

UG Programme : BSc Botany

Department of Botany  
Total Credits: 120  
Curriculum

	Course Code	Course	Credit	Marks			Weekly Contact Hours		Course Code	Course	Credit	Marks			Weekly Contact Hours
				Int.	Ext.	Total						Int.	Ext.	Total	
Semester I	ENG1CMR01	Common Course: English	4	20	80	100	5	Semester II	ENG2CMR03	Common Course: English	4	20	80	100	5
	ENG1CMR02	Common Course: English	3	20	80	100	4		ENG2CMR04	Common Course: English	3	20	80	100	4
		Common Course :Additional Language	4	20	80	100	4			Common Course: Additional Language	4	20	80	100	4
	BOT1 COR 01	Introduction to the World of Plant Diversity and Phycology	2+1 (T+P)	20	80	100	2+2		BOT2 COR 02 BOT1 P01 & BOT2 P02	Microbiology, Mycology and Lichenology	2+1 (T+P)	20 20	80 80	100 100	4
	CHE1CMP01	Complementary Chemistry - I	2 + 1 (T+P)	20	80	100	2+2		CHE2CMP02	Complementary Chemistry	2 + 1 (T+ P)	20	80	100	2 + 2
	ZOO1CMP01	Complementary Zoology - I	2 + 1 (T+P)	20	80	100	2+2		ZOO2CMP02	Complementary Zoology	2 + 1 (T+ P)	20	80	100	2 + 2
		<b>TOTAL</b>	<b>20</b>	<b>120</b>	<b>480</b>	<b>600</b>	<b>25</b>			<b>TOTAL</b>	<b>20</b>	<b>160</b>	<b>640</b>	<b>800</b>	<b>25</b>
Semester III	ENG2CMR05	Common Course: English	4	20	80	100	5	Semester IV	ENG4CMR06	Common Course: English	4	20	80	100	5
		Common Course: Additional Language	4	20	80	100	5			Common Course: Additional Language	4	20	80	100	5
	BOT3 COR 03 BOT3 P03	Bryology, Pteridology, Gymnosperms and	3+1 (T+P)	20	80	100	3 + 2		BOT4 COR 04 BOT3P03 & BOT4P04	Anatomy, Reproductive Botany of Angiosperms and	3+1 (T+P)	20 20	80 80	100 100	3 + 2







## B.Sc Botany Programme

SEMESTER I

Course 1

BOT1COR01

### AN INTRODUCTION TO THE WORLD OF PLANT DIVERSITY AND PHYCOLOGY

(Theory 36 hours, Practical 36 hours)

(Theory Credit 2, Practical credit 1)

#### Course objectives:

1. Introduce the students to diverse groups of plants.
2. Understand the various algal groups.

#### AN INTRODUCTION TO THE WORLD OF PLANT DIVERSITY

(Theory: 16 hours; Practical: 12 hours)

##### Module 1

##### Introduction to the Diversity of living organisms

12 hours

Five Kingdom Classification, Eichler's Classification, Five Kingdom Classification, Three Domain Classification.

##### 1. Prokaryotes

Bacteria, Cyanobacteria, Mycoplasma, Actinomycetes, Rickettsiae - General characteristics.

##### 2. Eukaryotes

###### a. Cryptogams

###### i. Algae:

- General characteristics
- Diversity in thallus morphology (Unicellular, colonial, unbranched filamentous, branched filamentous)
- Diversity in pigments (Pigments characteristic of Chlorophyceae, Rhodophyceae and Phaeophyceae)

###### ii. Fungi :

- General characteristics
- Diversity in thallus morphology (unicellular forms, aseptate and septate hyphal forms)

###### iii. Lichens

- General characteristics
- Diversity in thallus morphology (crustose, foliose and fruticose forms)

###### iv. Bryophytes

- General characteristics
- Diversity in thallus morphology
- Alternation of generation, prominence of gametophyte
- Concept of embryo

