

MAR IVANIOS COLLEGE (AUTONOMOUS)
Affiliated to the
University of Kerala



SYLLABI & GUIDELINES
FIRST DEGREE PROGRAMME IN BOTANY (FDP)

CHOICE BASED-CREDIT & SEMESTER- SYSTEM (CBCS)

(2015 admission onwards)

BOTANY (CORE)

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 equipment along with the collection and interpretation of scientific data to contribute the 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 in 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.
- To create the interest of the society in the subject and scientific hobbies, exhibitions and other similar activities.
- 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

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

Semester No.	Course Code	Course Title	Instructional hours/week		Credits	End Semester Exam Duration	Evaluation		Total credits
			T	P			CE	ESE	
I	AUEN111.2	English Language I	5	-	4	3hrs	20%	80%	16
	AUFR111.2	Additional Language I	4	-	3	„			
	AUHN111.2								
	AUML111.2								
	AUSY111.2								
	AUTM111.2								
	AUEN121.2	Foundation Course I	4	-	2	„			
AUBO141	Core Course I	2	2	3	„				
	Angiosperm anatomy								
	Reproductive Botany & Palynology								
	AUCH131.2a	Compl. Course I(CH)	2	2	2	„			
	AUZO131.2a	Complementary Course II(ZO)	2	2	2	„			
II	AUEN 211.2	English Language II	5	-	4	„	20%	80%	20
	AUEN212.2	English Language III	4	-	3	„			
	AUFR211.2	Additional Language II	4	-	3	„			
	AUHN211.2								
	AUML211.2								
	AUSY211.2								
	AUTM211.2								
	AUBO221	Foundation Course II	2	2	3	„			
	AUBO24PI	Core (Practical-1) II	-	(4)*	3	„			
AUCH231.2a	Compl. Course III(CH)	2	2	2	„				
AUZO231.2a	Complementary Course IV(ZO)	2	2	2	„				
III	AUEN 311.2	English Language IV	5	-	4	„	20%	80%	17
	AUFR311.2	Additional Language III	5	-	4	„			
	AUHN311.2								
	AUML311.2								
	AUSY311.2								
	AUTM311.2								
	AUBO 341	Core Course III	3	2	3	„			
AUCH331.2a	Compl. Course V(CH)	3	2	3	„				
AUZO331.2a	Complementary Course VI(ZO)	3	2	3	„				
IV	AUEN 411.2	English Language V	5	--	4	„	20%	80%	25
	AUFR411.2	Additional Language IV	5	-	4	„			
	AUHN411.2								
	AUML411.2								
	AUSY411.2								
	AUTM411.2								
	AUBO 441	Core Course IV	3	2	3	„			
	AUCH 431.2a	Compl.CourseVII(CH)	3	2	3	„			
	AUZO 431.2a	Complementary courseVIII(ZO)	3	2	3	„			
	AUCH43.2a PI	Compl IX (Practical CH)	-	(8)*	4	„			
AUZO43.2a PI	Compl X (Practical ZO)	-	(8)*	4	„				

V	AUBO 541	Core Course V	4	3	4	”	20%	80%	17
	AUBO 542	Core Course VI	5	2	4	”			
	AUBO 543	Core Course VII	4	2	3	”			
	AUBO545PII	Core (Practical-2)VIII	-	(4)*	4	”			
	AUBO 581.a AUBO 581.b AUBO 581.c	Open Course I Forestry Horticulture Mushroom cultivation & Marketing Project	3 - -	- 2	2 -	”			
VI	AUBO641	Core CourseIX	5	2	4	”	20%	80%	25
	AUBO642	Core Course X	4	2	4	”			
	AUBO643	Core Course XI	4	2	4	”			
	AUBO64PIII	Core (Practical-3)XII	-	(5)*	3	”			
	AUBO64PIV	Core (Practical-4)XIII	-	(8)*	4	”			
	AUBO691	Elective Course I	3	-	2	”			
	AUBO 644	Project	-	3	4	-			
									120

L = Lecture P = Practical ()*Practical hour already distributed in the semester concerned CE-Continuous evaluation ESE- End semester examination

Table 2. SEMESTER - I

Course Code	Course Title	Instructional hours/week		Credits	ESE Duration	Weightage		Total credits
		T	P			CE	ESE	
AUEN111.2	English Language I	5	-	4	3hrs	1	4	16
AUFR111.2	Additional LanguageI	4	-	3	”			
AUHN111.2								
AUML111.2								
AUSY111.2								
AUTM111.2								
AUEN121.2	Foundation Course I	4	-	2	”			
AUBO141	Core Course I	2	2	3	”			
AUCH131.2a	Compl. courseI(CH)	2	2	2	”			
AUZO131.2a	Complementary Course II(ZO)	2	2	2	”			

Table 3. SEMESTER - II

Course Code	Course Title	Instructional hours/week		Credits	ESE Duration	Weightage		Total credits
		T	P			CE	ESE	
AUEN 211.2	English Language II	5	-	4	3hrs	1	4	17
AUEN212.2	English Language III	4	-	3	”			
AUFR211.2	Additional Language II	4	-	3	”			
AUHN211.2								
AUML211.2								
AUSY211.2								
AUTM211.2								
AUBO221	Foundation Course II	2	2	3	”			
AUBO24PI	Core (Practical-1) (AUBO 141, AUBO221)	-	(4)*	3	”			
AUCH 231.2a	Compl. Course III(CH)	2	2	2	”			
AUZO231.2a	Complementary Course IV(ZO)	2	2	2	”			

Table 4. SEMESTER - III

Course Code	Course Title	Instructional hours/week		Credits	ESE Duration	Weightage		Total credits
		T	P			CE	ESE	
AUEN 311.2	English Language IV	5	-	4	3hrs	1	4	17
AUFR311.2	Additional Language III	5	-	4	”			
AUHN311.2								
AUML311.2								
AUSY311.2								
AUTM311.2								
AUBO 341	Core Course III	3	2	3	”			
AUCH331.2a	Compl. Course V(CH)	3	2	3	”			
AUZO331.2a	Complementary Course VI(ZO)	3	2	3	”			

Table 5. SEMESTER -IV

Course Code	Course Title	Instructional hours/week		Credits	ESE Duration	Weightage		Total credits
		T	P			CE	ESE	
AUEN 411.2	English Language V	5	--	4	3hrs	1	4	25
AUFR411.2	Additional Language IV	5	-	4	”			
AUHN411.2								
AUML411.2								
AUSY411.2								
AUTM411.2								
AUBO 441	Core Course IV	3	2	3	”			
AUCH 431.2a	Compl.CourseVII(CH)	3	2	3	”			
AUZO 431.2a	Complementary courseVIII(ZO)	3	2	3	”			
AUCH43.2a PI	Compl IX (Practical CH)	-	(8)*	4	”			
AUZO43 .2aPI	Compl X (Practical ZO)	-	(8)*	4	”			

