B.SC BOTANY

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DEFINITIONS

'Semester' means a term consisting of a minimum of **450** contact hours distributed over **90** working days, inclusive of examination days, within **18** five-day academic weeks.

'Academic Week' is a unit of five working days in which distribution of work is organized from Monday to Friday, with five contact hours of one hour duration on each day.

'Programme' means a three year programme of study and examinations spread over six semesters, according to the regulations of the respective programme, the successful completion of which would lead to the award of a degree.

'Course' means a complete unit of learning which will be taught and evaluated within a semester.

'Common Course I' means a course that comes under the category of courses for English and ***'Common Course II'*** means additional language, a selection of both is compulsory for all students undergoing undergraduate programmes.

'Core course' means a course in the subject of specialization within a degree programme.

'Complementary Course' means a course which would enrich the study of core courses.

'Open course' means a course outside the field of his/her specialization, which can be opted by a student.

'Credit' is the numerical value assigned to a course according to the relative importance of the content of the syllabus of the programme**.**

'Parent Department' means the department which offers core courses within a degree programme.

'Grade' means a letter symbol (A, B, C, etc.), which indicates the broad level of performance of a student in a course/ semester/programme.

'Grade point' (GP) is the numerical indicator of the percentage of marks awarded to a student in a course.

Words and expressions used and not defined in this regulation shall have the same meaning assigned to them in the Act and Statutes.

COURSE STRUCTURE OF BSc ZOOLOGY PROGRAMME

The U.G.programme in Zoology includes

(a) Common Courses
(b) Core Courses
(c) Complementary Courses
(d) Open Course
(e) Investigatory Project

No course shall carry more than 4 credits.
Student shall have the option to choose Open courses offered by any other Department.

Programme Duration	6 Semesters
Total Credits required for successful completion of the programme	120
Minimum credits required from common courses	38
Minimum credits required from Core courses + Complementary + Project	79
Minimum credits required from Open course	3
Minimum attendance required	75%

EXAMINATIONS

The evaluation of each course shall contain two parts:

(i) In-Semester Assessment (ISA)
(ii) End-Semester Assessment (ESA)

The in-semester to end-semester assessment ratio shall be 1:4, for both courses with or without practical. There shall be a maximum of **80** marks for end-semester evaluation and maximum of **20** marks for in-semester evaluation. For all courses (theory & practical), grades are given on a 07-point scale based on the total percentage of marks. ***(ISA+ESA)*** as given below

Percentage of Marks	**Grade**	**Grade Point**
90 and above	A+ - Outstanding	10
80-89	A - Excellent	9
70-79	B - Very Good	8
60-69	C - Good	7
50-59	D - Satisfactory	6
40-49	E - Adequate	5
Below 40	F - Failure	4

Note: Decimal are to be rounded to the next whole number

CREDIT POINT AND CREDIT POINT AVERAGE

Credit Point (CP) of a course is calculated using the formula

CP = C x GP, where C = Credit; GP = Grade point

Credit Point Average (CPA) of a Semester/Programme is calculated using the formula

CPA = TCP/TC, where TCP = Total Credit Point; TC = Total Credit

Grades for the different semesters and overall programme are given based on the corresponding CPA as shown below:

CPA	Grade
Above 9	A+ - Outstanding
Above 8, but below or equal to 9	A - Excellent
Above 7, but below or equal to 8	B -Very Good
Above 6, but below or equal to 7	C – Good
Above 5, but below or equal to 6	D – Satisfactory
Above 4, but below or equal to 5	E – Adequate
4 or below	F – Failure

Note: A separate minimum of 30% marks each for in-semester and end-semester (for both theory and practical) and aggregate minimum of 40% are required for a pass for a course. For a pass in a programme, a separate minimum of Grade **E** is required for all the individual courses. If a candidate secures **F** Grade for any one of the courses offered in a Semester/Programme only **F** grade will be awarded for that Semester/Programme until he/she improves this to **E** grade or above within the permitted period. Candidate who secures **E** grade and above will be eligible for higher studies.

MARKS DISTRIBUTION FOR END-SEMESTER EXAMINATION AND IN-SEMESTER EVALUATION

The end-semester examination of all semesters shall be conducted by the College at the end of each semester. In-semester evaluation is to be done by continuous assessment. Marks distribution for end-semester and in-semester assessments and the components for in-semester evaluation with their marks are shown below:

Components of the in-semester evaluation and their marks are as below.

1) For all courses without practical

a) Marks of end-semester Examination: 80
b) Marks of in-semester evaluation: 20

All the three components of the in-semester assessment are mandatory.

Components of In- semester Evaluation	***Marks***
Attendance	5
Assignment /Seminar/Viva	5
Test paper(s) (1 or 2) (1x10=10; 2x5=10)	10
Total	**20**

2) For all courses with practical

a) Marks of theory –End-semester Examination: 60

b) Marks of theory –In-semester Evaluation: 10

Components of Theory: In-semester Evaluation	**Marks**
Attendance	3
Assignment/Seminar/Viva	2
Test paper(s) (1 or 2) (1x5=5; 2x2.5=5)	5
Total	**10**

a) Marks of Practical: End-semester Examination: 20

b) Marks of Practical: In-semester Evaluation: 10

Components of Practical: In-semester evaluation	**Marks**
Attendance	2
Record	5
Lab involvement	3
Total	**10**

PROJECT EVALUATION

Components of Project Evaluation	**Max. Marks**
In-semester Evaluation	20
Dissertation (End-semester)	50
Viva-Voce (End-semester)	30
Total	**100**

ASSIGNMENTS

Assignments are to be done from 1st to 4th Semesters. At least one assignment should be done in each semester.

SEMINAR/VIVA

A student shall present seminar for each course in the 5th semester.
Student shall appear for a Viva-voce examination for each course in the 6th semester.

ATTENDANCE EVALUATION

1) For all courses without practical

Percentage of attendance	Marks
90 and above	5
85 – 89	4
80-84	3
76-79	2
75	1

(Decimals are to be rounded to the next higher whole number)

2) For all courses with practical

% of Attendance	Marks for theory
90 and above	3
80--89	2
75--79	1

% of Attendance	Marks for practical
90 and above	4
85--89	3
80--84	2
75--79	1

(Decimals are to be rounded to the next higher whole number)

IN-SEMESTER ASSESSMENT - TEST PAPERS

At least one in-semester test-paper is to be attended in each semester for each course. The evaluations of all components are to be published and are to be acknowledged by the candidates. All documents of in-semester assessments are to be kept in the college for two years. The responsibility of evaluating the in-semester assessment is vested on the teacher(s), who teach the course.

PATTERN OF QUESTIONS

Questions shall be set to assess knowledge acquired, standard application of knowledge, application of knowledge in new situations, critical evaluation of knowledge and the ability to synthesize knowledge. The question setter shall ensure that questions covering all skills are set. He/She shall also submit a detailed scheme of evaluation along with the question paper.

A question paper shall be a judicious mix of objective type, short answer type, short essay type /problem solving type and long essay type questions.

Pattern of questions for end-semester examination for theory paper without practical

	Total no. of questions	Number of questions to be answered	Marks of each question	Total marks
	10	10	1	10
	12	8	2	16
	9	6	4	24
	4	2	15	30
TOTAL	**35**	**26**	x	**80**

Pattern of questions for end-semester examination for theory papers with practical

	Total no. of questions	Number of questions to be answered	Marks of each question	Total marks
	8	8	1	8
	10	6	2	12
	6	4	4	16
	4	2	12	24
TOTAL	**28**	**20**	x	**60**

SEMESTER – 1

Course Code	Course Title	Hrs/week	Credit
CEN101	Common Course English -1	5	4
CEN102	Common Course English -2	4	3
	Common Course Sec. language -1	4	4
BBO101	General Botanic And Scientific Skills	2	2
BBO1P01	General Botanic And Scientific Skills- Practicals	2	1
DCH101	1st Complementary – Chemistry l	2	2
DCH1P01	1st Complementary - Chemistry- l practical	2	1
DZO101	2nd Complementary- Zoology -1	2	2
DZO1P01	2nd Complementary- Zoology - 1 Practical	2	1

SEMESTER – 2

Course Code	**Course Title**	**Hrs/week**	**Credit**
CEN203	Common Course -English -3	5	4
CEN204	Common Course -English -4	4	3
	Common Course - Sec. language -2	4	4
BBO202	Biological Evolution and Plant Classification	2	2
BBO2P02	Core Course- Practicals	2	1
DCH202	1st Complementary - Chemistry- 2	2	2
DCH2P02	1st Complementary - Chemistry- 2 practical	2	1
DZO202	2nd Complementary -Zoology -2	2	2
DZO2P02	2nd Complementary Zoology – 2 practical	2	1

SEMESTER 3

Course Code	**Course Title**	**Hrs/week**	**Credit**
CEN305	Common Course English -5	5	4
CEN306	Common Course Sec. language -3	5	4
BBO303	Microbiology and mycology and plant pathology	3	3
BBO3P03	Microbiology and mycology and plant pathology- Practical	2	1
DCH303	1st Complementary - Chemistry- 3	3	3
DCH3P03	1st Complementary - Chemistry - 3 practical	2	1
DZO303	2nd Complementary -Zoology -3	3	3
DZO3P03	2nd Complementary Zoology – 3 practical	2	1

SEMESTER 4

Course Code	**Course Title**	**Hrs/week**	**Credit**
CEN407	Common Course -English - 6	5	4
CEN408	Common Course Sec. language -4	5	4
BBO404	Phycology bryology	3	3
BBO4P04	Phycology bryology-Practical	2	1
DCH404	1st Complementary - Chemistry - 4	3	3
DCH4P04	1st Complementary - Chemistry - 4 practical	2	1
DZO404	2nd Complementary -Zoology -4	3	3
DZO4P04	2nd Complementary Zoology – 4 practical	2	1

SEMESTER 5

Course Code	**Course Title**	**Hrs/week**	**Credit**
BBO505	Pteridology, Gymnosperms	3	3
BBO5P05	Pteridology, Gymnosperms - Practical	2	1
BBO506	Angiosperm Morphology anatomy and ebryology	2	2
BBO5P06	Angiosperm Morphology anatomy and embryology - Practicals	4	2
BBO507	angiosperm taxonomy and economic botany	3	3
BBO5P07	angiosperm taxonomy and economic botany -Practicals	2	1
BBO508	Plant Physiology and Biochemistry	3	3
BBO5P08	Plant Physiology and Biochemistry -Practical	2	1
OBO501	Open Course:Beginners Botany	4	4

SEMESTER 6

Course Code	**Course Title**	**Hrs/week**	**Credit**
BBO609	Plant Ecology Phytogeography And Environmental Studies	3	3
BBO6P09	Plant Ecology Phytogeography And Environmental Studies - Practicals	3	1.5
BBO610	Cytology genetics and molecular biology	3	3
BBO6P10	Cytology genetics and molecular biology - Practicals	3	1.5
BBO611	Plant biotechnology and Bioinformatics	3	3
BBO6P11	Plant biotechnology and Bioinformatics -Practicals	2	1
BBO612	Core Choice - Agri-Horticulture and plant breeding	3	3
BBO613	Taught And Directed Research Paper	3	3
BBO6P12	Laboratory/Field /Library work	2	1

SEMESTER – 1
GENERAL BOTANICAL AND SCIENTIFIC SKILLS
THEORY :- (36 HOURS)

Module 1 – Microscopy(8 hours)
Introduction to microscopy, basic principle of light, phase contrast, fluorescent, TEM and SEM, confocal microscope and their specific uses, setting up using and caring compound and dissection microscope, preparing specimens for light microscopy, fixing, important fixatives-FAA, Carnoys fluid, whole mounts ,squashes, smears, hand sections, and serial sections, maceration, staining plant tissues: Safranin, Haematoxylin, Acetocarmine, Fast Green, Crystal Violet, double staining, mounting, important mountants-Glycerine, DPX, temporary, semi-permanent and permanent preparations, labeling microscopic preparations, analyzing microscopic image-micrometry, photomicrography, cell counting, plane of sectioning- TS, LS, TLS,RLS , Epidermal.