###### v. Pteridophytes

- General characteristics
- Diversity in morphology
- Concept of vasculature (study of different types of steles is not required)
- Alternation of generation, prominence of sporophyte

###### b. Phanerogams

###### i. Gymnosperms

- General characteristics
- Diversity in morphology
- As the first plant group exhibiting seed habit, advantages of seed habit
- Special structures which contributed to the development of seed (ovule, integuments of ovule, endosperm)

###### ii. Angiosperms

- General characteristics
- Diversity in morphology (dicots, monocots, herbs, shrubs, trees, climbers, twiners, branched, unbranched)

- Concept of fruit, advantages of fruit
- Special structures which contributed to the development of fruit (ovary, placenta)

## Module 2

### Evolutionary trends in the plant world

4 hours

(Shift in habitat from aquatic to terrestrial, shift in prominence of gametophyte to sporophyte, shift from thalloid forms to differentiated forms, evolution of conducting tissue; tracheids to vessels, origin of seed and fruit)

- Interactions in the plant world. Examples of,
  - Plant – plant interactions ( Brief account of Parasitic plants and Epiphytes)
  - Plant – microbe interactions (Brief account of root nodules and Mycorrhiza)
  - Plant – animal interactions (Brief account of Leaf and stem galls and Myrmecophily)

### Practicals (12 hours)

1. Collect, identify record and submit 3 genera each from algae, fungi, bryophytes, pteridophytes, gymnosperms and angiosperms. Use appropriate preservation techniques.
2. Study and submit a report on any one of the interactions observed in the plant world
3. Conduct a field visit to any one of the ecosystems/ botanical gardens to experience the plant diversity. Submit a report with photographs.
4. From a lot of given materials, identify a particular plant group
5. From a lot of given materials identify plants with vascular elements, plants which can produce seeds, fruits, embryos

## PHYCOLOGY

(Theory: 20 hours; Practical: 24 hours)

### Module 3

1 hour

Introduction - General characters of algae. Classification (Fritsch F. E, 1935; 1945.)

### Module 4

14 hours

General characters of the following major groups with special reference to the structure, reproduction and life cycles of the following types.

1. Cyanophyceae: *Nostoc*
2. Chlorophyceae: *Volvox*, *Oedogonium*,
3. *Cladophora*, *Chara*
4. Xanthophyceae: *Vaucheria*
5. Bacillariophyceae: *Pinnularia*
6. Phaeophyceae : *Sargassum*
7. Rhodophyceae : *Polysiphonia*

### Module 5

4 hours

#### Economic importance (Brief Account only)

- a. Algae as pollution indicator
- b. Commercial products: Agar, Alginates, Carrageenin, Diatomaceous earth
- c. Algae in soil fertility, Fertilizer, Nitrogen fixation, and symbiosis
- d. Sources of food & medicine
- e. Diatoms and Nanotechnology
- f. As a source of Hydrogen as fuel
- g. Toxic algae – Algal blooms, red tides & fish poisoning
- h. Algae as primary producers – Oxygen liberators
- i. Cyanobacteria as a source of restriction endonuclease
- j. Role of algae in aquaculture.

## Module 6

1 hour

Algal culture: scope and methods (brief account only)

### Practicals (24 hours)

1. Make micro preparation of vegetative structures of the types mentioned in the syllabus.
2. Identify the algal specimens up to the generic level by noting their key characters.

3. Make labelled sketches of the specimens observed.
4. Collect, identify and submit three algae/ or visit an algal research station or natural habitat.