Table 6. SEMESTER - V

Course Code	Course Title	Instructional hours/week		Credits	ESE Duration	Weightage		Total credits
		T	P			CE	ESE	
AUBO 541	Core Course IV -Angiosperm Morphology, Systematic botany, Economic botany, Ethno botany & Pharmacognosy	4	3		3hrs	1	4	20
AUBO 542	Core Course V- Environmental Studies & Phytogeography	5	2	4	”			
AUBO 543	Core Course VI- Cell Biology, Genetics & Evolutionary Biology	4	2	4	”			
AUBO545PII	Core (Practical-2)VIII (AUBO 341 &AUBO441)		(4)*	3	”			
AUBO 581.a	Open Course I Horticulture	-	-		”			
AUBO 581.b	Mushroom cultivation & Marketing	-	2	4	”			
AUBO 581.c	Forestry							
	Project	-	3	-				

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Table 7. SEMESTER - VI

Course Code	Course Title	Instructional hours/week		Credits	ESE duration	Weightage		Total credits
		T	P			CE	ESE	
AUBO641	Core Course IX Plant physiology & Biochemistry	4	3	4	3hrs			25
AUBO642	Core Course X- Molecular Biology, General informatics and Bioinformatics	4	2	4	”			
AUBO643	Core Course XI- Plant breeding, Horticulture & Research methodology	4	2	4	,			
AUBO64PIII	Core (Practical-3)XII (BO1541 & BO1542)	-	(5)*	3	”	1	4	
AUBO64PIV	Core (Practical-4)XIII IV (AUBO543, AUBO641, AUBO642, AUBO643)	-	(8)*	4	”			
AUBO691	Elective Course I- Biotechnology & Nano biotechnology	3	-	2	”			
AUBO646	Project & Viva-voce	-	3	4				

**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		credit	Contact hours		credit	Contact hours		credit	Contact hours		credit	Contact hours		credit	Contact hours		credit	Contact hours	Credit
		T	P		T	P		T	P		T	P		T	P		T	P			
AUBO141	Angiosperm anatomy Reproductive Botany & Palynology	2	2	3															4	3	
AUBO221	Methodology & Perspectives in Plant Science				2	2	3												4	3	
AUBO24PI	Practical-I (AUBO141, AUBO221)		2*		2*															3	
AUBO341	Microbiology, Phycology, Mycology Lichenology & Plant Pathology							3	2	3									5	3	
AUBO441	Bryology, Pteridology, Gymnosperms &Paleobotany										3	2	3						5	3	
AUBO541	Angiosperm Morphology Systematic botany, Economic botany Ethno botany & Pharmacognosy													4	3	4			7	4	
AUBO542	Environmental Studies & Phytogeography													5	2	4			7	4	
AUBO543	Cell Biology, Genetics & Evolutionary Biology													4	2	3			6	3	
AUBO54PII	Practical-II (AUBO341 & AUBO441)							*	2		*	2								4	
AUBO551. a AUBO 551. b AUBO 551.c	Forestry Horticulture Mushroom cultivation & Marketing													3					3	2	
AUBO641	Plant Physiology &Biochemistry																5	2	4	7	4
AUBO642	Molecular Biology, General informatics and Bioinformatics																4	2	4	6	4
AUBO643	Plant breeding, Horticulture& Research methodology																4	2	4	6	4
AUBO64PIII	Practical-III (AUBO 541 & AUBO542)													5*						3	
AUBO64PIV	Practical-IV (AUBO 543, AUBO 641,AUBO 642, AU643)																8	*		4	

AUBO691	Elective-I Biotechnology & Nano biotechnology																	3				3	2	
AUBO 644	Project report Viva-Voce																	2				3	5	4
	Total																							57

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, Elective & Project

Semester	Course Code	Course Title	Marks		Duration of ESE.
			ESE	CE	
I	AUBO141	Angiosperm anatomy Reproductive Botany & Palynology	80	20	3 hrs
II	AUBO221	Methodology & Perspectives in Plant Science	80	20	3 hrs
	AUBO24PI	Practical-I(AUBO141, AUBO221)	80	20	3 hrs
III	AUBO341	Microbiology, Phycology, Mycology Lichenology & Plant Pathology	80	20	3 hrs
IV	AUBO441	Bryology, Pteridology, Gymnosperms & Paleobotany	80	20	3 hrs
V	AUBO541	Angiosperm Morphology Systematic botany, Economic botany Ethno botany & Pharmacognosy	80	20	3 hrs
	AUBO542	Environmental Studies & Phytogeography	80	20	3 hrs
	AUBO543	Cell biology, Genetics & Evolutionary Biology	80	20	3 hrs
	AUBO54PII	Practical-II (AUBO341 & AUBO441)	80	20	3 hrs
	AUBO551. a AUBO551.b AUBO551.c	Forestry Horticulture Mushroom cultivation & Marketting	80	20	3 hrs
VI	AUBO641	Plant Physiology & Biochemistry	80	20	3 hrs
	AUBO642	Molecular Biology, General informatics and Bioinformatics	80	20	3 hrs
	AUBO643	Plant breeding, Horticulture & Research methodology	80	20	3 hrs
	AUBO64PIII	Practical-III (AUBO541 & AUBO542)	80	20	3 hrs
	AUBO 64PIV	Practical-IV (AUBO543, AUBO641, AUBO642, 643)	80	20	3 hrs
	BO 691	Elective I Biotechnology & Nano biotechnology	80	20	3 hrs

	BO644	Project report	80	-	-
		Viva-Voce	20	-	-

END SEMESTER EXAMINATION (ESE)

The Controller of Examinations of the College shall conduct the end semester examinations for all semesters. There will not be any supplementary exams. The practical examinations for **Core courses** shall be conducted after 1st, 5th and 6th semesters and **Complementary** courses at the end of 4th semester according to the common calendar and questions set up by the Controller of Examinations of the College. The Board of Examiners constituted by the Controller of Examinations will have the right to make necessary changes in the pattern of practical examination as and when needed.

Evaluation and Grading

The Evaluation of each Course shall consists of two parts

- 1) Continuous Evaluation (CE)
- 2) End Semester Evaluation (ESE)

The CE and ESE ratio shall be 1:4 for all the Courses with or without practical.

There shall be a maximum of 80 marks for ESE and maximum of 20 marks for CE.

For all Courses (Theory and Practical), Grades are given on a 7-point scale based on the total percentage of mark (CE+ESE) as given below.

Criteria for Grading

Percentage of marks	CCPA	Letter Grade
90 and above	9 and above	A+ Outstanding
80 to < 90	8 to <9	A Excellent
70 to <80	7to<8	B Very Good
60 to < 70	6to<7	C Good
50 to < 60	5to<6	D Satisfactory
40 to < 50	4to<5	E Adequate
Below 40	<4	F Failure

CONTINUOUS EVALUATION (CE)

There shall be maximum 20 marks for CE and are distributed as follows

Internal exam : Maximum marks 10

Attendance : Maximum marks 5

Assignments or Seminars: Maximum marks 5

Internal exam (Max. marks 10)

For each Course there shall be one internal exam during a semester. Valued answer scripts shall be made available to the students for perusal within 10 working days from the date of the test

Attendance (Max.marks 5):

The allotment of marks for attendance shall be as follows:

ATTENDANCE %	MARKS
Less than 75%	0 mark
75%	1 mark
76 to 80%	2 marks
81 to 85%	3 marks
86 to 90%	4 marks
Above 90%	5 marks

Assignments or Seminars: (Max. marks 5)

Each student shall be required to do one assignment or one seminar for each Course. Valued assignments shall be returned to the students. The seminars shall be organized by the teacher/teachers in charge of CE and the same shall be assessed by a group of teachers including the teacher/ teachers in charge of that Course. Assignments/Seminars shall be evaluated on the basis of their quality. The teacher shall define the expected quality of an assignment in terms of structure, content, presentation etc. and inform the same to the students. Due weight shall be given for punctuality in submission. Seminar shall be similarly evaluated in terms of structure, content, presentation, interaction etc.

