and uredospores.
21. What are dwarf shoots?
22. What is alternation of generation?

(8x2=16 marks)

### Section –C

III. Answer any **six** of the following not more than 120 words. **Each** carry **four** marks.

23. Describe with labelled diagram the structure of sporophyte of *Funaria*.
24. Explain the salient features of Phaeophyceae.
25. Explain the parts of globule and nucule of *Chara*.
26. Describe the different types of pigments in Algae.
27. Write the ecological and economic importance of *Usnea*.
28. Describe the reproduction in *Pteris*.
29. Write an account on the reproduction in *Oedogonium*.
30. Write the causative organism, symptoms and control measures of Powdery Mildew of Rubber.
31. Explain the xerophytic adaptations found in the anatomy of *Pinus* needle.

(6x4=24)

### Section –D

Write an essay on **any two** of the following, **each** carry **15** marks.

32. Explain with diagrams the structure, reproduction and life cycle of *Polysiphonia*.
33. Give an account of different stages of life cycle of *Puccinia* with suitable Diagrams.
34. Describe the vegetative, sexual reproduction and alternation of generation in *Riccia*.
32. Write an essay on the reproduction and life cycle of *Selaginella*.

(2x15=30)

**MODEL QUESTION PAPER**

**THIRD SEMESTER B. SC. DEGREE (CBCSS) EXAMINATION**

**Complementary Botany for Zoology, Home Science and Biochemistry**

**BO 1331 : SYSTEMATIC BOTANY, ECONOMIC BOTANY, ETHNOBOTANY,  
PLANT BREEDING**

**(2019 Admission Onwards)**

**Time. 3 Hrs**

**Total Marks: 80**

*(Draw diagrams wherever necessary)*

**SECTION –A**

**I. Answer all** questions in one word or two sentences; Each question carries **one** mark.

1. What is the characteristic fruit of the family Rutaceae?
2. Give the binomial for Clove.
3. Write the floral formula of Annonaceae.
4. Define syngenesious stamen.
5. What is heterosis?
6. Give the binomial of “*Arogyapacha*”?
7. Write the morphology of useful part of Asafoetida.
8. Name the typical inflorescence of the family Euphorbiaceae.
9. Define plant introduction.
10. Give the binomial for Sugarcane.

**(1×10=10 marks)**

**SECTION B**

**II. Answer any eight** of the following :Each question carries **two** marks

11. Write down the binomial of any two tropical fruits.
12. What is emasculation? Briefly describe the procedure.
13. Write an account on breeding for disease resistance.
14. Give the binomial of any two oil yielding plants.
15. Differentiate between monadelphous and diadelphous stamen.
16. Briefly explain natural system of classification.
17. Explain descendingly imbricate aestivation.

18. What is acclimatization?
19. Give the binomial of any two medicinally important plants you have studied.
20. Give examples for two economically importance plants in Solanaceae.
21. Write down the basic rules for binomial nomenclature.
22. Briefly explain phylogenetic system of classification.

**(8×2=16 marks)**

### **SECTION C**

**III.** Answer **any six** of the following .Each question carries **four**marks

23. Describe the floral characteristic of the family Asteraceae.
24. What are the different types of placentation?
25. Write down the significance of herbarium.
26. What are the primitive characters of the family Annonaceae?
27. Write down the polyploidy method adopted for the genetic improvement of crops?
28. What are the principles of mass selection?
29. Why Poaceae is considered as an advanced family among Monocots?
30. Write down the binomial, family and morphology of useful part of any four spices you have studied.
31. Explain mutation breeding. Mention its achievements.

**(6×4=24 marks)**

### **SECTION D**

**IV.** Write an essay on **any two** of the following .Each question carries **fifteen**marks

32. Explain Bentham and Hooker's system of Classification. Write down the merits and demerits.
33. Briefly explain the various types of inflorescence you have studied.
34. Compare and contrast the vegetative and floral characters of the various sub families under Leguminosae.
35. What is hybridization? What are the different techniques employed in the production of hybrids? Explain different types of hybridizations.