Module 2–Logic of Science (9 hours)
Logic: Deductive, Inductive, definition of science, goals of science, basic tenets of science, reflection on the value of learning science, method of science– hypothetico-deductive, empiricism, experimentation, variables, controls, , scientific process and skills. Classic experiments in biological science –Edward Jenner, Robert Koch, Loius Pasteur

Module 3–Information technology and online bibliographic resources (8 hours)
MS word; word processor toolbars, and their uses in making a document, working with word templates. MS Excel; spreadsheet toolbars, and their uses in making worksheets, performing calculations with formulas and functions, raw data, transformation of raw data into informational data, working with charts, MS PowerPoint; tools of PowerPoint, creating a .ppt presentation.

Module 4–Descriptive statistics(7 hours)
Data collection, data; grouped, ungrouped.Mean, median, mode,range, variance; standard deviation, coefficient of variation, standard error. Graphical representation of data. Data interpretation.

Module 5–Laboratory etiquettes (4 hours)
Basic rules of laboratory and field work, biosafety regulations and biosafety levels, biological containment.

GENERAL BOTANICAL AND SCIENTIFIC SKILLS
PRACTICAL:- (36 HOURS)

1. whole mount of an alga
2. Macerationof anther.
3. Squashes of root tip
4. Making a stainedTS, LS TLS,RLS sectionsof plants and observe the anatomical details.
5. Make microphotograph of the above preparations
6. Epidermal peel of onion scale leaves and observes the details of cells.
7. Measuring microscopic objects with micrometer
8. Counting the number of yeast cells using a haemocytometer

9. Reasoning with venn diagrams
10. Making serial dilutions
11. Making up stock solutions and dispensing aliquots
12. Making a raw database of the quantitative feature of a plant in the campus, analyse, Interpret and present the data graphically along with a written report of the work in 250 words and make a power point presentation.

SEMESTER –2
BIOLOGICAL EVOLUTION AND PLANT CLASSIFICATION
THEORY :- (36 HOURS)

Module 1 – Concept of Evolution (2 hours)
Nature's war -the evolution of the concept of evolution from de Candollee, Malthus Darwin and Wallace, Hooker

Module 2 – Evidence of Evolution (5 hours)
Evidence for evolution, fossils , fossils types, dating of fossils, radiometry, molecular clocks, plant fossils, - paleogeoraphy, discontinuous distribution of flora and fauna, Paleo flora of India, Contributions of Birbal Sahni, History of life on earth, geological time scale

Module 3 – Theories of Evolution (3 hours)
Theories of evolution Lamarck, Wallace, Charles Darwin, Hugo De Vries

Module 4 – Origin of life on earth (3 hours)
Origin of life on earth, Operins hypothesis and Miller's exp. from molecules to life; origin of cells and the first organisms

Module 5 – Forces of Evolution (2 hours)
Mutation,migration, selection and genetic drift; Evolution of species, populations reproductive and geographic isolation and mechanisms

Module 6 – Human Evolution (3 hours)
Human evolution, evolution & society

Plant Classification
Module 1 – Introduction (3 hours)
Classification;purpose and significance,two kingdoms, five kingdoms, three domains.
naming; polynomial to binomial
Module 2 – Systems of Plant Classification (5 hours)
Approaches in plant classification; artificial, natural, phyletic, cladstic, evolutionary
History of plant Classification.
Module 3 – Introduction to Plant diversity (10 hours)
Salient features of plants, diagnostic features and basic life cycle pattern of algae, fungi, bryophyte, pteridophyta, gymnosperms, and angiosperms. Adaption in land plants against that of an aquatic plant. Plant distribution; endemism and cosmopolitan.

BIOLOGICAL EVOLUTION AND PLANT CLASSIFICATION
PRACTICAL:- (36 HOURS)

1. Identify the different types of fossils
2. Draw to scale the geological history of earth and place on the time line the appearance of algae and angiosperms

3. Explore the industrial Melanism of ***Biston betularia from*** population data
4. Compare the adaptations in land plants, against that of an aquatic plant
5. Study the diagnostic features of algae, fungi, bryophyte, Pteridophyta, gymnosperms and angiosperms
6. Chart the life cycle patterns in and algae, fungi, bryophyte pteridophyta, gymnosperms, angiosperms,
7. Investigate leaf adaptations in stinging nettles, mimosa, Utricularia, Casurina
8. Conduct a field trip of minimum 2 days in Kerala to study the diversity, distribution, endangered, endemic plants of Kerala and write an illustrated report of the work in 750 words

SEMESTER – 3
MICROBIOLOGY, MYCOLOGY AND PLANT PATHOLOGY
THEORY :- (54 HOURS)

MICROBIOLOGY(18 hours)

Module - 1 General introduction (4 Hours)
Introduction, History of microbiology, Germ theory, Koch's postulates. Brief classification and general characters of microbes:- bacteria, archaea, protozoa, viruses . introduction to Bergey's manuel, examples and characteristics (brief account) of gram negative bacteria, gram positive bacteria, bacteria with unusual properties, gram positive filamentous bacteria with complex morphology.

Module - 2Structure of bacterial cell (4 Hours)
Structures external to cell wall: Cell wall: composition, structure, function, cell wall and Gram staining mechanism, Flagella: structure of flagella, different types of arrangements of flagella, Fimbriae and pili. Structures internal to cell wall: Plasma membrane, composition, structure and function Spheroplast, cytoplasm, ribosome, nucleoid, plasmid, inclusions, endospores.

Module - 3Genetic material in bacteria (4 Hours)
Genetic materials in bacteria. Bacterial chromosome. Extrachromosomal genetic elements,plasmid,mechanism of genetic recombination – transformation, transduction and conjugation. Reproduction by binary fission

Module - 4Virology (6 Hours)
Characteristics of viruses, size range, host range. classification of viruses, Structure of viruses: general morphology, nucleic acids, capsid and envelope ,Sub viral particles - prions, viroids, virusoid, Ultra structure of TMV and T_4 bacteriophage. Methods to culture bacteriophages in the laboratory, culturing animal viruses: in living animals, in embryonated eggs, in cell cultures.Viral multiplication: Multiplication of bacteriophages; lytic cycle, lysogenic cycle.

MYCOLOGY(27hours)

Module - 1 General introduction (5 Hours)
Introduction to fungi, structure, basic life cycle patterns, evolutionary trends, Classification based on Ainsworth (1973). Economic importance of Fungi –useful and harmful aspects, Fungi of Agricultural importance – mycoherbicides, myconematicides, mycoparasites ; Mycorrhiza – diversity , function and significance.

Module - 2Detailed type study (20 Hours)
Distinguishing characters of different classes of fungi (as per Ainsworth) with special reference toreproductive structures and life history of the following genera

A. Myxomycotina – General Characters
   Mastigomycotina – *Albugo*
   Zygomycotina - *Rhizopus*
B. Ascomycotina
   Hemiascomycetes -*Saccharomyces*
   Plectomycetes - *Pencillium*
   Pyrenomycetes – *Xylaria*
   Discomycetes -*Peziza*

C. Basidiomycotina
Teliomycetes - *Puccinia*
Hymenomycetes -*Agaricus*
D. Deuteromycotina – *Cercospora*

Module - 3Lichenology (2 Hours) 1.
Lichenology- General account , crustose, foliose and fruticose lichens, economic and ecological importance of lichen ,thallus structure, reproduction and life cycle of *Parmelia*

PLANT PATHOLOGY(9 hours)

Module - 1 General introduction (2 Hours)
History of plant pathology, Classification of plant diseases on the basis of causative organism; fungi, bacteria, virus, insect pest; symptoms and dissemination of diseases.
Module - 2 Control of plant diseases (2 Hours)
Physical, chemical and biological control *(Psudeomonas, Trichoderma, Bruvaria, PGPR, VAM)*. Classes of fungicides, pesticides, nematicides,weedicides and bactericides, types of pesticides based on toxicity- red, blue ,yellow, green labels and residual effect. Method of application, different types of sprayers and their working. Bordeaux mixture, Tobacco decoction, preparation.
Module - 3 Detailed study of plant diseases (5 Hours)
Study of following diseases with emphasis on causative organism, symptoms, and control. Bunchy top of Banana, leaf mosaic of tapioca, root wilt of Coconut, abnormal leaf fall of Rubber, quick wilt of pepper, leaf roller and stem borer of rice, Pseudostem borer of banana.

MICROBIOLOGY, MYCOLOGY AND PLANT PATHOLOGY PRACTICAL :- (36 HOURS)

Mycology (12hours)
1. Detailed study of the thallus anatomy and morphology of reproductive structures of the fungal and lichen genera mentioned in the syllabus
2. Stainingof VAM
3. Observation of fungal succession on cow dung
4. Isolation and identification of fungus from dung, air ,fruits ,vegetables.
5. Familiarizing the slide culture technique of fungus.

Microbiology (15 hours)
1. Gram staining technique
2. Acid fast staining technique
3. Endospore staining technique
4. Flagella staining technique
5. MPN analysis of water samples

Plant Pathology(9 hours)
1. Identify the diseases mentioned in the syllabus with respect to causal organisms and symptoms

2. Prepare an illustrated report on the prevalence of the diseases and pest in your locality and interview the farmers concerned and collect the details of the control measures used and submit it along with practical record.
3. Preparation of Bordeaux mixture, Tobacco decoction
4. Familiarize with the various kinds of sprayers and biocontrol agents

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6. Sharma P.D 2004 , *The Fungi* , 2nd Edition , Rasthogi publication
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8. Vasishta B.R !990 *Botany for Degree Students* , Fungi S. Chand &Co, NewDelhi.
9. Kun LY. 2006. *Microbial Biotechnology*. World Scientific.
10. Tortora et al. 2008. Microbiology an introduction, Pearson Education
11. Michael J Pelczar et al. 2000. TATA McGraw Hill
12. Bilgrami K.S and Dube H.C 1976 *A Text book of Modern Plant pathology* ,: Vikas
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14. Gupta V .K & Paul T.S 2004, *Fungi & Plant deseases*. Kalyani publishers , New Delhi
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SEMESTER – 4
PHYCOLOGY AND BRYOLOGY
THEORY – 54 HRS

PHYCOLOGY(36 HOURS)

Module 1 - Introduction (7 hours)
General characters – habitat, habit, pigmentation, reproduction and life cycles of algae. Classification by Fritsch F. E, 1935; 1945.