QUESTION PAPER PATTERN**For all semesters**

Question Type	Total number of Questions	Number of Question to be answered	Marks for each Questions	Total Marks
Very short answer type(One word to Maximum of 2 sentences)	10	10	1	10
Short answer(Not to exceed	12	8	2	16

one paragraph)				
Short essay	9	6	4	24
Long essay	4	2	15	30
Total	35	26		80

ELIGIBILITY TO APPEAR FOR PRACTICAL EXAMINATION

Submission of the following

- Certified and bonafied practical record
- Certified herbarium sheets
- Certified field work
- Certified tour report
- Project report/Dissertation (certified and bonafied)

PROJECT

Project work/Dissertation is compulsory. It can be carried out either individually or by a group not exceeding 15 students. 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 40 pages) shall be prepared 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 10 pages)
10. Summary and Conclusion
11. References

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

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 day trips).
- A brief report of the trip has to be submitted

CORE COURSES

Semester	Course Code	Course Title	Contact hrs/week		credits
			L	P	
I	AUBO141	Angiosperm anatomy Reproductive Botany & Palynology	2	2	3
II	AUBO24PI	Practical-I (AUBO141, AUBO221)		4	3
III	AUBO341	Microbiology, Phycology, Mycology Lichenology & Plant Pathology	3	2	3
IV	AUBO441	Bryology, Pteridology, Gymnosperms & Paleobotany	3	2	3
V	AUBO541	Angiosperm Morphology Systematic botany, Economic botany Ethno botany & Pharmacognosy	4	3	4
	AUBO542	Environmental Studies & Phytogeography	5	2	4
	AUBO543	Cell Biology, Genetics & Evolutionary Biology	4	2	3
	AUBO64PII	Practical-II (AUBO341 & AUBO 441)		4	4
VI	AUBO641	Plant Physiology & Biochemistry	5	2	4
	AUBO642	Molecular Biology, General informatics and Bioinformatics	4	2	4
	AUBO643	Plant breeding, Horticulture & Research methodology	4	2	4

	AUBO644	Practical-III (AUBO541 & AUBO542)		5	3
	AUBO64PIV	Practical-IV (AUBO543, AUBO642, AUBO642 & AUBO643)		8	4

Semester I

ANGIOSPERM ANATOMY, REPRODUCTIVE BOTANY AND PALYNOLOGY

Course code : AUBO141

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	3hrs	-
Angiosperm Anatomy	21 hrs	27 hrs
Reproductive Botany & Palynology	12 hrs	09 hrs
Total	36 hrs	36 hrs

Introduction to Botany

MODULE – I

3hrs

1. Overview of plant Diversity, Vocabulary of biological terms.
2. History of botany –botanical achievements of various era, contribution of botanist with special reference to Indian scientist & professors ; Objective and scope of Botany-Botany as hobby (floriculture, dry flower arrangements,gardening,); Botany as ‘mother science’ - influence on other science fields ,medicine, arts, paintings, literary works-poetry, aesthetic values, philosophical approach, ecotourism,
(Excluded from examination view point)

Angiosperm Anatomy

MODULE-II

9hrs

3. Cell wall organization - Gross structure - Primary and secondary wall pits – plasmodesmata -microscopic and sub microscopic structures – Extra cell wall material. Non living inclusions of the cell – Reserve food - secretory products, by products.
4. Tissues – Meristems, Definition, Classification based on origin, position, growth patterns, functions.

- Apical meristems & theories on apical organization - Apical cell theory, Histogen theory, Tunica -Corpus theory. Organization of root apex in dicots & monocots.
5. Permanent tissues – Definition, classification - simple, complex and secretory.
 6. Tissue systems – Epidermal tissue systems-stomata, structure and functions, Ground tissue systems & vascular tissue systems. Different types of vascular arrangements

MODULE-III

8 hrs

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

Practical

27 hrs

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

MODULE- IV

Reproductive Botany &Palynology

14 hrs

1. Introduction to angiosperm embryology with special reference to Indian embryologists.
2. Micro sporogenesis - 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 - Fertilization - Barriers of fertilization - Germination of pollen grains – Double fertilization.
6. Structure of Embryo- Dicot [*Capsella*], Monocot [*Sagittaria*] & Endosperm types.
7. Palynology: Pollen structure, pollen morphology, pollen allergy, Economic and Taxonomic importance

Practical

9 hrs

Students should be familiar with the structure of anther and embryo. (Permanent slides can be used)

REFERENCES

1. Coutler E. G. (1969) Plant Anatomy – Part I Cells and Tissues – Edward Arnold, London.
2. Esau K. (1965) - Plant Anatomy – Wiley Eastern, New York.
3. Fahn A. (1985) - Plant Anatomy – Pergamon Press, Oxford.

4. Pandey, B .P. (1997) - Plant Anatomy - S.Chand and co. New Delhi Biology - McGraw Hill Co, New York.
5. Vashista .P. C (1984) - Plant Anatomy – Pradeep Publications – Jalandhar
6. Maheswari P. - Embryology of Angiosperms - Vikas Pub:
7. Nair PKK Palynology of Angiosperms
8. Stephen Webster , Thinking about biology, Cambridge university press.
9. Bhojwani S.S.,Bhatnagar S.P. ,Embryology of Angiosperms
10. Pijush Roy, Plant Anatomy. New Central Book Agency (P) Ltd. London.

Semester-II - Foundation course

METHODOLOGY AND PERSPECTIVES IN PLANT SCIENCES

Course code: AUBO221

Number of credits: 3

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

Distribution of Hours		Theory	Practical
MODULE-I	Scientific Studies	8 hrs	
MODULE- II	Data handling in science	12 hrs	16 hrs
MODULE-III	Microtechnique	6 hrs	8hrs
MODULE-IV	Biophysics	10 hrs	12hrs

Aim of the course: To introduce the methodology and perspectives of Science in general so 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 as a human enterprise
- To see how science works
- To apply scientific methods independently
- To interpret scientific data using basic statistical methods

MODULE-I Scientific Studies

8 hrs

1. Types of knowledge: practical, theoretical and scientific knowledge
2. Information: What is science; what is not science; laws of science; basis of scientific laws and factual truths.
3. Science as a human activity; scientific temper and empiricism, Science disciplines
4. Revolution in Science and Technology
5. Ethics in Science: Scientific information; depositories of scientific information, Primary, secondary and digital sources; sharing of knowledge; transparency and Honesty; danger of pre conceived ideas.
6. Methods and tools in science: Steps in scientific method. Null hypothesis and alternative hypothesis. Inductive and deductive reasoning.