#### REFERENCES

1. Agarwal SK, 2008, *Foundation course in Biology*, Ane Books Pvt.Ltd., New Delhi.
2. Bilgrama K. S & Saha L. C, 1996, *Text Book Of Algae*, C B S Publishers & Distributors
3. Chapman, V J, 1962. *The Algae.*: Macmillan& co. Ltd, London.
4. Collins H. and T Pinch, 1993, *The Golem: What every one should know about science*, University Press, Cambridge.
5. David A Micklos, Greg A Freyer 2003. *DNA science: A first course*. Cold Spring Harbor Laboratory Press.
6. Fritsch F E 1945. *Structure and Reproduction of Algae*. Vol.1: Cambridge University Press, London.
7. GW Stout, DJ Taylor, 2008. *Biological Sciences*. NPO Green, University Press, Cambridge.
8. Harold C Bold, 1999. *The Plant Kingdom*. Prentice Hall of India Pvt. Ltd
9. Judson HF, 1979. *The eighth day of creation*. Simon Schuster, New York.
10. Krishnamurthy K.V (2004) *Advanced text book on biodiversity, principles and practice* IBH Pub Oxford.
11. Mamatha Rao, 2009, *Microbes and Non flowering plants- impact and application* Ane Boopks Pvt Ltd.
12. Prithipalsingh, 2007, *An Introduction to Biodiversity*, Ane Books India
13. Ray Spangenburg and Diane K Moser, 1999. *The history of science in the nineteenth century*. Universities Press.
14. Schrodinger, AH 1992, *What is life? The physical aspects of living cell with mind and matter*. University Press Cambridge.
15. Singh, Pande, Jain, 2007. *Diversity of Microbes and Cryptogams*, Rastogi publication.
16. Sobti R.C and Sharma V.L, 2008, *Essentials of Modern Biology*. Ane Books Pvt. Ltd. India.
17. Sharma O.P. 2004, *Text Book of Algae*, Tata Mc. Graw Hill Co.
18. Vasishta B. R, Sinha A.K , Singh V.P, 2004, *Botany For Degree Students . Algae*, S. Chand& Co. Ltd. New Delhi.

#### Online resources

<http://www.phycology.net/>

<http://www.algaebase.org/>

<http://www.seaweed.ie/>

<http://www.brphycsoc.org/> (The British Phycological society)

<http://www.intphycsoc.org/> (International Phycological society)

<http://www.isaseaweed.org/> (The International Seaweed association)

<http://botany.si.edu/projects/algae/>

<http://botany.si.edu/projects/algae/> (Smithsonian national museum of natural history)

**B.Sc. BOTANY PROGRAMME**

**Semester II**

**Course-2**

**BOT2COR02**

**MICROBIOLOGY, MYCOLOGY AND LICHENOLOGY**

**(Theory: 36 hours; Practical: 36)**

**(Theory Credit 2, Practical Credit1)**

**Course objectives:**

Enable the students to

1. Understand the world of microbes
2. Understand the identifying characters of the lower groups of plants
3. Have an idea on diverse groups of plants
4. Understand the application of microbiology in different fields.
5. Understand the diversity of fungal and lichen world and its significance.

**MICROBIOLOGY**

**(Theory: 15 hours; Practical: 12 hours)**

**Module 1**

**1 hour**

Introduction, History of Microbiology, Contributions of Leeuwenhoek, Louis Pasteur, Robert Koch. Scope of Microbiology.

**Module 2**

**Bacteria**

**4 hours**

1. Bacteria - Morphology and classification based on staining (Gram staining only), morphology and flagellation
2. Fine structure - cell wall – Peptidoglycan (NAG, NAM and amino acid cross linking), capsule, cell membrane, mesosomes, - cytoplasm - Nucleoid, plasmid, Cell surface appendages-Flagella-structure, pili.
3. Reproduction- Binary fission, endospore formation
4. Archaeobacteria, Mycoplasma, Actinomycetes, (brief account only)

**Module 3**

**Virus**

**5 hours**

1. Virus- General composition (Capsid, viral envelope and viral genome)
2. Properties. Living or non-living? Justifications for both.
3. Classification of virus based on genome, envelope and symmetry
4. Architecture or structure of TMV, HIV.
5. Bacteriophages-structure, Multiplication and transmission (Lytic and lysogenic cycle). Viroids, virusoids and prions.

**Module 4**

**Applied Microbiology (Brief Account only )**

**5 hours**

1. Role in Nitrogen fixation.
2. Biofertilizers & Biopesticides.
3. Biogas production.
4. Bioremediation.
5. Spoilage and preservation of food.
6. Antibiotics.
7. Production of Vinegar, curd, Yoghurt, single cell protein and
8. Probiotics.
9. Bioreactors.