Module 2 - Detailed Type study (20 hours)
General characters of the following major classes with special reference to the systematic position, habitat, thallus structure, reserve food, reproduction (excluding developmental stages) and life cycle of the following types:-
Cyanophyceae: *Nostoc*; *Oscillatoria*, Chlorophyceae: *Chlamydomonas*, *Chlorella*, *Volvox*, *Oedogonium*, *Cladophora*, *Coleochaete*, *Chara*; Xanthophyceae: *Vaucheria* Bacillariophyceae: *Pinnularia*; Phaeophyceae: *Sargassum;* Rhodophyceae: *Polysiphonia*

Module 3-Economical and ecological significance (6 hours)
Algae as pollution indicator and in waste water treatment; Algae as primary producers – Oxygen liberators; Algae in soil fertility, cyanobacteria and nitrogen fixation, soil algae; Toxic algae – Algal blooms and red tides; Role of algae in aquaculture; Commercial products: Agar, Alginates, Carrageenin, Diatomaceous earth; Algae as a source of fuel - Hydrogen.

Module 4 - Experimental Phycology (3 hours)
Recent trends in Algal research; Diatoms and Nanotechnology; Cyanobacteria as a source of restriction endonuclease; Algal culture: scope and methods; Indian contribution to algal research.

BRYOLOGY (18 HOURS)

Module 1 - Introduction (5 hours)
General characters – habitat, habit, reproduction, and life cycle of Bryophytes; alternation of generation. Classification; Kasyap and Smith and evolution of sporophyte and gametophyte in Bryophytes.

Module 2 –Detailed Type study (10 hours)
General characters of the following major groups with special reference to the systematic position, occurrence, structure (morphology and anatomy), reproduction -vegetative, asexual, and sexual (excluding developmental stages) and life cycle of the following types: Hepaticopsida:*Riccia*, *Marchantia*; Anthocerotopsida: *Anthoceros*; Bryopsida: *Funaria*.

Module 3 - Ecological and economical importance: (3 hours)
Bryophytes as ecological indicators, role in plant succession,prevention of soil erosion, water retention, Economic importance of Bryophytes: Antibiotics, Horticultural importance.

PHYCOLOGY AND BRYOLOGY
PRACTICAL - 36 HRS

PHYCOLOGY (24 HOURS)

1. Detailed study of the thallus anatomy of the algal genera mentioned in the syllabus
2. Detailed study of the morphology and anatomy of reproductive structures of the algal genera mentioned in the syllabus
3. Collect and submit any five genera of algae mentioned in the syllabus
4. Familiarize with algal culture

BRYOLOGY(12 HOURS)

1. Detailed study of the thallus morphology and anatomy of the genera mentioned in the syllabus.
2. Detailed study of the Reproductive structures of the genera mentioned in the syllabus.

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12. Smith GM Cryptogamic botany vol.2

SEMESTER – 5
PTERIDOPHYTES AND GYMNOSPERMS
THEORY – 54HRS

PTERIDOPHYTES(27 HOURS)

Module 1 - General characters of Pteridophytes (4 Hours)

General characters of Pteridophytes, basic life cycle patterns in pteridophytes ; life cycles of homosporous and heterosporuspteridophytes , vascular tissues in Pteridophytes, stelar types and their evolution , Classification of Pteridophytes by Smith

Module 2 – Detailed type study (19 hours)

Structural organization of sporophyte and gametophyte (development of sex organs not necessary) of *Psilotum ,Lycopodium , Selaginella , Equisetum , Pteris , Marsilea*

Module 3 – General topics (4 hours)

Telome theory, Heterospory and seed habit, Economic importance of Pteridophytes , ecological importance of Pteridophytes,

GYMNOSPERMS (27 HOURS)

Module 1 - General characters of Gymnosperms (4 Hours)

General characters ,Classification (Sporne's system)

Module 2 – Detailed type study (19 hours)

Study of morphology, anatomy and reproductive features of,*Cycas,Pinus* and*Gnetum.*

Module 3 – General topics (4 Hours)

Evolutionary tendencies among Gymnosperms ,Affinities of Gymnosperms, Economic importance of Gymnosperms

PTERIDOPHYTES AND GYMNOSPERMS
PRACTICAL - 36HRS

PTERIDOPHYTES–(18 HOURS)

Study of the morphology, anatomy and reproductive structures of the types mentioned.

GYMNOSPERMS– (18 HOURS)

Study of the morphology, anatomy and reproductive structures of the types mentioned

Reference

1. Bhatnagar S P &Moitra A., 2003, *Gymnosperm*s, New Age International (P)Ltd., New Delhi.
2. Coutler J.M & Chamberlain C. J ,1958. *Morphology of Gymnosperm*s. Central Book Depot Allahabad.
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4. Pandey S.N.et al, 2006, A text book of Botany, Vikas Publishing House, New Delhi.
5. Rasheed A. 1999, *An Introduction to Pteridophyta,*Vikas Publishing House, New Delhi.
6. Vashista B. R ,1993.*Gymnosperms*, S Chand & Co., New Delhi.
7. Vashista B. R, 1993. *Pteridophyta*, S Chand & Co., New Delhi
8. Smith GM Cryptogamic botany vol.1
9. Sporne KR morphology of Gymnoperm

SEMESTER –5
ANGIOSPERM MORPHOLOGY, ANATOMY AND EMBRYOLOGY
THEORY – 36 HRS

ANGIOSPERM MORPHOLOGY (12 HOURS)

Module 1 - Plant habit and morphology of vegetative parts (3 hours)
Diverse Plant habits ; herbs, shrubs, trees, twiners, climbers, lianas Morphology of vegetative parts ; Leaf - compound and simple, phyllotaxy, leaf modifications,; stem modifications, root modifications

Module 2 – Structure of flower(3 hours)
Floral parts, symmetry of flower ,union of floral parts, types of flowers based on ovary position, types of aestivation, floral diagram, floral formula

Module 3 – Inflorescences (3 hours)
Racemose types-simple raceme, corymb, umbel, spike, catkin,spadix;Cymose types-simple cyme, monochasial cyme -scorpoid and helicoid, dichasialcyme, Special type- cyathium, hypanthodium, head, coenanthium, Panicle.

Module 4 – Fruits (3 hours)
Different types of fruits belonging to Simple, fleshy, dry dehiscent, indehiscent, aggregate,multiple categories with examples

ANGIOSPERM ANATOMY(12 HOURS)

Module 1 – Plant cell and tissues (5 hours)
The plant cell wall,gross structure , primary and secondary cell walls, channels of intercellular transport;pits ,plasmodesmataTissues- simple , complex,composition of xylem and phloem, meristematic tissue,types. Tissue Systems; Epidermal tissue -epidermis, cuticle, trichome, stomata,hydathodes,bulliform cells, cork and silica cells. Ground Tissue - cortex, endodermis, pericycle, pith and pith rays. Vascular Tissue - different types of vascular bundles and their arrangement in root and stem.

Module 2 – Structure and Organisation of Root and Shoot Apices(1 hour)
Histogen theory, Tunica-Corpus theory and Korper- Kappe theory

Module 3 – Secondary growth (4 hours)
Cambium; Development, structure and function, Normal secondary growth in dicot stem and root ;stelar and extrastelar, periderm, bark, polyderm, rhytidome and lenticels. Anomalous secondary growth inBougainvillea stem, Bignonia stem and Dracaena stem.

Module 3 – Wood anatomy(2 hours)
Wood; basic structure, heart wood, sap wood, hard wood, soft wood, tyloses, growth rings and dendrochronology, porous and non porous wood, ring porous and diffuse porous wood, wood rays;structure and cell types, uniseriate and multiseriate rays; heterocellular and homocellular rays. Wood anatomy in wood identification

ANGIOSPERM REPRODUCTIVE BOTANY (12 HOURS)

Module 1 – Microsporogenesis(3 hours)
Anther; structure, different types, pollinium, development, dehiscence. Development of male gametophyte, pollen germination and viability.

Module 2 – Megasporogenesis(3 hours)
Structure and development of ovule, placentaion types, Structure of mature embryo sac.- monosporic (polygonum type), bisporic (Allium type) and tetrasporic (Peperomia type).

Module 3 – Pollination and fertilization (3 hours)
Pollination,mechanisms and agencies, natural Mechanisms to prevent self-pollination-hercogamy, heterostyly, protrandry and protogyny, Special typ of pollination mechanism, Fertilisation; syngamy, triple fusion.

Module 4 – Embryo development (3 hours)
Development of endosperm,cellular, nuclear and helobialendosperms . Structure of embryo in dicots and monocots, variancein embryo developmentpolyembryony and apomixes ,apogamy, apospory, parthenocarpy. Development and general structure of fruits(dry and fleshy) and seed (pea and paddy)

ANGIOSPERM MORPHOLOGY, ANATOMY AND EMBRYOLOGY PRACTICAL (72 HRS)

Identifications

1. Cell types and tissues
2. Non living inclusions – starch grains, cystolith, raphides, aleurone grains.
3. Anther (Monothecous and Dithecous), embryo sac , embryo and PlacentationTypes
4. Following inflorescence and fruits:-
   (a) Different Inflorescence types mentioned in the syllabus
   (b)Different Fruit types mentioned in the syllabus

Micropreparations

5. Primary structure of stem, root and leaf-Dicots and Monocots.
6. Stomatal types: - anomocytic, anisocytic, paracytic, diacytic and grass type.
7. Secondary structure of dicot stem and root.
8. Anomalous secondary structure of *Bougainvillea* stem, *Bignonia* stem and *Dracaena* stem.

Experimentation and Field work

9. Preparation of floral formula and floral diagram from floral description and flower dissection
10. Pollen germination study
11. Field work for a minimum of 3 days under the guidance of a teacher

References

1. Ashok Bendra and Ashok Kumar, 1980. *Economic Botany*. Rastogi Publication, Meerut.
2. Cornquist A. 1968. *The Evolution and Classification of Flowering plants*.

3. Davis P.H. and Heywood V.H. 1967. *Principles of Angiosperm taxonomy*. Oliver and Boyl, Edinburgh.
4. Eames A.J. 1961 *Morphology of Angiosperms*. New York: McGraw Hill.
5. Eames A.J. 1961. *Morphology of Angiosperms* Mc. Graw Hill, New York.
6. Fahn A. 1982. Plant Anatomy (3rd edition) Pergamon Press Oxford.
7. Foaster A.S and Giffad E.M. 1962. *Comparative Morphology of Vascular Plants*, Allied Pacific Pvt. Ltd., Bombay
8. Foaster A.S. and Giffad E.M. 1962 *Comparative Morphology of Vascular Plants*. Allied Pacific Pvt. Ltd. Bombay.
9. Henry and Chandrabose 2001. *An Aid to the International Code of Botanical nomenculature.* Botanical Survey of India, Coimbatore.
10. Heywood V.H. 1967. *Plant Taxonomy*. Edward Arnold, London.
11. Hill A.F. 1982. *Economic Botany*. McGraw Hill, New York.
12. Jain S.K. 1981. *Glimpses of Indian Eethnobotany*, Oxford and IBH, New Delhi
13. Jain S.K. 1987. *A Manual of Ethnobotany*. Scientific Publishers, Jodhpur.
14. Jain S.K. and Rao R.R. 1976. *A Hand Book of Field and Herbarium Technique*. Today and Tomorrow's Publishers, New Delhi.
15. Jeffery C, 1968. *An Introduction to Plant Taxonomy*, J and A Churchill, London.
16. Maheshwari P. 1971, *An introduction to the Embryology of Angiosperms*. Tata McGraw- Hill Publishing Company Ltd., New Delhi.
17. Maheswari P. and Umaro Singh, 1965. *Dictionary of Economic Plants in India*, ICAR, New Delhi.