**(2×15=30 marks)**

**MODEL QUESTION PAPER**  
**FOURTH SEMESTER B. SC. DEGREE (CBCSS) EXAMINATION**  
**Complementary Botany for Zoology, Home Science and Biochemistry**  
**BO 1431: PLANT PHYSIOLOGY, PLANT ECOLOGY, HORTICULTURE**  
**AND PLANT BIOTECHNOLOGY**  
**(2019 Admission Onwards)**

Time : 3 hours

Max. Marks. 80

*(Instruction: draw diagrams wherever necessary.)*

**SECTION – A**

**I.** Answer **all questions** in one word or one sentence. Each question carries **one Mark**.

1. Define Totipotency
2. What is Imbibition?
3. What is R.Q.?
4. Which are 'turgor operated valves' in plants ?
5. Name any two antitranspirants
6. Which are primary macro nutrients?
7. What is Redifferentiation?
8. Expand RuBP
9. What are Lithophiloushalophytes ?
10. What are drought escaping plants? **(10x1=10 Marks)**

**SECTION – B**

**II.** Answer **any eight** questions, not to exceed a paragraph. Each question carries **two** marks.

11. What is substrate level phosphorylation ? Give an example.
12. Write a note on plasmolysis.
13. Distinguish between apoplastic and symplastic pathways.
14. Comment on cohesion and adhesion properties of water.
15. What is Guttation?
16. Mention symptoms of deficiency due to phosphorus.
17. In a non-turgid cell  $DPD = OP - WP$ , explain.
18. How wind influence stomatal transpiration?
19. Write four major differences between respiration and photopiration.
20. Write about organic fertilizers.

21. Write a note on physiological effects of cytokinin.

22. Define food chain.

**(8x2=16 Marks)**

### **SECTION – C**

**III.** Answer **any six** questions, not to exceed 120 words. Each question carries **four** marks.

23. Explain the different phases of growth.

24. How plant cell act as an osmotic system?

25. Explain the structure of chloroplast with diagram.

26. Explain Red drop and Emerson's enhancement effect.

27. Write is note on water potential and its components.

28. What is grafting? Explain approach and wedge grafting.

29. What are different types of ecological pyramids?

30. Explain the role of Phytochrome in flowering.

31. Explain cyclic photophosphorylation with illustration

**(6x4=24 Marks)**

### **SECTION – D**

**IV.** Write essay on **any two** of the following, not more than three pages. Each question carries **15** marks.

32. Explain C3 pathway and briefly explain how it differs from C4 pathway?

33. Define callus and how it is produced? Explain somatic embyogenesis

34. What is ecological succession? Describe kinds of succession and mechanisms of succession.

35. Explain Krebs cycle and write a brief note on its significance.

**(2x15=30 Marks)**

## MODEL QUESTION PAPER

### B. Sc. Degree Programme (CBCSS) Practical Examination

#### Botany Complementary Practical -Course Code: BO1432

1. Make suitable micropreparation of **A**, identify giving reasons and describe its structure with the help of labelled diagram. Leave the preparation for valuation.

(Preparation-2, Labelled Diagram-2, Reasons-3, Identification-1)(**8 Marks**)

2. Refer the specimen **B** to its family giving reasons. **(8 Marks)**

(Identification-1, Reasons upto series-2, Description of plant in technical terms -2, Family characters-2)

3. Make micropreparations of **C** and **D**. Stain and mount in glycerine and leave the preparation for valuation. Draw a cellular diagram and identify giving reasons.

(Preparation-2, Labelled Diagram-1, Identification-1, Reasons-2) **(2 x 6 =12 Marks)**

4. Make a suitable micropreparation of **E**. Identify the ecological group and write the anatomical adaptations. **(5 Marks)**

(Ecological group-1, Morphological Adaptations-2, Anatomical Adaptations-2 )

5. Identify and draw labelled diagram of **F** **(3 Marks)**  
(Identification-1, Labelled diagram- 2)

6. Identify the disease **G** and name the causative organism. **(2 Marks)**  
(Disease-1, Causative organism-1)

7. With the help of a labelled diagram explain the aim and working of the experiment **H**.  
(Aim-1, Labelled Diagram-1, Working-2) **(4 Marks)**

8. Identify and write notes on **I** **(3 Marks)**  
(Identification-1, Notes-2)

9. Spot at sight specimens, **J, K** and **L** **(3 x 3 = 9 Marks)**

(Major group 1, Genus-1, Part of the plant-1)

10. Write the binomial, family and morphology of the useful part of **M** and **N**

(Binomial 1, Family-1, Morphology-1) **(3x2=6 Marks)**

**Record -20 marks (Content-15, Neatness-5)**

## KEY TO SPECIMENS

- A Anatomy - Primary Root/Stem  
Normal Secondary Dicot stem/Root (*Vernonia/Papaya*)/Aerial Root  
(*Ficus/Tinospora*) Anomalous Secondary Dicot Stem (*Boerhaavia*)
- B Taxonomy
- C Thallophyta/Bryophyta
- D Pteridophyta/Gymnosperm
- E Ecology-Hydrophyte/Xerophyte/Epiphyte
- F Embryology
- G Plant Pathology
- H Plant Physiology
- I Stains/Fixatives
- J Thallophyta
- K Bryophyta/Pteridophyta
- L Gymnosperms
- M Economic Botany
- N Economic Botany