**Practical (12 hours)**

Students are expected to do the following practical

1. Preparation of bacterial smear.
2. Gram staining.
3. Isolation of microbes from soil by Streaking method.



## MYCOLOGY AND LICHENOLOGY (Theory 21 hours; Practical: 24 hours)

### II MYCOLOGY

#### Module 5

19 hours

1. Introduction, structure, reproduction, life cycle, evolutionary trends.  
Classification based on Ainsworth (1973)
2. Distinguishing characters of different classes of fungi with special reference to reproductive structures and life history of the genera mentioned in each group
  - a. Myxomycotina – General Characters
  - b. Mastigomycotina – *Albugo*
  - c. Zygomycotina – *Mucor*
  - d. Ascomycotina
    - i. Hemiascomycetes -- *Saccharomyces*
    - ii. Plectomycetes -- *Pencillium*
    - iii. Pyrenomycetes – *Xylaria*
    - iv. Discomycetes -- *Peziza*
  - e. Basidiomycotina
    - i. Teliomycetes ---*Puccinia*
    - ii. Hymenomycetes—*Agaricus*
  - f. Deuteromycotina – *Fusarium*
3. Economic importance of Fungi (specify) –useful and harmful aspects.
4. Fungi of Agricultural importance –Mycoherbicides, Myconematicides , Mycoparasites.
5. Mycorrhiza -Ecto, endo (Vesicular Arbuscular Mycorrhiza) Ect -endo Mycorrhiza , Function and Significance.
6. Fungal biotechnology- Fundamental principles.
  - a. Mushrooms- edible and poisonous types.
  - b. Cultivation technique-Spawn production.
  - c. Cultivation of Oyster mushroom

#### Practicals (24 hours)

1. Students are expected to identify the following types by making suitable micropreparations and make labeled sketches *Rhizopus, Albugo, Saccharomyces, Pencillium , Xylaria, Peziza, Puccinia, Fusarium and Parmelia*.
  2. Isolation and culture of Oyster mushroom mycelium.
  - 3 Preparation of bed for mushroom cultivation.
    1. Staining of Endomycorrhiza / fungus.
    2. Isolation of fungus from dung, air, fruits, vegetables.
    3. Slide culture technique of fungus.
- Collection and identifications of common lichens

### II LICHENOLOGY

2 hours

#### Module 6

General account , classification based on thallus structure- Economic and Ecological importance of lichens. Structure, Reproduction and Life cycle of *Parmelia*.

#### REFERENCES

1. Ainsworth G.C ., Sparrow K.F & Sussman A.S (eds) 1973. *The Fungi an advanced*
2. Alexopoulos C.J, Mims, C.W & C.W Blackwell,M 1996 *Introductory Mycology* .
3. Aneja K. R. 1996. *Experiments in Microbiology, Plant pathology, Tissue culture and Mushroom cultivation. Wishwa Prakasan, Delhi*.
4. Campbell R 1987 *Plant Microbiology* , ELBS Edward Arnold , London.
5. Carpenter P L, 1967. *Microbiology.*, W. B Saunder& Co, Philadelphia.
6. Dule.H.C 2008. *Fungi, Bacteria and Viruses*, Agrobios, Meerut.
7. Frazier W C & Westhoff D C 1978. *Food Microbiology*. TMH Edn.