SEMESTER –5
ANGIOSPERM TAXONOMY AND ECONOMIC BOTANY
THEORY – 54 HRS

TAXONOMY (45 HOURS)

Module 1 – Different taxonomic approaches(6 hours)

Objectives of taxonomy, research scope and opportunities in taxonomy , .Types of Classification- Linnean sexual system(Brief account),Bentham and Hooker(Detailed account), APG system(Brief account), Binomial Nomenclature, Interdiciplinary approach in Taxonomy; Cytotaxonomy, Chemotaxonomy, Molecular taxonomy, Numerical taxonomy.

Module 2 – Herbarium (3 hours)

Herbarium technique- Preparation of herbarium, preservation , ICBN, Botanical, gardens and BSI (Brief account)

Module 3 – Detailed Study of Angiosperm Families (36 hours)

Study of the following families of Bentham and Hooker's System with special reference to their morphological and floral characters. Special attention should be given to common and economically important plants within the families.

Annonaceae, Nymphaeaceae,Capparidaceae, Malvaceae, Sterculiaceae, Rutaceae, Meliaceae, Anacardiaceae, Leguminosae (Mimosaceae, Caesalpiniaceae and Fabaceae), Combretaceae, Myrtaceae, Cucurbitaceae, Apiaceae, Rubiaceae, Compositae (Asteraceae), Sapotaceae,Apocynaceae, Asclepiadaceae, Solanaceae, Convolvulaceae, Scrophulariaceae, Acanthaceae, Verbenaceae, Lamiaceae (Labiatae), Amaranthaceae, Euphorbiaceae, Orchidaceae, Liliaceae, Arecaceae, Graminae (Poaceae)

ECONOMIC BOTANY (9 HOURS)

Module 1 – Economic Botany (6 hours)

Study of the following groups of plants based on their uses with special reference to the botanical name, family and morphology of the useful part ,

Cereals- Rice, Wheat, Maize
Millets- Ragi
Pulses- Green gram, Bengal gram, Black gram
Fruits:- Apple, Pineapple, Grape, Mango and Banana
Vegetables:- Bittergourd,Snake gourd, Ash gourd, Ladies finger, Carrot and Cabbage.
Sugar: - Sugar cane, Sugar beet
Timber yielding plants:- Teak wood and Jack wood, Rose wood
Beverages- Tea, Coffee
Oil yielding plants- Ground nut, Gingelly
Rubber yielding plants- Para rubber
Gums and Resins- White damer, Gum Arabic, Asafoetida
Spices – Cardamom, cloves , ginger, star anise, nutmeg , pepper
Insecticide yielding Plants- Tobacco and Neem

Module 2 – Ethanobotany (3 hours)

Ethnobotany and it's significance. Methodology of ethnobotanical studies, Study of the following plants used in daily life by tribals and village folks for Food, Shelter and Medicine

Food :-*Artocarpus, Corypha*
Shelter - *Bamboosa, Ochlandra and Calamus*
Medicine –*Scoparia dulcis, Aegle marmalose, Saraca ashoka, Coleus umbonicus*

ANGIOSPERM TAXONOMY AND ECONOMIC BOTANY PRACTICAL:- (36 HOURS)

1. Preparation of floral formula from floral description.
2. Identify the member plants belonging to the families mentioned in the syllabus
3. Students must describe the floral parts, draw the L.S., floral diagram and write the floral formula of at least one flower from each family.
4. Study the finished products of plants mentioned in the syllabus of economic botany with special reference to the morphology, botanical name and family.
5. Prepare herbarium of 25 plants with field notes.
6. Conduct field work for a minimum of 5 days under the guidance of a teacher

References

1. Ashok Bendra and Ashok Kumar ,1980. *Economic botany*.:Rastogi publications, Meerut.
2. CornquistA. ,1968. *The evolution and Classification of FloweringPlants*.
3. Davis P.H and Heywood V.H. 1967 *Principles of Angiosperm Taxonomy*. Edinburgh: Oliver and Boyl.
4. Henry and Chandra Bose 2001 *An Aid to the International Code of Botanical Nomenclature*. Botanical Survey of India. Coimbatore.
5. Heywood V.H. 1967. *Plant Taxonomy*. London: Edward Arnold.
6. Hill A.F. 1982. *Economic Botany*.:McGraw Hill ,New York.
7. Jain S K 2004, *A Manual Of Ethnobotany*, Scientific Publishers, India
8. Jain S. K. 1981. *Glimpses of Indian Ethnobotany*.:Oxford and IBH. New Delhi
9. Jain S. K. 1987. A Manual of Ethnobotany. Jodhpur Scientific Publishers.
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12. Maheshwari P. and Umaro Singh. (1965) *Dictionary of Economic Plants in India*, ICAR. New Delhi.
13. Naik V.N. (1984) *Taxonomy of angiosperms*. Tata McGraw- Hill Publishing Company, New Delhi.
14. Pandey&Misra 2008 *Taxonomy of Angiosperms*. Ane Book Pvt. Ltd.
15. Pandey B.P. 2000 *Economic Botany* S. Chand& Company Ltd. New Delhi.
16. Rendle A.B. (1979) *Classification of flowering plants*. Vikas Publishing House, U.P. Vols. I & II.
17. Singh V. and Jain D. K. (1989)*Taxonomy of Angiosperms*. Meerut :Rastogi Publication.

18. Sivarajan V.V. (1982) *Introduction to Principles of Taxonomy*, Oxford and IBH Publication. New Delhi
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20. Sreemali J.L. (1979) *Economic Botany*. Allahabad :KitabMAhal.
21. Swain T. (1963) *Chemical Plant Taxonomy*. New York: Academic Press.
22. Verma .V. *Text book of Economic Botany* ,Ane Book Pvt. Ltd.

SEMESTER – 5
PLANT PHYSIOLOGY AND BIOCHEMISTRY
THEORY – 54HRS

PLANT PHYSIOLOGY (36 HOURS)

Module 1- Water relation of plants (5 hours)
Physical aspects of absorption-Diffusion, imbibition, osmosis, OP, DPD, TP, WP, Concept of Water potential, Permeability and its importance.Absorption of water-active and passive, pathway of water movement, symplast, apoplast, transmembrane pathways Ascent of sap, cohesion and adhesion, Transpiration- types, mechanism, theories- (starch-sugar, H^+-K^+ion exchange), significance, anti-transpirants, guttation.

Module 2- Mineral Nutrition and absorption (3 hours)
Essential and non essential elements- macro& microelements, biological role- deficiency symptoms. Absorption of minerals – passive -ion exchange, active - carrier concept.

Module 3- Photosynthesisand Photorespiration (9 hours)
Structure of chloroplast - Photosynthetic pigments, antenna complexes and reaction centre, details of electromagnetic spectrum, photo excitation and energy transfer, conversion of light energy to chemical energy, Fluorescence, Phosphorescence - absorption and action spectra, red drop and Emerson effect, concept of two photosystems, Cyclic & Non Cyclic photophosphorylation (Z- scheme), Carbon assimilation pathways-C_3, C_4, CAM. Photorespiration, significance, factors affecting photosynthesis.

Module 4- Translocation of organic solutes (2 hours)
Direction of translocation, mechanism of translocation - pressure flow, Munch hypothesis and protoplasmic streaming theory, role of p proteins, phloem loading and unloading.

Module 5 - Respiration (6 hours)
Structure of mitochondria, aerobic respiration- Glycolysis, Krebs cycle, Electron transport system & Oxidative phosphorylation, ATPases - chemi osmotic theory, anaerobic respiration- Fermentation, RQ and its significance, respiratory inhibitors, factors affecting respiration.

Module 6-Nitrogen metabolism (2 hours)
Assimilation of nitrate by plants, biological nitrogen fixation, ammonification, nitrification and denitrification.

Module 7: Physiology of growth and development (4 hours)
Phases and measurement of growth, physiological effects and practical application of plant growth substances and hormones:Auxins, gibberellins, cytokinins, abscisic acid, ethylene. Seed dormancy and germination: Seed dormancy, causes of seed dormancy, dormancy breaking methods, Seed germination- types, factors affecting seed germination.

Module 8: Physiology of flowering and plant movements (3 hours)
Phytochrome mediated flowering, photoperiodism, vernalisation. Plant movements- classification, movements of curvature and movements of variation (paratonic and nasticmovements)

Module 9 - Stress physiology and plant responses to environment(2 hours)
Abiotic- plant responses to water, temperature and salt stresses. Biotic- pathogens and insects, Allelochemicals and herbivory

BIOCHEMISTRY (18 HOURS)

Module 1- Water, Solutions & pH (3 hours)
Physical and chemical properties of water, Acid and bases, pH definition, significance, measurement, pH indicators, buffer and buffer action.
Module 2: Chemistry of bio molecules (10 hours)
Carbohydrates- structure of common monosaccharaides, disaccharides and poly-saccharides seen in plants.
Proteins –Basic structure of amino acids, Essential and non-essential amino acids; peptide bond formation; primary, secondary, tertiary and quaternary structure of proteins.
Lipids - general features and biological role - fatty acid types and structure - fatty acid derivatives- fats and oils, structure and functions - compound lipids
Module 3: Enzymes (5 hours)
Classification, nomenclature, concepts of holoenzyme, apoenzyme, coenzyme andCofactors; Mechanism of action,Regulation of enzyme activity, enzyme kinetics, factors affecting enzyme action.

PLANT PHYSIOLOGY AND BIOCHEMISTRY
PRACTICAL - 36HRS

PLANT PHYSIOLOGY PRACTICAL (24 HOURS)
Core Experiments

1. Determination of osmotic pressure of plant cell sap by plasmolytic method.
2. Measurement of transpiration rate using Ganong'spotometer/ Farmer's potometer.
3. Separation of leaf pigments by thin layer chromatography/paper chromatography.
4. Measure the effect of environmental conditions on photosynthetic rate using Willmott's bubbler or any suitable method.
5. Estimation of plant pigments by colorimeter.

Demonstration only experiments.