MODULE- II Data handling in science-

12 hrs

1. Nature and types of data-typical examples, Data collection, Data presentation- Classification and tabulation, diagrammatic (bar, pie diagrams) and graphic presentation.
2. Samples and sampling techniques.

3. Statistical treatment of data: Statistical terms and symbols. Measures of central tendencies (mean, median, mode), Measures of dispersion (range, mean deviation, variance, standard deviation, coefficient of variation), Significance tests (chi-square test).
4. Data analysis – Normal frequency distribution and binomial distribution.

Practical-

16hrs

1. Workout problems on frequency distribution, measures of central tendencies (Mean, Median, Mode)
2. Workout problems on measures of dispersion. (range, mean deviation, variance, standard deviation, coefficient of variation)
3. Workout problems on chi-square test.

MODULE-II1

Microtechnique -

6 hrs

1. Introduction - microscopy - simple and compound – phase contrast; dark field illumination and electron microscopes (SEM and TEM).
2. Micrometry, camera lucida
3. Sectioning - hand and microtome– rotary and sledge
4. Killing and fixation agents – Carnoy’s formula, Farmers formula, F .A. A
5. Dehydration - reagents
6. Stains and staining techniques - double staining. General account; Stains: saffranin, hematoxylin, acetocarmine.
7. Mounting media: D. P. X and Canada balsam
8. Whole mounts - cytological methods: maceration, smear and squash preparation.

Practical

8 hrs

1. Familiarize stains, fixatives and mounting media
2. General awareness of Micro technique - maceration, smears & squash
3. Demonstration of microtome sectioning and hand sectioning
4. Measurement of specimens using micrometer (Demonstration only).
5. Photomicrography and camera lucida drawings (Demonstration only).

MODULE-IV

Biophysics

10 hrs

1. Principles and applications of Colorimeter, Spectrophotometer and Centrifuge.
2. Basic knowledge of the separation methods: - Chromatography, Electrophoresis.
3. Buffers -their functions in biological systems -Uses of buffers in biological research, pH meter.
4. Cryobiology – cryopreservation, freeze drying (lyophilisation) and its applications.

Practical

2 hrs

1. Preparation of buffer
2. Measurement of pH
3. Separation of plant pigments by paper chromatography/TLC.
4. Construct the absorption spectrum of any sample.

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CBS Publishers and Distributors Delhi
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India Pvt Ltd.
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India Pvt. Ltd
15. Rarnco - *Bio-Statistics – Saras Pub:*
16. T .K .Saha - *Bio-statistics – Theory & Practical - Emkay Pub:*
17. Richard Grey – *Hand book of microtechnique*-Mac Graw Hill Book company
18. Donald A. Johansen-*Plant Microtechnique*- Mac Graw Hill Book company
19. Prasad and Prasad (1972) *Out lines of Botanical Micro technique*, Emkay publishers, New
Delhi

Semester III

MICROBIOLOGY, PHYCOLOGY, MYCOLOGY, LICHENOLOGY AND PLANT PATHOLOGY

Course code: AUBO341

Number of credits: 3

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

Distribution of Hours	Theory	Practical
Microbiology	8 hrs	07 hrs
Phycology	20hrs	15 hrs
Mycology	20hrs	10 hrs
Plant Pathology	6 hrs	04 hrs
Total	54 hrs	36 hrs

MODULE-I

08 hrs

Microbiology

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.
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

7 hrs

1. Gram staining of bacteria.
2. Test for the Coli form 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

20 hrs

Phycology

1. Introduction – Range of thallus structure – Phylogenic trends – Pigments – Reproduction – Life cycle – Classification proposed by F .E Fritsch
2. 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*
3. Economic importance of algae
 - a. Commercial products of algae – Agar, Alginates, Carrageenin, Diatomaceous earth

b. Algae - medicinal aspects, algal blooms and red tides

Practical

15 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 labelled sketches of the specimens observed.

MODULE-III

20 hrs

Mycology

1. Introduction, structure, reproduction, life cycle, evolutionary trends, Classification based on Ainsworth.
2. Distinguishing characters of different classes of fungi representing the following genera (**Excluding**

Developmental details)

- a. Myxomycotina -General characters.
 - b. Zygomycotina - *Rhizopus*
 - c. Ascomycotina
 - Hemiascomycetes - *Saccharomyces*
 - Plectomycetes - *Penicillium*
 - Pyrenomycetes - *Xylaria*
 - Discomycetes – *Peziza*
 - d. Basidiomycotina
 - Teliomycetes - *Puccinia*
 - Hymenomycetes - *Agaricus*
 - e. Deuteromycotina - *Cercospora*.
3. Economic importance of Fungi

Lichenology: General account and economic importance; the structure, reproduction and life cycle of *Usnea*

Practicals

10 hrs

A detailed study of structure and reproductive structures of types given in the syllabus and submission of record. *Rhizopus, Saccharomyces, Penicillium, Xylaria, Peziza, Puccinia, Agaricus, Cercospora* and *Usnea*.

MODULE-IV

06 hrs

Plant Pathology

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

4 hrs

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.

REFERENCE

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2. Alain Durieux 2009, Applied Microbiology, Springer International Edition
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8. Alexopoulos C.J & MIMS C.V 1988. Introductory Mycology, John Wiley & Sons.
9. Jim Deacon 2007, Fungal Biology, 4th edition, Blackwell Publishing, Ane Books Pvt. Ltd.
10. Smith G.M 1955, Cryptogamic Botany, Vol.I McGraw Hill.
11. Vashishta B.R. 1990, Botany for Degree Students, Fungi, S.Chand & Co.
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13. Chapman V.J & Chapman D.J, The Algae, Macmillan.
14. Fritsch F. B 1945, Structure and Reproduction of Algae Vol.I & II. Cambridge University Press.
15. Smith G.M 1955, Cryptogamic Botany Vol.I, McGraw Hill
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18. Webster J 1970, Introduction to Fungi, Cambridge University Press.

Semester IV

BRYOLOGY, PTERIDOLOGY, GYMNOSPERMS AND PALAEOBOTANY

Course code : AUBO441

Number of Credits :3

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

Distribution of hours	Theory	Practical
Bryology	18hrs	9hrs
Pteridology	18hrs	16hrs
Gymnosperms	14hrs	10hrs
Paleobotany	4hrs	1hr
Total	54hrs	36hrs

MODULE-1

Bryology

18hrs

1. Introduction and classification- general account

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, Funaria

3 .Economic importance of Bryophytes

Practical

9 Hrs

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.*Funaria*- Habit V.S. of archegonial cluster, V.S of Antheridial cluster, Sporophyte V.S

MODULE -11

Pteridology

18hrs

1.Introducton: 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). *Psilotum*, *Selaginella*, *Pteris* and *Marselia*

3.General topics- Stellar evolution in Pteridophytes . Economic importance of Pteridophytes

Practical

16hrs

1.*Psilotum*; External features, Stem T.S., Synangium T.S

2.*Selaginella*; Habit , rhizophore , T.S stem, strobilus, V.S of strobilus, Megasporophyll and Microsporophylls

3.*Pteris* Habit , Rachis T.S Sporophyll T.S, Prothallus

4. *Marselia* Habit, Rhizome and Petiole T.S, Sporocarp T.S , V.S

MODULE-III

Gymnosperms

14hrs

1. Introduction –General characters and classification of Gymnosperms
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