1. Papaya petiole osmoscope.
2. Demonstration of tissue tension.
3. Relation between transpiration and absorption.
4. Necessity of chlorophyll, light and CO_2 in phytosynthesis.
5. Simple respiroscope
6. Respirometer and measurement of R.Q.
7. Fermentation- Kuhne's tube

BIOCHEMISTRY – PRACTICAL. (12 HOURS)

1. General test for carbohydrates- Molischs test, Benedicts's tests, Fehling's test.
2. Colour test for starch – lodine test.
3. Colour tests for proteins in solution. Biuret test, Million's test, Ninhydrin test.
4. Detect the presence of any three major organic compounds in the given food stuff/material viz. reducing /non-reducing sugar, fat, proteins, starch/sucrose.
5. Action of various enzymes in plant tissues: peroxidase, alpha amylase.
6. Estimation of protein using colorimeter.

References

1. Datta, S.C.1989. *Plant Physiology*, Central Book Depot, Allahabad.
2. Dayananda, B. 1999. *Experiments in Plant Physiology*, Narosa Publishing House, New Delhi.
3. De Robertis, E.D.P. and De Robertis, E.M.F.Jr. 2002. *Cell and Molecular Biology*, Lipponcott Williams and Wilkins. USA.
4. Hopkins, W.G. 1999. *Introduction to Plant Physiology*. John Wiley and sons, New York.
5. Jain J.L. Sanjay Jain &Nitin Jain. 2005. *Fundamentals of Biochemistry*. S. Chand & Company Ltd., New Delhi.
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7. Kochar, P.L. 1964. *A Text Book of Plant Physiology*, Atmaram& Sons, Delhi.
8. Lehninger A.L.1961. *Biochemistry*, Lalyan Publishers, Ludhiana.
9. Leopald, A.C. and Kriedemann, P.E. *Plant Growth and Development*. Tata McGraw Hill, New Delhi.
10. Malik, P.C. 1680. *Plant Physiology*, Kalyani Publishers, New Delhi.
11. Nelson, D.L. and Cox, M.M. 1993. *Principles of Biochemistry*. MacMillan Worth Publications.
12. Pandey, S. N. and Sinha, B. K.1986. *Plant Physiology*. Vikas Publishing house Pvt. Ltd.
13. Plummer D.T. 1988. *An Introduction to Practical Biochemistry*, Tata McGraw- Hill Publishing Company, New Delhi.
14. Sadasivam.S&Manickam, A. 1996. *Biochemical Methods*. New Age International (P) Ltd. New Delhi.
15. Salisbury, F.B. & Ross, C.W. 1985. *Plant Physiology*, CBS Publishers and Distributers, Delhi. (should be compulsorily introduced to students)
16. Srivastava H.S. 2005. *Plant Physiology*. Rastogi Publications, Meerut.
17. Taiz, L. and Zeiger, E. 2003. *Plant Physiology* (5rd Edition). PanimaPublishing Corporation, New Dlehi.

SEMESTER – 5
BEGINNERS BOTANY (OPEN COURSE)
THEORY – 72 HRS

Module 1- Basic architecture of plants (12 hours)
Plant groups (general features only), Algae, Fungi, Bryophytes, Pteridophytes, Gymnosperms and Angiosperms; Dicots and Monocots; Parts of an angiosperm plant Root, Stem, Leaf. Functions of the different parts. Plant part modifications: Stem modifications, tuber, rhizome, bulb, corm, sucker, Root modifications, tuber, aerial roots , Leaf , function, phyllotaxy, simple and compound leaves

Module 2 – Plant growth and reproduction(12hours)
Growth in length, growth in girth, meristem, cambium, increase in girth, buds. Flower, parts, inflorescences, racemose and cymose, pollination, pollination agents, development of fruits and seeds, seed dispersal, parts of a seed,

Module 3- Plant propagation (12 hours)
Propagation through seeds, seed germination, vegetative propagation; stem, root and leaf cuttings, layering, grafting and budding

Module 4 – Plant Nutrition (12 hours)
Major nutrients, minor nutrients, sources of nutrients in soil, types of fertilizers; organic and inorganic fertilizers, green manure, biofertilizer, methods of applying fertilizers; base dressing, top dressing, liquid feeding, foliar feeding

Module 5 – **Medicinal plants and their identification**(12 hours)
Study of the common name , binomial and important medicinal uses of the following common medicinal plants of Kerala: *Eclipta alba, Vernonia cineraria, Emelia sonchifolia, Ocimum sanctum, Leucas aspera, Adhathoda vasica, Boerhavia diffusa, Scoparia dulcis, Aegle marmalose, Saraca ashoka, Coleus umbonicus, Eupatorium ayapana, Rauwolfia serpentine, Alpinia galanga, Achorus calamus, Kaempheria galanga, Andrographis paniculata, Terminalia catapa, Terminalia tibula, Phyllanthus niruri* .

Module 6 – Applied botany (12 hours)
Totipotency of plant cells, *in vitro* plant propagation through tissue culture, advantages, requirements, aseptic techniques, basic composition of tissue culture medium, direct and indirect organogenesis, somatic embryo genesis, cell suspension culture, hardening of tissue culture plants. Somaclonal variation.
Edible and poisonous mushrooms, Mushroom cultivation, requirements and basic steps, detailed cultivation practices of Oyster mushroom

SEMESTER –6
ECOLOGY AND ENVIRONMENTAL SCIENCE
THEORY :- (54 HOURS)

Module - 1 General introduction (2 Hours)
Relevance and scope of ecology,Ecology and Environmental Science, Interdisciplinary nature of environmental science, Types of resources-Renewable and non-renewable, Sustainable development and ecological footprints

Module - 2 Ecosystems: Structure and function (10 Hours)
Ecosystem components- abiotic and biotic**,** Energy flow: Ecological energetics, trophic levels, food chain and food web and ecological pyramids, Productivity – primary, secondary and net productivity, Lebig's law of minimum, Nutrient cycles: Biogeochemical cycles of C, N and S. Habitat, ecological niche and microclimate

Module - 3 Population and Community ecology(10 Hours)
Population characteristics, population growth, Metapopulations, Ecotypes and Ecads, Community characteristics: Quantitative (eg. frequency, density and abundance), Qualitative (eg. physiognomy and phenology), Synthetic (eg. dominance), ecotone and edge effect, Ecological succession: types of succession, process of succession. Hydrosere and xerosere.

Module - 4 Plants and environment (10 Hours)
Ecological complexes and factors affecting plants growth and response: Climatic factors: temperature and pressure, water - precipitation, humidity, soil water holding capacity, light - global radiation,Topographic factors: altitude and aspects, Edaphic factors – Soil profile and physical and chemical properties of soil, soil formation, Biotic factors: interactions – positive and negative, Adaptation of plants to environment: Xerophytes, Hydrophytes, epiphytes and halophytes, Climate, vegetation and botanical zones of India. Western Ghats – a brief study

Module - 5 Global environmental problems and management (12 Hours)
Definition and general introduction, Air pollution, Water pollution, Land pollution, Noise pollution, Thermal pollution, Radioactive pollution, Solid waste management , Phytoremediation, ecological indicators, EIA: Environmental Impact Assessment in polluted areas, Global warming, Acid rain, Ozone layer depletion, Impacts of climate change on agricultural production, human health and global distribution of ecosystems.

Module - 6 Biodiversity and Conservation of resources (10 Hours)
Biodiversity general introduction, Endemism: Definition, types, Hotspots in India, IUCN-threat categories, Red data book, Biodiversity loss: Causes and rate of biodiversity loss, extinction causes; habitat destruction, invasive species, over exploitation and pollution, Conservation efforts: In situ and ex situ conservation methods, National parks and wild life sanctuaries of Kerala. Joint Forest Management (JFM). Ecotourism

PLANT ECOLOGY, PHYTOGEOGRAPHY AND ENVIRONMENTAL SCIENCE
PRACTICAL :- (54 HOURS)

1. Estimation of CO_2, Dissolved O_2 and total alkalinity of water samples (Titremetry)
2. Determination of pH of soil and water
3. Assessment of diversity, abundance, and frequency of plant species by quadrate method (Grasslands, forests)
4. Study of the most probable number (MPN) of coliform bacteria in water samples
5. EIA studies in degraded areas (Sampling – line transect, Quadrate)
6. Visit to any forests types including grasslands and preparation of the list of Rare and threatened (R&T) plants (no collection of specimens) OR Visit to any ecotourism center in Kerala and prepare a report on the project.
7. Collection, identification and preparation of the list of exotic species in the locality.
8. Study of anatomical, morphological, physiological adaptation of plants to the environment (Xerophytic, Hydrophytic, Epiphytic and Halophytic)
10. Collection and recording of rain data by using simple rain gauge.
11. Western ghats conservation; issues and approaches, Comparison of Kasthuri Rangan report and Gadgil report

REFERENCES:

1. Peter Stiling Ecology: Global insights and investigations (2012), Mc Grew Hill
2. H.D Kumar (2000)*Modern Concepts of Ecology* Vikas Publishing House, New Delhi
3. K Rakhavan Nambiar, Text book of Environmental studies, Scitech publications, Chennai.
4. Odum, E.P. 1971. *Fundamentals of Ecology WB Sunders.*
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6. Smith T. M. and Smith R. L. 2012 Elements of ecology ,Pearson publication, New Delhi
7. Sulekha and Chendel. *Plant Ecology and Soil*. S. Chand & Co. Ltd. New Delhi
8. Trivedi R.K. and Goel P.K. chemical and biological methods for water pollution studies

SEMESTER – 6
CYTOLOGY, GENETICS AND MOLECULAR BIOLOGY
THEORY :- (54HOURS)

CYTOLOGY(18HOURS)

Module 1- Cell architecture and membrane structure (3hours)
Cell Architecture: prokaryotic and eukaryotic cells. Biomembrane structure :The Phospholipid Bilayer: Composition and structuralOrganization.

Module 2 - Cell structure (3hours)
The detailed structure of plant cell.Sturcture and function of the following organelles-nucleus, endoplasmic reticulum, plastids, mitochondria, ribosomes, dictyosome, microbodies, lysosomes, vacuole, nucleolus. Differences between animal cell and plant cell

Module 3 - Transmembrane Transport of Ions and Small Molecules(3hours)
Overview of Transmembrane Transport , Facilitated Transport of Glucose and Water , ATP-Powered Pumps and the Intracellular Ionic Environment, Nongated Ion Channels and the Resting Membrane Potential, Cotransport by Symporters and Antiporters; Transcellular Transport

Module 4–Cytoskeleton (3hours)
Structure and organization of actin filaments, Myosins, Myosin-Powered Movements, assemblies of actin and myosin, structure and assembly of microtubules, chromosome movement, Kinesins and dyneins, structure and function of intermediate filaments

Module 5 – Cell Cycle and Cell Division (3hours)
Overview of the Cell Cycle and its Control, Model Organisms and Methods to Study the Cell Cycle, Details of mitosis and meiosis

Module 6 – Chromosomes (3hours) Morphology - fine structure Nucleosome model , karyotype and idiogram; Special type of chromosomes - salivary gland,Lamp brush and B chromosome ; Change in number of chromosomes -Aneuploidy and Euploidy,Down's, Klinefelter's and Turner's syndromes, Change in the structure of chromosomes , deletion, duplication, inversions and translocations and their meiotic behavior

GENETICS(18 HOURS)

Module 1 - Mendelism and its extension(3 hours)
Experiment of Mendel with *Pisum sativum*, recessive and dominant traits, alleles, principles of inheritance,incomplete dominance and codominance; Lethal alleles, Epistasis; dominant and recessive, multiple alleles; Pleiotropy, Polygenic inheritance, pedigree analysis,Chromosome theory of inheritance.

Module 2 – Limkage (3 hours)
Linkage, crossing overand chromosome mapping, Linkage and crossing over-Cytological basis of crossing over; Recombination frequency, twofactor and three factor crosses; Interference and coincidence; Sex Linkage, eye color in Drosophila, Haemophilia in man

Module 3 - Extrachromosomal Inheritance(3 hours)
Extrachromosomal Inheritance**,** Chloroplast mutation: Variegation in Four o'clock plant; Mitochondrial mutations in yeast;Maternal effects-shell coiling in snail; Infective heredity-Kappa particles in Paramecium.

Module 4 – Sex Determination (3 hours)
Sex determination- sex chromosomes and autosomes- chromosomal basis of sex determination; XX-XY, XX-XO mechanism; sex determination in higher plants (*Melandrium album*)
Module 5 – Mutation (3 hours)
Mutations, definition, importance of mutation, types of mutations, gene mutations, types of gene mutations, causes of mutations

Module 6 – **Population Genetics**(3 hours)
Gene pool, gene frequency, genotype frequency, Hardy Weinberg law and its applications

MOLECULAR BIOLOGY(18 HOURS)

Module 1- Genetic material (3hours)
Introduction to heredity and the genetic material, characteristics of genetic material, Early studies on DNA [works of F.Miescher, Albert Kossel, Phoebus Levene, Erwin Chargaff], The discovery of transforming principle [Griffith's experiment], Identification of the transforming principle[Avery, MacLeod and McCarty's experiment]; [Hershey and Chase experiment], Watson and Crick's discovery of the structure of DNA,

Module 2- Structure of DNA (3hours)
The structure of DNA, Primary structure; structure of ribose and deoxyribose sugars, Structure of N bases, structure of nucleosides and nucleotides, phosphodiester bond and structure of a polynucleotides, Secondary Structure; structure of DNA double helix, different secondary structures [A,B and Z] , circular DNA

Module 3- DNA replication and DNA repair (3hours)
Suspected forms of DNA replication, conservative, dispersive and semi-conservative, Meselson and Stahl's experiment, Requirements for replication; template, raw materials, enzymes and other proteins,direction of replication, mechanism of replication, Bacterial DNA replications, eukaryotic DNA replication. DNA repair, mismatch repair, direct repair, base-excision repair, nucleotide excision repair, photoreactivation, SOS response

Module 4- Transcription (3hours)
Concept of gene, Transcription, the structure of RNA, types of RNA, mRNA, tRNA, rRNA, snRNA, snoRNA, miRNA, requirements for transcription, the template and non-template strands of DNA, experiments by Julius Marmur, Promoters; bacterial and eukaryotic, RNA polymerase;

bacterial and eukaryotic, the process of bacterial transcription, the process of eukaryotic transcription, RNA processing; addition of 5' cap and 3'polyA tail, split genes, exons, introns, RNA splicing.

Module 5 - Translation (3hours)
Structure of tRNA, clover leaf and 'inverted L' models of tRNA, the genetic code, characteristics of the code, process of translation, polyribosomes, translation inhibitors

Module 6–Gene Regulation (3hours)
Levels of gene regulation, gene regulation in bacterial cells; operon concept, negative and positive control, inducible and repressible operons, *lac* operon of *E.coli*, *trp* operon of *E.coli*, Gene regulations in eukaryotes; chromatin remodelling, histone acetylaltion, DNA methylation, alternative splicing of mRNA, RNA silencing, epigenetics

CYTOLOGY, GENETICS AND MOLECULAR BIOLOGY PRACTICAL :- (54HOURS)

Cytology
1. Study of plant cell structure using Onion epidermal peel
2. Isolation of chloroplast
3.Isolation of mitochondira and staining using Janus Green B
4. Study of the different stages of mitosis using onion root tip squash
5. Study of the different stages of meiosis using permanent slides
6. Study of normal human karyotype and differentiating it with the karyotypes of Down's, Klinefelter's and Turner's syndromes

Genetics
1. Work out problems in:
   a. Monohybrid , dihybrid and back crosses.
   b. All types of modified Mendelian ratios mentioned in the syllabus.
   c. Multiple alleles and their inheritance
   c. Sex linked inheritance
   d. Population genetics (Mendelian traits with typical dominant and recessive relations only)
2. Raise a population of Drosophila and List the contrasting features among the individuals in the Drosophila population

Molecular Biology
1. Work out problems based on DNA structure , replication, transcription and translation
2 . Isolation of DNA from plant tissue
3. Agarose Gel Electrophoresis of DNA
4. Spectrophotometric quantification of DNA

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Cooper GM and Hausman (2013), The Cell, a molecular approach , 6th Edition,Sinauer Associates, Sunderland

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Harvey, L., Arnold, B., Lawrence, S., Zipursky, Paul, M., David, B., and James, D(2000), Molecular Cell Biology (4th Ed.), W. H. Freeman, New York

Lodish et al.2004. Molecular Cell Biology " (Scientific American Book)

Stern, K.R. (2002), Introduction to plant Biology (8th Ed.), Mc Graw Hill, Boston

SEMESTER – 6
PLANT BIOTECHNOLOGY AND BIOINFORMATICS
THEORY:- (54 HOURS)

BIOTECHNOLOGY (36 HOURS)

Module 1 – History and basic concepts (3 hours)
Experiments of Gottlieb Haberlandt, P R White, Gautheret, Nobecourt, Skoog and Steward, Cellular totipotency, *in vitro* differentiation–de differentiation and re-differentiation

Module 2 – Tissue culture Media (6 hours)
Basic components of tissue culture media, inorganic nutrients, carbon source, vitamins, organic supplements, chelating agents, plant hormones, gelling agents, adsorbents, pH of medium, general methodology of medium preparation with special reference to MS medium

Module 3 – Sterilization techniques (6 hours)
Sterilization of equipments, glasswares, medium end explant. sterilization using hot air, steam, filter, UV, alcohol and chemicals . Working of hot air oven, autoclave and laminar air flow chamber, layout of a tissue culture lab

Module 4 – Micropropagation (11hours)
Micropropagation- different methods – axillary bud proliferation, meristem and shoot tip culture, direct and indirect organogenesis, somatic embryogenesis, subculturing, hardening, transplantation and field evaluation, advantages and disadvantages of micropropagation, somaclonal variation, production of haploids through tissue culture; androgenic methods, gynogenic methods, uses of haploids, cryopreservation of plant cells

Module 4 – Recombinant DNA Technology(10 hours)
Gene cloning strategies – recombinant DNA construction – cloning vectors – plasmids pBR322, bacteriophage based vectors, Ti plasmids. Restriction endonucleases and ligases – Ligation techniques, transformation and selection of transformants – using antibiotic resistances markers, PCR.

BIOINFORMATICS (18 HOURS)
Module 1 –Bioinformatics introduction (3 hour)
An Introduction to bioinformatics. Scope and relevance of bioinformatics. Elementary commands and Protocols, Formats: FASTA format ,ASN.1 format, PDB flat file format

Module 2: Biological Data bases (8 hours)
Online databases and search tools, data organization, NCBI .Biological data bases, structural data bases, DNA and RNA sequence data bases.

Nucleic acid sequence databases : GenBank ,EMBL, DDBJ
Protein sequence databases: GenBank ,SWISS-PROT
Protein structure database : Protein Data Bank
Bibliographic databases : PubMed

Module 3: Alignment (4hours)
Sequence comparison, Pair wise sequence alignment, Global alignment: Use of ALIGN, Local alignment: Use of BLAST.

Module 4: Molecular Visualization Tools (3 hours)
Molecular structure viewers : RasMol, SWISS-PDBViewer.

PLANT BIOTECHNOLOGY AND BIOINFORMATICS
PRACTICALS:- (36 HOURS)

- Preparation of nutrient medium – Murashige and Skoog medium
- Establishing shoot tip, axillary bud cultures
- Establishing single cell culture of any one plant and preparing a growth curve
- Immobilization of whole cells or tissues in sodium alginate.
- Determination of appropriate flower bud containing uninucleate pollen for anther culture using cytological techniques
- Establishment of the axenic culture of any one crop plant
- Analysis of Nucleotide sequence using GENBANK
- Analysis of structural features of proteins using protein data bank and RASMOL
- Similar DNA sequences search using BLAST

References

1. Bioinformatics : A Machine Learning Approach. P Baldi and S Brunak. MIT Press
2. David W Mount, Bioinformatics: sequence and genome analysis, CBS Publishers
3. Developing Bioinformatics Computer Skills. Cynthia Gibas and Per Jambeck. O'Reilly Genomes . TA Brown. Wiley-Liss.
4. Genomics: The Science and Technology Behind the Human Genome Project. CR Cantor and CL Smith. John Wiley and Sons.
5. Bioinformatics ,databases, tools and algorithms, Orpita Bosu, Simminder Kaurthukral.

SEMESTER – 5
AGRI-HORTICULTURE AND PLANT BREEDING
THEORY :- (54 HOURS)

PLANT BREEDING (27 hours)

Module1- History and objectives (2 hour)
History and objectives of plant breeding. Centers of origin of cultivated plants.

Module1- Plant Introduction (2 hour)
Plant introduction- procedure, quarantine regulations, acclimatization.Agencies of plant introduction in India.Achievements.

Module3 – Selection (6 hours)
Selection- mass, pureline, clonal, achievements.

Module4 – Hybridization (10 hours)
Hybridization: procedure- intergeneric, interspecific and intervarietal hybridization with examples.Composite and synthetic varieties.Heterosis in plant breeding, inbreeding depression; Single cross: pedigree method, bulk population method, multiple cross, back cross, polyploidy breeding, male sterility in plant breeding.Use of apomixis in plant breeding.

Module 5 – Mutation breeding (5 hour)
Mutation breeding: Mutagens- physical and chemical, spontaneous and induced mutations, effect of mutation, methods of mutation breeding.Gamma gardens and its working. Breeding for Biotic(disease)and abiotic (drought) stress resistance

Module 6 – Modern trends (2 hour)
Modern trends in plant breeding; Somaclonal variations in crop improvement ,genetically modified crops

HORTICULTURE (27 hours)

Module 1 – Basics of Horticulture (4 hours)
Scope and importance, Divisionsof horticulture, Global scenario of horticultural crops, export and import, HorticultureZones of India and Kerala, Horticultural developmental agencies in India

Module 2 – Soil and climate (4 hours)
Soil; physical and chemical properties, climatic factors; light,temperature, photoperiod, relative humidity, rainfall, micro climate, influence of biotic and abiotic stresses on crop production

Module 3 – Plant Propagation (7 hours)

Propagation of horticultural plants- by seeds- Seed viability, seed dormancy, seed testing and certification, seed bed preparation, seedling transplanting, hardening of seedling; advantages and disadvantages of seedpropagation.