10hrs

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

4hrs

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

Practical

1hr

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

REFERENCES

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2. Parihar N .S. – An introduction to Bryophyta - Central Book Depot. Alahabad
3. Vasishta B. R. - Bryophyta - S. Chand and Co. New Delhi
4. Coutler. J. M. - and Chamberlain C. J. (1958) – Morphology of Gymnosperms - Central Book Depot , Allahabad
5. Gupta V .K. and Varshneya U. D (1967) – An Introduction to Gymnosperms – Kedarnath, Ramnath – Meerut.
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Semester V

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

[Theory: 72 Hours. Practical: 54 Hours Total: 126 Hours]

Course code : AUBO541

Number of credits : 4

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

Distribution of Hours	Theory	Practical
Morphology	10 hrs	10 hrs
Systematic Botany	38 hrs	35 hrs
Economic Botany	12 hrs	06 hrs
Ethnobotany & Pharmacognosy	12 hrs	3 hrs
Total	72 hrs	54 hrs

MODULE-I

Morphology

10 hrs

Brief account on the various types of inflorescence including special types (Cyathium, Verticillaster, Hypanthodium, Coenanthium and Thyrsus) with examples; floral morphology-Flower-as a modified shoot, Flower parts, their arrangements, relative position, numeric- plan, cohesion, adhesion, symmetry of flower, aestivation types, placentation types; floral diagram and floral formula
Fruit types: simple, aggregate and multiple. Seeds: albuminous and exalbuminous .

MODULE-II

4 hrs

Systematic Botany

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

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

MODULE-III

4 hrs

Basic rules of Binomial Nomenclature and International Code of Botanical nomenclature (ICBN). Importance of Herbarium, Herbarium techniques and Botanical gardens. A brief account on the Modern trends in taxonomy; Chemotaxonomy and Molecular taxonomy

MODULE-IV

30 hrs

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

Practical

45 hrs

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.
3. Students must submit practical records, Herbarium sheets (25 Nos:) and Field book at the time of practical examination.
4. Field trips are to be conducted for three days either as continuous or one day trips.

MODULE-V

12 hrs

a) Economic botany

1. Study of the major crops in Kerala with special reference to their Botanical description, morphology of the useful part and economic importance— Coconut and Paddy.

Cereals and millets - Wheat and Ragi

Pulses - Black gram and Bengal gram

Sugar yielding Plants –Sugar cane

Spices - Pepper and Cardamom

Beverages -Coffee

Fibre yielding plant - Cotton

Dye Yielding plants - Henna and *Bixa orellana*

Resins - Asafoetida

Tuber crops - Tapioca

Oil yielding Plants - Sesame and Ground nut

Latex yielding plant-Rubber

Medicinal plants - *Sida*, *Zingiber officinalis*, *Aloe vera* and *Vinca rosea*

Insecticides - Neem

Practical

6 hrs

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

b) Ethnobotany

6 hrs

1. Definition — importance, scope, categories and significance.
2. Study of various methods to collect Ethno botanical data.
3. Plant parts used by tribes in their daily life as food, clothing, shelter, agriculture and medicine.

4. Study of common plants used by tribes. *Aegle marmelos*, *Ficus religiosa*, *Cynadon dactylon*, *Ocimum sanctum* and *Trichopus zeylanicus*

c) Pharmacognosy

6 hrs

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

Practical

3 hrs

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

REFERENCE

1. Sivarajan, V.V. Introduction to the principle of plant taxonomy, Oxford and IBH Publishing Company
2. Pandey SN and Misra SP, 2008 Taxonomy of Angiosperous; Ane Books Pvt. Ltd.
3. Verma V, 2009 Text Book of Economic Botany; Ane Books Pvt. Ltd.
4. Kapoor LD, 2001 Hand Book of Ayurvedic Medicinal Plants, CRC Press New York, Ane Books Pvt. Ltd
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16. S.K. Jain. Glimpses of Ethnobotany. Oxford and IBH Publishing Company, New Delhi.
17. S.K. Jain, 1987. A Manual of Ethno botany. Scientific Publishers, Jodhpur
18. T.E Walles. Text book of Pharmacognosy

Semester V

ENVIRONMENTAL STUDIES AND PHYTOGEOGRAPHY

[Theory: 90 hrs; Practical: 36 hrs; Total: 126 hrs]

Course code: AUBO542

Number of credits: 4

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

Distribution of Hours	Theory	Practical
Environmental Studies	81 hrs	36 hrs
Phytogeography	09 hrs	00 hr
Total	90 hrs	36 hrs

MODULE- I

14 hrs

1. Definition- Scope and relevance to society and human environment. Need for public awareness
2. 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
3. Conservation of Natural resources
Land and soil- afforestation, regeneration of wasteland
Water - Rain water harvesting, ground water dams
Energy - Promoting use of renewable resources-solar, hydel, tidal and wind; biodiesel, biofuels.
Forests- Reforestation, Community forestry programmes
4. Role of an individual in conservation of natural resources, sustainable life styles.

MODULE II

ECOSYSTEMS

22 hrs

1. Ecosystems - Concept, definition, structure and function; components- biotic and abiotic; energy flow
2. Food chains -Food web & ecological Pyramids, biogeochemical cycles - Carbon and Phosphorous 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.
 1. Forest ecosystem
 2. Grassland ecosystem
 3. Desert ecosystem
 4. Aquatic ecosystems- Ponds, Streams, Rivers, Oceans, Estuaries (brief account only)

MODULE-III

24 hrs

Biodiversity and its conservation

1. Introduction
2. Definition- genetic, species and ecosystem diversity.
3. Terrestrial (Tropical rain forest) and Aquatic Biomes(mangroves).
4. Hot-spots of biodiversity; India as mega-diversity nation.
5. Threats to biodiversity: land use changes & habitat destruction, poaching of wild life- hunting & export, Overuse of pesticides, invasive species.

6. IUCN, Red data Book; Extinct and Threatened species- endangered & Rare; Endemic species of Western Ghats.
7. 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.
8. Global initiatives in biodiversity conservation- Stockholm Conference, Montreal Protocol, Convention on Biological diversity Regional initiatives- *Chipko* movement, A brief account on conservation efforts in Kerala- People Biodiversity Register.

MODULE-IV

21 hrs

Environmental pollution & Issues

1. Definition causes, effects and control measures of – 1. Air pollution 2. Water pollution 3. Soil pollution 4. Marine pollution 5. Noise pollution 6. Thermal pollution 7. Nuclear hazards.
2. Solid Waste Management- waste minimization, Recycling and Reuse, Consuming environment friendly products. E-waste management.
3. Environmental Issues - Climate change, Global warming, Acid rain, Ozone layer depletion.
4. Environmental Legislations - Environment protection Act (1986); Air [prevention and control of pollution] Act (1981; Amended 1987); Water [prevention and control of pollution] Act (1974; Amended 1988); Wildlife Protection Act (1972); Forest conservation Act (1980). (Scope and relevance only)
5. Environmental Organisations –UNEP, IPCC, WWF, Central Pollution Control Board

MODULE-V

9 hrs

Phytogeography- concept & definition

Vegetation in India – Forests- tropical, temperate, sholas, sub alpine, alpine, mangroves & Grass lands. Phytogeographical regions of India - Western and eastern Himalayas, Dessert, Western Ghats, Deccan Peninsula, Gangetic Plain, North East India, Coasts & Islands.