Vegetative propagation- organs used in propagation- natural and artificial vegetative propagation; methods- cutting, layering, grafting and budding; stock scion union, advantages and disadvantages of vegetative propagation,

Module 4 – Gardening (6 hours)

Garden tools and implements, Irrigation methods- surface, sub, drip and spray irrigations, mist chambers- advantages and disadvantages. Ornamental gardens, indoor gardens, kitchen gardens- terrestrial and aquatic gardens.Garden designing- garden components- lawns, shrubs and trees, borders, hedges, edges, walks, drives.

Landscape architecture- home landscape design, parks. Physical control of plant growth- training and pruning;selection of plant for bonsai, bonsai containers and method of bonsai formation

Module 5 – Precision Farming (6 hours)

Need for precision agriculture, technologies for precision farming, fertigation, methods of irrigation, crop scouting,plant growing structures; hot beds, cold frames, cloth houses, glass houses, green houses , hydroponics , Israel model

Reference:

1. Adams C.R., Early M.P. 2004. *Principles of Horticulture*. Elsevier, N. Delhi.
2. Barton West R. 1999. *Practical Gardening in India*. Discovery Pub. House, New Delhi.
3. Edmond J.B., Senn T.L., Andrews F.S., Halfacre P.G. 1975. *Fundamentals of Horticulture*. 4thEdn.TMHN.Delhi .
4. John Weathers. 1993, *Encyclopaedia of Horticulture*. Discovery Pub. House. New Delhi.
5. Jules Janick. 1979. *Horticultural Science*. Surjeet publications, Delhi.
6. Kumar N., 1994. *Introduction to Horticulture*. Rajalakshmi Pub. Nagarcoil.
7. ManibhushanRao K. 2005. *Text Book of Horticulture*. Macmillan India Ltd.
8. Randhawa G.S., Mukhopadhyay A. 1986. *Floriculture in India*. Allied Publishers Pvt. Ltd. Ahamedabad.
9. Sadhu M.K. 1996. *Plant propagation*. New age international publishers, N. Delhi.
10. Schilletter J.C., Richey H.W. 1999. *Text Book of General Horticulture. Biotech Books*, New Delhi.
11. Shukla R.S., Chandel P.S. 2004. *Cytogenetics Evolution and Plant breeding*. S. Chand&Co.Ltd New Delhi.

SEMESTER – 6
TAUGHT AND DIRECTED RESEARCH PAPER
THEORY:- (54 HOURS)

1. Search and research,
2. Characteristics of research
    a. Sufficient and necessary conditions
    b. Systematic and rigorous
    c. Logic and validity,
    d. Controls
    e. Empirical observations, public scrutiny, openness to criticism,reproducibility ,
3. Kinds: Descriptive, Explanatory Co Relational Exploratory
4. Function: Pure, Applied Practical
5. Epistemology : Intuitive, Serendipity , Authoritative,, Empirical, Logical, Hypothetico-Experimental-Deductive,
6. Ontology :Positivism, Logical Positivism, Subjective
7. Research process
    a. Raising questions one or many
    b. Defining problem- articulate the problem in a sentence
    c. Literature review:1- to establish necessary sufficient and conditions –do they say there are gaps
    d. Guessing the tentative solutions
    e. Literature review:2- to establish the theoretical bonds between the problem and hypothesis/es –the research proposal
    f. Designing method and controls to capture data - in time
    g. Collecting data
    h. Analyzing data for hypothetico- experimental-deductive conclusions
    i. Writing the thesis
8. Key skills.
    a. Inferential statistics to test hypothesis
    b. Literature review with online bibliographic packages
    c. Writing the research proposal
    d. Writing a research paper
    e. Writing the thesis in specified format

TAUGHT AND DIRECTED RESEARCH PAPER
PRACTICAL:- (36 HOURS)

1. Develop your research proposal with the guidance of a faculty and submit it before the undergrad research committee for evaluation, recommendations and clearance to undertake the research work
2. Undertake the research work in the college with the guidance of a faculty
3. Conduct a capstone seminar on the topic of your research
4. Submit the thesis in the specified format before a pre announced deadline and defend your thesis before the undergrad viva vice committee for evaluation

COMPLEMENTARY COURSES IN BOTANY FOR B.SC ZOOLOGY PROGRAMME

Semester	Course Code	Course title	Hours/week	Credit
1		Cryptogams And Gymnosperms	2	2
		Cryptogams And Gymnosperms - Practicals	2	1
II		Physiology	2	2
		Physiology -Practical	2	1
III		Angiosperm Morphology And Taxonomy	3	3
		Angiosperm Morphology And Taxonomy – Practicals	2	1
1V		Anatomy And Applied Botany	3	3
		Anatomy And Applied Botany - Practicals	2	1

SEMESTER – 1
CRYPTOGAMS AND GYMNOSPERMS
THEORY :- (36 HOURS)

Module – 1 Classification (3 hours)
Classification and naming , purpose and significance, 2 kingdoms, 5 kingdoms, 3 domains.

Module – 2 Algae (9 hours)
General features, classification based on pigments, salient features of thallus and life cycle of the following,

Cyanophyceae : *Nostoc*
Chlorophyceae : *Oedogonium*
Phaeophyceae : *Ectocarpus*
Rhodophyceae : *Polysiphonia*

Economic importance of Algae (general account)

Module – 2 Fungi (6 hours)
General features, classification, salient features of hyphae, and life cycle of the following groups.

Phycomycetes : *Phytophthora*
Ascomycetes : *Peziza*
Basidiomycetes : *Puccinia*

Economic importance of Fungi (general account)

Module – 3 Lichens (2 hours)
Symbiosis of algae and fungi in lichen, classification based on thallus form and economic importance, Thallu morphology and anatomy of *Parmelia*

Module – 4 Bryophytes (4 hours)
General features, classification, salient features of the thallus and life cycle of *Riccia* ,Economic importance of Bryophytes

Module – 5 Pteridophytes (4 hours)

General features, classification, salient features of the sporophytes and gametophyte and life cycle of *Pteris*, Economic importance of Pteridophytes

Module – 5 Gymnosperms (4 hours)
General features, classification, salient features of the life cycle of *Cycas* , Economic importance of Gtymnosperms

Module – 6 Plant Pathology (4 hours)
Plant - pathogen interaction, host defense mechanisms, Control of plant diseases; physical, chemical & biological methods. Study of the following diseases (causative organism, symptoms and control measures); Nut fall of Arecanut, Abnormal leaf fall of Rubber, Leaf mosaic of Tapioca

CRYPTOGAMS AND GYMNOSPERMS
PRACTICAL:- (36 HOURS)

Student should be able to

1. Identify Cryptogamic and Gymnosperm specimens and their parts prescribed in the syllabus; make micro-preparations wherever necessary
2. Identify plant diseases mentioned in the syllabus.

References:

1. Ahamdijan, Vernon and Mason H. E (1973) The Lichens. New York: Academic press.
2. Alexopoulose C. J. and Mims C. W. (1983) Introductory Micology, New York: Wiley Eastern
3. Bhatia K. N (1975) A treatise on Algae. New Delhi. S. Chand and co. Publishing, New Delhi, Vikas publishing House Pvt.Ltd.
4. Bilgramic K. S and Dube H. C (1976). Text Book of Modern Plant Pathology. New Delhi. Vikas Publishing House Pvt.Ltd
5. Bishwas S.B and Biswas A. (1973). An Introduction to Viruses. New Delhi. Vikas Publishing House Pvt. Ltd.
6. Chaube H. S. and Ramji S. (2000) Introductory Plant Pathology, International Book Distributing Co. Lucknow.
7. Chopra R.N and Kumra P. K (1988) Biology of Bryophytes. New Delhi, Wiley Eastern Ltd.
8. Fritsch F. B (1945), Structure and Reproduction of Algae Vol. I & II. CambridgeUniversity Press.
9. Gangulee H. C and Kar A. K(1993) College Botany Vol. II Calcutta, New Central Book Agency.
10. Kanika Sharma (2009), Manual of Microbiology, Ane Books Pvt. Ltd.
11. MamathaRao(2009) Microbes and Non- flowering plants, Impact and applications, Ane Books Pvt.Ltd..
12. Pandey S. N and Trivedi P. S(1994) . A Textbook of College Botany Vol I
13. Pandey S. N. and Trivedi P. S(1998). A text Book of College Botany Vol.II
14. Pandey B.P (2007), College Botany Vol. I, S. Chand and Company
15. Pandey B. P(2007), College Botany Vol II, S. Chand and Company

16. Sharma P. D(2003) Microbiology and Plant Pathology and Biochemistry, Rasthogy Publications
17. Vasishta B. R. Bryophyta – S. Chand and Co. New Delhi

SEMESTER – 2
BOT 102 – PLANT PHYSIOLOGY
THEORY :- (36 HOURS)

Module 1 - Plant and water (10 hours)
Physical aspects of water absorption –imbibition, diffusion and osmosis. Plant cell as an osmotic system. Diffusion pressure deficit, water potential, plasmolysis, Mechanism of water absorption, active and passive absorption. Transpiration – types, structure and mechanism of stomtal transpiration, theories, significance and factors affecting transpiration, antitranspirants, guttation.

Module 2 - Photosynthesis (12 hours)
Structure of chloroplast, Pigments, two pigments systems, light and dark reaction, Cyclic & Non Cyclic photophosphorylation, C_3, C_4 and CAM mechanisms, photo respiration, Factors affecting Photosynthesis: External and Internal.

Module 3 - Translocation of solute (2 hours)
Translocation of organic solutes: Path and mechanism of Translocation, Munch mass flow hypothesis

Module 4 - Nitrogen metabolism (3 hours)
Symbiotic nitrogen fixation, Nitrogen Cycle, Carnivorous plants

Module 5 - Seed Physiology (3 hours)
Dormancy of seeds, factors causing dormancy, photoblastisms, techniques to break dormancy, germination – mobilization of food reserves

Module 5 - Plant growth and movement (6 hours)
Growth and Movements: Sigmoid curve, measurement of growth, regions of growth, general account of growth hormones, effect of ABA. Senescence and Abscission. Tropic and nastic movements with reference to geotropism, phototropism,. Photoperiodism and Vernalization.

PLANT PHYSIOLOGY
PRACTICAL:- (36 HOURS)

Core Experiments:

1. Determination of osmotic pressure by plasmolytic method
2. Separation of Chlorophyll pigments by paper chromatography.
3. Effect of carbon dioxide concentration on the rate of photosynthesis by *Hydrilla* plants
4. Demonstration of osmosis using plant membrane

Demonstration Experiments:

1 .Determination of transpiration under different environmental conditions using Ganong's / Farmer's Potometer
2. Relation between transpiration and absorption
3. Evolution of O_2 during photosynthesis
4. Light screen expt.
5. Mohl's experiment
6. Experiment with variegated leaf
7. Measurement of growth using Arc Auxanometer
8. Experiment with Kleinostat.
9. Effect of hormones on growth

References

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Jain V. K., 2008. Fundamentals of Plant Physiology, S. Chand and Co.
Kochhar P. L. &Krishnamoorthy H. N. Plant Physiology, Atmaram and Sons, Delhi, Lucknow.
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Malik C. P. 2002. Plant Physiology, Kalyani Publishers
Malik C. P. and Srivastava A. K- Text Book of Plant Physiology – Kalyani Publishers, New Delhi.
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Noggle G. R. & Fritz G.J- Introductory Plant Physiology- Prentice Hall of India.
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Sinha A.K 2004. Modern Plant Physiology, Narosa Publishing House, New Delhi.
Srivastava H. S.,2004. Plant Physiology & Biochemistry, Rasthogi Publications.
Verma V. 2007. Text Book of Plant Physiology, Ane Books Pvt Ltd.
Verma S. K.&Mohit Verma,2006. A Text book of Plant Physiology, Biochemistry & Biotechnology, S. Chand and Co.
William G. Hopkins- Introduction to Plant Physiology –John Wiley & Sons, New York.

SEMESTER – 3
ANGIOSPERM MORPHOLOGY, TAXONOMY AND ECONOMIC BOTANY
THEORY – 54 HRS

Module 1 – Introduction (4 hours)
Importance of plant taxonomy , types of classification, binomial nomenclature; ICB N, cytotaxonomy, chemotaxonomy.

Module 2– Herbarium (3 hours)
Herbarium techniques :Field study, field note, vasculum, plant press, disinfecting and mounting, labeling, importance of herbarium.

Module 3– Classification system (3 hours)
Bentham and Hooker's system of classification.

Module 4– Morphology (4 hours)
Morphology of Angiosperms , Plnt habits, leaf, stem and root modifications , flowers, inflorescence, fruits

Module 5 – Detailed Study of Angiosperm Families (22 hours)
Study of the following families of Bentham and Hookers system of classification with special reference to major identifying characters and economic importance : Annonaceae, Malvaceae, Rutaceae, Leguminosae, Apiaceae (Umbelliferae), Rubiaceae, Asteraceae, Apocynaceae, Lamiaceae (Labiatae), Euphorbiaceae, Arecaceae (Palmae), Poaceae (Gramineae).

Module 6 – Economic Botany (18 hours)
(a) Study of the following economic plants with special reference to their botanical name, family, morphology of useful part, economic products and uses.

Cereals	: Paddy, Wheat.
Pulses	: Green gram, Bengal gram.
Tuber crops	: Tapioca.
Spices	: Pepper, Cardamom.
Beverages	: Tea, Coffee.
Oil yielding plants	: Coconut, Groundnut
Fiber yielding plants	: Cotton, Coir.
Timber yielding plants	: Teak, Rose wood.
Latex yielding plants	: Para rubber.
Bio pesticides	: Neem, Tobacco.
Ornamental plants	: Rose, Orchids, Anthurium.

(b) Study of the following medicinal plants with special reference to their binomial, family, morphology of useful parts and uses.

1.*Adhatoda vasica* 2. *Aloe vera*, 3.Bacopa moniri ,4.*Catharanthus* roseus 5.*Eclipta alba*, 6. *Azadirachta indica*, 7. *Ocimum sanctum*, 9.*Phyllanthus amarus*, 9.*Rauvolfia serpentina*, 10.*Sida. acuta*

ANGIOSPERM MORPHOLOGY AND TAXONOMY
PRACTICAL : (36 HOURS)

1.Practice to identify typical plants belonging to the families prescribed in the syllabus. Learn to describe the floral parts in technical terms, draw floral diagrams and write floral formula.

2.Learn to identify the economic products obtained from the plants included in the syllabus (Module 6). Should record and study the botanical name, family, morphology of the useful part and the uses of the plants mentioned in module 6.

Reference

1.Eames, A. J. 1969. *Morphology of Angiosperms*.McGraw – Hill, New York.
2.Hill, A.F. 1952. *Economic Botany: A Text book of Useful Plants and Plant Products*. Tata McGraw-Hill Publishing Company Limited, New Delhi.
3.Kochhar, S.L. 1981. *Economic Botany in the Tropics*.Macmillion India Limited,Delhi.
4.Lawrence, G.H.M. 1951. *Taxonomy of Vascular Plants*.Oxford & IBH, New Delhi.
5.Naik, V.N. 1984. *Taxonomy of Angiosperms*.Tata McGraw – Hill Publishing Co; New Delhi.
6.Sharma, O.P. 1993. *Plant Taxonomy*. Tata McGraw – Hill Publishing Co Ltd., New Delhi.
7.Simpson, B.S and M. Conner – Ogorzaly. 1986. *Economic Botany: Plants in Our World.* .McGraw – Hill Book Company, New York.
8.Singh, G. 1999. *Plant Systematics – Theory and Practice.* Oxford & IBH, New Delhi

SEMESTER – 4
PLANT ANATOMY AND APPLIED BOTANY
THEORY – 54 HRS

PLANT ANATOMY (27 HOURS;)

Module 1 – Plant Cell (4 hours)
Plant cell – living and non living inclusions, cell wall – ultra structure of cell wall (brief account only)

Module 2– Plant Tissues (5 hours)
Tissues: simple and complex; structure and function, meristems, secretary tissues.

Module 3– Primary Structure of plant organs (6 hours)
Primary structure of leaf, stem and root in dicots and monocots.

Module 4– Secondary Growth (8 hours)
Secondary thickening in dicot stem and dicot root; cambium, growth rings, heart wood and sap wood; hard wood and soft wood; ring porous wood and diffuse porous wood, Anomalous secondary thickening in *Bignonia*.

Module 5– Ecological Anatomy (4 hours)
Study of the morphological and anatomical adaptations of the following groups; Hydrophytes , Xerophytes, Epiphytes and Halophytes

APPLIED BOTANY (27 HOURS)

Module 1 – Introduction to Plant Breeding (2 hours)
History and objectives

Module 2– Methods of plant improvement (6 hours)
Plant introduction, acclimatization, plant quarantine : Selection: Mass selection; pureline selection and clonal selection: Hybridization; intervarietal, interspecific and intergeneric; procedure of hybridization.

Module 3– Special methods of plant breeding.(7 hours)
Mutation breeding, Polyploidy breeding, Apomixis, apogamy, apospory ,amphimixis, parthenogenesis, parthenocarpy, polyembryony.

Module 4– Horticultural practices(6 hours)
Propagation through cutting, layering, budding and grafting

Module 4– Plant Tissue culture(6 hours)
Principles, techniques and applications; culture media, asepsis, callus, organogenesis, somatic embryogenesis, anther culture, artificial seeds.

PLANT ANATOMY AND APPLIED BOTANY
PRACTICAL: (36 HOURS)

a. Using suitable micropreparations observe the different tissue types in the plant organs mentioned in the syllabus
b. Observe the structure of stem and root of dicots and monocots.
c. Learn the structure of dicot stem and dicot root after secondary thickening.
d. Learn the secondary thickening in *Bignonia.*
e. Observe the anatomy of monocot and dicot leaf.
f. Find out the morphological and anatomical adaptations of Hydrophytes (*Nymphaea* petiole), Xerophytes (*Nerium* leaf), Epiphytes (Velamen root of *Vanda*), Halophyte (Pneumatophore and vivipary of *Avicinia* or *Rhizophora*).
g. Practice emasculation using pea or *Caesalpinia* flower buds.
h. Practice 'T'budding , approach grafting and air layering.

Reference.

1. Christopher, E.P. 1958. *Introductory Horticulture*. McGraw – Hill, New York.
2. Esau, K. 1965. Plant Anatomy. Wiley, New York.
3. Fahn. 1985. *Plant Anatomy*. Pergamon Press, Oxford.
4. Hartman, H.T. and D.E. Kester. 1991. *Plant Propagation – Principles and Practices*. Prentice – Hall of India, New Delhi.
5. Kumar, N. 1994. *Introduction to Horticulture*. Rajalakshmi Publications, Nagercoil.
6. Pandey, B.P. 1984. *Plant Anatomy*. S. Chand and Company , New Delhi.
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SEMESTER – 4
PLANT ANATOMY AND APPLIED BOTANY
THEORY – 54 HRS

PLANT ANATOMY (27 HOURS;)

Module 1 – Plant Cell (4 hours)
Plant cell – living and non living inclusions, cell wall – ultra structure of cell wall (brief account only)

Module 2– Plant Tissues (5 hours)
Tissues: simple and complex; structure and function, meristems, secretary tissues.

Module 3– Primary Structure of plant organs (6 hours)
Primary structure of leaf, stem and root in dicots and monocots.

Module 4– Secondary Growth (8 hours)
Secondary thickening in dicot stem and dicot root; cambium, growth rings, heart wood and sap wood; hard wood and soft wood; ring porous wood and diffuse porous wood, Anomalous secondary thickening in *Bignonia*.

Module 5– Ecological Anatomy (4 hours)
Study of the morphological and anatomical adaptations of the following groups; Hydrophytes , Xerophytes, Epiphytes and Halophytes

APPLIED BOTANY (27 HOURS)

Module 1 – Introduction to Plant Breeding (2 hours)
History and objectives

Module 2– Methods of plant improvement (6 hours)
Plant introduction, acclimatization, plant quarantine : Selection: Mass selection; pureline selection and clonal selection: Hybridization; intervarietal, interspecific and intergeneric; procedure of hybridization.

Module 3– Special methods of plant breeding.(7 hours)
Mutation breeding, Polyploidy breeding, Apomixis, apogamy, apospory ,amphimixis, parthenogenesis, parthenocarpy, polyembryony.

Module 4– Horticultural practices(6 hours)
Propagation through cutting, layering, budding and grafting

Module 4– Plant Tissue culture(6 hours)
Principles, techniques and applications; culture media, asepsis, callus, organogenesis, somatic embryogenesis, anther culture, artificial seeds.

PLANT ANATOMY AND APPLIED BOTANY
PRACTICAL: (36 HOURS)

i. Using suitable micropreparations observe the different tissue types in the plant organs mentioned in the syllabus
j. Observe the structure of stem and root of dicots and monocots.
k. Learn the structure of dicot stem and dicot root after secondary thickening.
l. Learn the secondary thickening in *Bignonia.*
m. Observe the anatomy of monocot and dicot leaf.
n. Find out the morphological and anatomical adaptations of Hydrophytes (*Nymphaea* petiole), Xerophytes (*Nerium* leaf), Epiphytes (Velamen root of *Vanda*), Halophyte (Pneumatophore and vivipary of *Avicinia* or *Rhizophora*).
o. Practice emasculation using pea or *Caesalpinia* flower buds.
p. Practice 'T'budding , approach grafting and air layering.

Reference.

1) Christopher, E.P. 1958. *Introductory Horticulture*. McGraw – Hill, New York.
2) Esau, K. 1965. Plant Anatomy. Wiley, New York.
3) Fahn. 1985. *Plant Anatomy*. Pergamon Press, Oxford.
4) Hartman, H.T. and D.E. Kester. 1991. *Plant Propagation – Principles and Practices*. Prentice – Hall of India, New Delhi.
5) Kumar, N. 1994. *Introduction to Horticulture*. Rajalakshmi Publications, Nagercoil.
6) Pandey, B.P. 1984. *Plant Anatomy*. S. Chand and Company , New Delhi.
7) Vasishta, V.C. 1978. *Plant Anatomy*. S. Nagin and Company, Jallundhur.