Practical

36 hrs

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

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12. Vashista P.C – Plant Ecology Edu. Vishali Publications.
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14. The Geography of Flowering Plants – Good
15. Kumaresan B. – *Plant Ecology & Phytogeography* – Rastrogi Pub:

Semester V

CELL BIOLOGY, GENETICS AND EVOLUTIONARY BIOLOGY

[Theory: 72 hrs; Practical: 36 hrs; Total: 108 hrs]

Course code :AUBO543

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
Total	72 hrs	36 hrs

MODULE-I

Cell biology

25 hrs

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

12 hrs

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

MODULE-II

Classical Genetics

36 hrs

1. Mendelian Genetics- Mendel and his experiments, Mendel's success, Mendelian principles, Mendelian ratios, monohybrid and dihybrid crosses, back cross and test cross
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. Rh factor.
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 color 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

24 hrs

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

MODULE-III

Evolutionary Biology

11 hrs

1. Progressive and Retrogressive evolution.
2. Parallel and Convergent evolution.
3. Micro and Macro evolution.
4. Theory of Lamarck, Wiesman 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.

REFERENCE

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2. Veer Bala Rastogi (2008), Fundamentals of Molecular Biology Ane Books Pvt. Ltd
3. Taylor (2008) Biological Sciences. Cambridge University Press India Pvt. Ltd
4. Nicholl T (2007) An Introduction to Genetic Engineering, Cambridge University Press India Pvt. Ltd
5. Durbin (2007) Biological Sequence Analysis. Cambridge University Press India Pvt. Ltd
6. John Ringo (2004) Fundamental Genetics. Cambridge University Press India Pvt. Ltd.
7. Darnel, J.Lodish, Hand Baltimore, D. (1991) Cell and molecular biology. Lea and Fibiger, Washington.
8. De Robertis, E.D.P and Robertis, E.M.P (1991) Cell and molecular biology Scientific American books.
9. Cohn, N.S. (1964) Elements of Cytology. Brace and World Inc, New Delhi
10. Dobzhansky, B (1961) Genetic and origin of species, Columbia university Press New York
11. Gardner, E.J and Snustad, D.P (1984) Principles of Genetics. John Wiley, New York.
12. Gerald Karp (1985) Cell biology, Mc Graw Hill company.
13. Gupta, P. K. Genetics, Rastogi Publications.
14. Lewin, B, (1994) Genes, Oxford University Press, New York.
15. Roy S.C. and Kalayan kumar De (1997) Cell biology. New central Boos Calcutta
16. Gupta P. K. – Genetics (Rastogi publications).
17. Sharma, A.K and Sharma a (1980) Chromosome technique Theory and practice, Aditya Books, New York
18. Swanson, C.P (1957) Cytology and Genetics. Englewood cliffs, New York.

Semester VI

PLANT PHYSIOLOGY AND BIOCHEMISTRY

Course code : AUBO641

Number of credits : 4

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

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

Plant Physiology [Theory: 60 hrs; Practical: 16 hrs]

MODULE-I

20 hrs

- General introduction: physiological processes, their significance and applications.
- Water relations of plants: Importance of water to plant life.
 - 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.
 - Ascent of sap- vital and physical theories.
 - 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.
- 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 - sand culture, hydroponics and aeroponics. Mechanism of mineral absorption (a) passive absorption- ion exchange and Donnan equilibrium (b) active absorption- carrier concept, Lundegardh hypothesis.

MODULE-II

20 hrs

- 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 C3, C4, and CAM plants; Photorespiration Bacterial photosynthesis and chemosynthesis (Brief account only)
- Factors affecting photosynthesis - Law of limiting factor.
- 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 - R .Q and its significance - Factors affecting respiration.

MODULE-III

20 hrs

- Translocation of solutes: Path way of movement, phloem transport, mechanism of transport - Munch hypothesis, protoplasmic streaming theory - activated diffusion hypothesis, electro osmotic theory.
- Nitrogen metabolism: Source of nitrogen - Biological nitrogen fixation – symbiotic and asymbiotic. Nitrogen fixation by blue green algae - rotation of crops. Nif genes - Leghaemoglobin.
- 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
- Vernalization - phytochrome and its significance. Physiology of bud and seed dormancy, germination.
- Plant movements: Tropic and nastic movements. Circadian rhythm and biological clock.
- Stress physiology: water stress, salt stress.

Practical

20hrs

- Water potential of onion peel / *Rhoeo* peel by plasmolytic method.
- 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. Measurement of photosynthesis by Wilmot's bubbler.
10. Evolution of CO₂ during respiration.
11. Ganong's respirometer and measurement of R .Q.
12. Simple respiroscope.
13. Alcoholic fermentation using Kuhn en's fermentation vessel.
14. Geotropism using clinostat.
15. Measurement of growth using Arc auxanometer.

Biochemistry

[Theory: 30 hrs; Practical: 20 hrs]

MODULE-IV

15 hrs

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 Amino acids - 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

15 hrs

5. Lipids- classification – Simple lipids- fats & oils, waxes; Compound lipids- phospholipids, spingolipids and glycolipids; Derived lipids- Cholesterol and terpenes; Fatty acids – Alpha-oxidation and Beta-oxidation; Synthesis of ester bonds.
6. 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
7. Secondary Plant Products – Introduction – classification and function [General account]

Practical

16 hrs

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

REFERENCES

1. Verma V 2007, Text Book of Plant Physiology. Ane Books Pvt. Ltd
2. Nagini S (2009) Instant Biochemistry. Ane Books Pvt. Ltd
3. Devlin & Witham – Plant Physiology (C B S publishers).
4. Kochhar P. L. & Krishnamoorthy H. N. – Plant Physiology. (Atmaram & Sons- Delhi, Lucknow).
5. Richard F Venn 2004, Principles and Practice of Bioanalysis, Taylor & Francis, Ane Books Pvt. Ltd
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7. Malic C. P. & Srivastava A. K. – Textbook of Plant Physiology (Kalyani Publishers- New Delhi).
8. Noggle G R & Fritz G J – Introductory Plant physiology (Prentice Hall of India).
9. Pandey S.N. & Sinha B. K. – Plant physiology (Vikas publishing House- New Delhi).
10. Salisbury F. B. & Ross C. W. - Plant physiology. (Wadsworth publishing company).
11. Sundara Rajan S. – Colgate Botany Vol.IV (Himalaya publishing House).
12. William G. Hopkins – Introduction to Plant Physiology (John Wiley & Sons, New York).
13. Keith Wilson and John Walker (2008) Principles and techniques of Biochemistry and Molecular Biology, 6th Edition, Cambridge University Press, India Pvt. Ltd.
14. Jain J. L. – Fundamentals of Biochemistry (S. Chand & Company).
15. Lehninger - Principles of Biochemistry (CBS publishers).
16. Plummer D. T. – An introduction to Plant Biochemistry (Tata Mc Graw Hill).

Semester VI

MOLECULAR BIOLOGY, GENERAL INFORMATICS & BIOINFORMATICS

Course code : AUBO642

Number of credits : 4

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

Distribution of Hour	Theory	Practical
Molecular Biology	28 hrs	12 hrs
General informatics & Bioinformatics	44 hrs	24 hrs
Total	72 hrs	36 hrs

MODULE-I

28 hrs

Molecular Biology

- DNA as genetic material**- experimental evidence- Griffith's experiment on Bacterial transformation, Avery's experiment, Hershey-Chase Experiment.
- 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
- Replication of DNA**- 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; Enzymology of replication: topoisomerase, helicase, primase, polymerase and ligase; DNA repairing mechanism- photoreactivation.
- RNA structure**- Structure, Properties and functions of tRNA, mRNA and rRNA; Genetic code.
- Synthesis of protein**: Transcription; RNA modifications- introns, exons, removal of introns, spliceosome; Translation -Central dogma-reverse transcription
- Regulation of gene expression in prokaryotes and eukaryotes**- *lac* operon; transcriptional gene regulation in eukaryotes-promoters, enhancers, transcription factors; RNA interference.
- Concept of gene**-Units of a gene, cistron, recon, muton; Types of genes- House keeping genes (constitutive genes), Luxury genes (non constitutive genes), overlapping genes.
- Transposable genetic elements**- General account, Characteristic, Transposons (jumping genes), Cellular oncogenes (general account only).

Practical

12 hrs

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

Module- II

22 hrs

General Informatics

- Overview of Information Technology**: Features of the modern personal Computer and peripherals, computer network and internet, overview of operating systems- Windows & Linux, and major application softwares- Excel, Power point, MS word.

2. **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, case study of educational software, Academic services-INFLIBNET, NICNET and BRNET.
3. **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.

Module-III

Bioinformatics

22 hrs

1. Introduction: Definition, Origin of concept of Bioinformatics; Brief history, Importance of bioinformatics, Wet lab and Web lab.
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 databases
 - Protein structure databank- PDB
4. 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
 - Molecular visualization- use of Ras mol
6. Molecular Phylogeny and Phylogenetic trees- Advantages of Molecular phylogeny and phylogenetic analysis- PHYLIP

Practical

24 hrs

1. Create, Copy and Save a document with Header, Footer, Page Number, Date and Time using Word processing
2. Insert a table in the above Document
3. Prepare the mark list of students in a class using Excel
4. Prepare five slides each using power point with different design templates
5. 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.
6. Blast Search
7. Molecular visualization using Rasmol

REFERENCE

1. Karp, G. 2010 Cell and Molecular Biology: Concepts and Experiments. 6th edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P and Robertis, E.M.P (1991) Cell and molecular biology. Scientific American books.
3. Veer Bala Rastogi (2008), Fundamentals of Molecular Biology Ane Books Pvt. Ltd
4. Darnel, J.Lodish, Hand Baltimore, D. (1991) Cell and molecular biology. Lea and Fibiger, Washington.
5. Durbin (2007) Biological Sequence Analysis. Cambridge University Press India Pvt. Ltd
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7. Twymann, R.M. (1998) Advanced molecular biology Viva books New Delhi.

8. Selzer PM, Marhofer RJ, Rohwer A (2009) Applied Bioinformatics. Springer- Verlag Berlin Heidelberg, Germany
9. Ingvar Eidhammer, Inge Jonassen, William R Taylor 2009, Protein Bioinformatics, Wiley India Edition
10. Venkatarajan S Mathura and Pandjassarame Kanguane (2009) Bioinformatics- a concept based introduction. Springer-Verlag Berlin Heidelberg, Germany
11. Agrawal S (2009) Bioinformatics for Beginners: Introduction to Bioinformatics. Ane Books India Pvt. Ltd
12. Niel C Jones and Pavela Pevzner (2009) An introduction to Bioinformatics Algorithms. Ane Books India Pvt. Ltd
13. Selzer (2008) Applied Bioinformatics: An Introduction, Ane Books India Pvt. Ltd
14. Kolchanov (2008) Bioinformatics of Genome regulation and Structure. Ane Books India Pvt. Ltd.
15. Rubin (2007) The Avenues in Bioinformatics. Ane Books India Pvt. Ltd.
16. Joseph Seckback and Eitan Rubin (2007) Springer, Kluwer Academic publishers
17. Jin Xiong (2007) Essential Bioinformatics. Cambridge University Press India Pvt. Ltd
18. Higgs (2005), Bioinformatics and Molecular evolution. Ane Books India Pvt. Ltd
19. Ethan Cerami (2005) XML for Bioinformatics. Springer International Edition
20. Moni K and Vijayraj N (2000) Bioinformatics a practical Approach, Coimbatore
21. Mukerjee DP (2000) Fundamentals of Computer Graphics and Multimedia. Prentice Hall of India Pvt. Ltd.

WEB RESOURCES

- www.fgcu.edu/support/office2000
- www.openoffice.org *Open office official website*
- www.microsoft.com/office *MS Office website*
- www.lgta.org *Office online lessons*
- www.learntheneth.com *Web Primer*
- www.computer.org/history/timeline
- www.computerhistory.org
- <http://computer.howstuffworks.com>
- <http://vmoc.museophile.org> *Computer history*
- www.dell.com *Dell Computers*
- www.intel.com *Intel*
- www.ibm.com *IBM*
- www.keralaitmission.org *Kerala Govt. IT Dept.*
- www.technopark.org
- <http://www.studentworkzone.com/question.php?ID=139>

Semester VI

HORTICULTURE, PLANT BREEDING & RESEARCH METHODOLOGY

Course code : AUBO643

Number of credits : 4

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

Distribution of Hours	Theory	Practical
Horticulture	35 hrs	20 hrs
Plant breeding	20 hrs	16 hrs
Research methodology	17 hrs	-
Total	72 hrs	36 hrs

HORTICULTURE

MODULE I

18 hrs

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

MODULE II

17 hrs

6. 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
7. Indoor garden, Roof garden (Brief account only)
8. Bonsai
9. Flower Arrangement- Containers and requirements for flower arrangements- Free style, Shallow and Mass arrangement- Japanese- Ikebana. Dry flower arrangement

Practical

20 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-III

20 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

16 hrs

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

MODULE-IV

17 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.

REFERENCES

1. Arora J.S 1990, Introductory Ornamental Horticulture, Kalyani Publications
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, Vegetable Production in India, RamPrasad & Sons
5. Kumar N 1989, Introduction to Horticulture, Rajalakshmi Publications
6. Manibhushan Rao K 1991, Text Book of Horticulture, Macmillan Publications
7. Shujnmoto, 1982, The Essentials of Bonsai, David & Charles, Newton
8. Allard RW (1999). Principles of Plant Breeding (2nd Edition), John Wiley and Sons.
9. Acquaah G (2007). Principles of Plant Genetics and Breeding, Blackwell Publishing Ltd. USA.
10. B D Singh Plant breeding
11. N. Gurumani Research Methodology: For Biological Sciences, MJP Publishers, 2006. ISBN, 8180940160
12. C. R. Kothari, Research Methodology New Age International

OPEN COURSES

OPEN COURSE – I

Offered to the students of other disciplines

Semester	Course Code	Title of the Course	Contact hrs/week	Credits
V	AUBO581.a	Forestry	3	2
	AUBO581.b	Horticulture		
	AUBO581.c	Mushroom Cultivation and Marketing		

ELECTIVE COURSE

Offered to the students of Botany

Semester	Course Code	Title of the Course	Contact hrs/week	Credits
VI	AUBO691	Biotechnology & Nanobiotechnology	3	2

OPEN COURSE -I (a)

FORESTRY

Course code : AUBO581.a

Number of credits : 2

Number of contact hours : Lecture: 54 hrs

MODULE I

10 hrs

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

MODULE II

16 hrs

• 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*, *Mahagoni* *Dalbergia sisso* and *Santalum album*, jack wood, Rubber.

• Wood: Homogenous and heterogenous- spring and autumn wood- Porous and non porous wood- Heart and sap wood.

• Relevance of wood anatomical studies in Kerala- Identification of wood- preparation of key and their uses

MODULE III

10 hrs

• Social and agro forestry. Selection of species and role of multipurpose trees. Food, fodder and energy.

• Social forest- Avenue plantation. Sacred plants- definition, importance of sacred trees like *Ficus religiosa*, *Emblia officinalis*, *Aegle marmelous*.

MODULE IV

9 hrs

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

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

MODULE V

9 hrs

• Forest resources and utilization. Forest products- timber, pulp wood, secondary timbers, non timber forest products (NTFPs).

• 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. Sagreiya, K.P. 1994. Forests and Forestry (Revised by S.S. Negi). National book trust. New Delhi.
2. Tribhawan Mehta, 1981. A handbook of forest utilization. Periodical Expert Book Agency, New Delhi.
3. Kollmann and Cote 1988. Wood science and Technology. Vol.I & II Springer verlag.
4. Sharma P.D. 2004. Ecology and Environment. Rastogi publications, Meerut
5. Singh M.P. and Vinita Vishwakarma. 1997. Forest environment and Biodiversity. Daya publishing house, New Delhi.
6. Tiwari K.M. 1983. Social forestry in India.
7. Anil Kumar Dhiman. 2003. Sacred plants and their medicinal uses. Daya publishing house, New Delhi.
8. B.S. Chundawat and S.K.Gautham. 1996. Text book of Agroforestry. Oxford and

- IBH Publishing house, New Delhi.
9. A Hand book of Kerala Timbers- KFRI, Trichur.

OPEN COURSE –I (b)

HORTICULTURE

Course code :AU BO581.a

Number of credits : 2

Number of contact hours : Lecture: 54 hrs

MODULE I

10 hrs

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.
7. vermiculite
8. Soil types, Soil preparation
9. Irrigation methods
10. Hydroponics

MODULE II

12 hrs

I Propagation methods

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

MODULE III

12 hrs

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

10 hrs

1. Flower Arrangement
2. Containers and requirements for flower arrangements Free style, Shallow and Mass arrangement
3. Japanese – Ikebana

4. Bouquet and garland making
5. Dry flower arrangement
6. Harvesting Methods, Storage
7. Marketing of Fruits, vegetables and flowers
8. Preservation and processing of fruits and vegetables

MODULE V

10 hrs

1. Growth regulators in horticulture
2. Rooting hormones , Growth promoters , Flower induction , Parthenocarpy
3. Plant protection
Common diseases of fruits and vegetable crops (Mango, Tomato)
4. 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, Kalyani Publications
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, Vegetable Production in India, RamPrasad & Sons
5. Kumar N 1989, Introduction to Horticulture, Rajalakshmi Publications
6. Manibhushan Rao K 1991, Text Book of Horticulture, Macmillan Publications
7. Shujnroto, 1982, The Essentials of Bonsai, David & Charles, Newton 50

OPEN COURSE -I (c)

MUSHROOM CULTIVATION AND MARKETING

Course code :AU BO581.c

Number of credits : 2

Number of contact hours : Lecture: 54 hrs

MODULE I

12 hrs

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

MODULE II

8hrs

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

MODULE III

12 hrs

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

MODULE IV

12hrs

- Diseases- Common pests, disease prevention and control measures.
- Processing - Blanching, steeping, sun drying, canning, pickling, freeze drying.
- Storage – short term and long term storage.

MODULE V

10hrs

- Common Indian mushrooms.
 - Production level, economic return, Foreign exchange from Mushroom cultivating countries and international trade.
- Field Study: Visit to a mushroom cultivating Laboratory

REFERENCES

1. Pandey B P 1996. A textbook of fungi. Chand and company N Delhi.
2. Kaul T N 2001. Biology and conservation of mushrooms. Oxford and IBH publishing company N.Delhi
3. Gupta P.K. Elements of Biotechnology. 51
4. Harander Singh. 1991. Mushrooms- The Art of Cultivation- Sterling Publishers.
5. Indian Journal of Mushrooms. Published by I.M.G.A. Mushroom Research Laboratory. College Agriculture, Solan

ELECTIVE COURSE

BIOTECHNOLOGY AND NANO BIOTECHNOLOGY

Course code :AUBO691

Number of credits : 2

Number of contact hours : Lecture: 54 hrs

Biotechnology

MODULE- I

12 hours

1. Introduction – History- major achievements-Biotechnology in India.
2. Plant Tissue culture – Totipotency- definition and importance – dedifferentiation and redifferentiation. Cytodifferentiation.
Culture media, composition, preparation and sterilization.
Callus and suspension culture, meristem culture- Somaclonal variation- Somatic embryogenesis and organogenesis. Synthetic seeds – anther culture and production of haploids – protoplast culture – somatic hybrids – cybrids.

MODULE- II

12 hours

1. Recombinant DNA technology:
General account of cloning vehicles – plasmid, bacteriophages, 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

12 hours

1. Methods in Biotechnology.
 - a. Isolation and purification of DNA from plant cells.
 - b. Agarose gel electrophoresis
 - c. PCR, RFLP, DNA sequencing-Sanger's method, Southern blotting, ELISA.
2. Application of biotechnology in
 - a. Medicine – edible vaccines from plants, gene therapy.
 - b. Agriculture – *nif* genes, GMO foods.
 - c. Industry and environment (brief account only)
3. Biosafety and ethical issues, Intellectual Property Rights (IPR)

MODULE IV

10 hours

Microbial and industrial biotechnology

1. Microbes in biotechnology.
2. Microbial culture methods of culturing, media and composition (LB and PDA)
3. Application of recombinant microbes.
4. Industrial microbiology: Production of alcohol, vinegar, bread, dairy products & single cell protein. (brief account only)

MODULE V

8 hours

Nanobiotechnology

1. Introduction-background and definition of nanotechnology
2. Nanosystems in nature
3. Nanoscaled biomolecules (nucleic acids and proteins)
4. Technologies for visualization of biological structures at the nano scale-atomic force microscope
5. Nanoparticles- Quantum dots, Paramagnetic iron Oxide Crystals, Dendrimers, Carbon nanotubes.
6. Application of nanotechnology in life sciences;

Field Study

- 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 flow system.
- Demonstration Agarose Gel Electrophoresis, Preparation of media, sterilization, inoculation and callus induction, (demonstration only).

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