8. Gupta V.K & Paul T.S 2004, *Fungi & Plant diseases*. Kalyani publishers , New Delhi
9. Hale M.E 1983 *The Biology of Lichen*, 3<sup>rd</sup> edition Edward Arnold, London.
10. Hans G Schlegel 1995. *General Microbiology*. Cambridge University Press, London.
11. Jim Deacon 2007 *Fungal Biology* , 4<sup>th</sup> edition , Blackwell Publishing ,Ane Books Pvt. Ltd.
12. Kanika Sharma 2005 *Manual of Microbiology tools & Techniques*. Ane books, Ansari road, New Delhi.
13. Malhotra & Aggarwal Ashok 2003 *Plant Pathology*, Tata Mc Graw Hill Publishing Co.
14. Misra A and Agrawa P.R 1978 *Lichens* ,New Delhi : Oxford and IBH.
15. Nair M.C (eds) 1990 *Mushroom Technical Bulletin 17* , Kerala Agricultural University Mannuthy
16. Nita Bahl 2002. *Hand book on Mushrooms*, Oxford & IBH Publishing C. Pvt. Ltd. New Delhi.
17. Parihar. L, 2008. *Advances in Applied Microbiology*, Agrobios, Meerut.
18. Pellczar M J. Reid and Chan E C S 1977. *Microbiology*. Tata McGraw-Hill publishing
19. Prescott.S.C, 2009. *Industrial Microbiology*, Agrobios, Meerut.
20. Sharma P D 2005. *Microbiology and Plant Pathology* ,Rastogi publication, Meerut.
21. Sharma P.D 2004 , *The Fungi* , 2<sup>nd</sup> Edition , Rasthogi publication
22. Singh, Pande Jain 2007, *Diversity of Microbes and Cryptogam*, Rastogi Publications.
23. Tripathi D.P 2005. *Mushroom Cultivation*, Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.
24. Vasishta B.R 1990 *Botany for Degree Students* , Fungi S. Chand &Co, NewDelhi.

Online resources:

[http://www.mushroomexpert.com/major\\_groups.html](http://www.mushroomexpert.com/major_groups.html)  
<http://www.fungibank.csiro.au/>  
<http://www.in2.dk/fungi/imageintroTxt.htm>  
<http://www.fungi4schools.org/>  
<http://www.fungiphoto.com/>  
<http://www.britmycolsoc.org.uk/> (British mycological society)  
<http://www.mycology.com/>  
<http://www.bgbm.fu-berlin.de/sipman/keys/default.htm> (lichen)  
<http://www.bspp.org.uk/>  
<http://www.fs.fed.us/r6/nr/fid/coolpath.shtml>  
<http://fruit.wsu.edu/>  
<http://www.apsnet.org>

**B.Sc. BOTANY PROGRAMME**

**Semester III**

**Course 3**

**BOT3COR03**

**BRYOLOGY, PTERIDOLOGY, GYMNOSPERMS & PALEOBOTANY**

**(Theory: 54 hours; Practical: 36 hours)**

**(Theory Credit 3, Practical Credit1)**

**Course objectives:**

1. Understand the diversity in habits, habitats and organization of various groups of plants.
2. Understand the evolutionary trends in plants.
3. Identify the anatomical variations in lower groups of plants.
4. Understand the significance of Paleobotany.

**BRYOLOGY**

**(Theory: 16 hours; Practical: 15 hours)**

**Module 1**

1. Introduction, general characters, classification, Evolution of Bryophytes. **2 hours**
2. Morphology, anatomy and reproduction in *Riccia*, *Marchantia*, *Anthoceros* and *Funaria*.  
Evolution of sporophyte and gametophyte. **12 hours**  
(Development of sex organs not necessary).
3. Importance of Bryophytes, Prevention of soil erosion, pollution monitoring and control, Antibiotics, Horticultural importance. **2 hours**

**Practical (10 hours)**

Make micro preparations of the types mentioned. Study vegetative and reproductive structures.

**PTERIDOLOGY**

**(Theory: 16 hours; Practical :18 hours)**

**Module 2**

1. Introduction, general characters, classification, evolution of Pteridophytes. **2 hours**
2. Structural organization of sporophyte and gametophyte (development of sex organs not necessary) of the following types with special reference to stelar structure, heterospory and seed habit. (General anatomy required only for practicals) **14 hours**

1. *Psilotum*
2. *Lycopodium*
3. *Selaginella*
4. *Equisetum*
5. *Pteris*
6. *Marsilea*

**Practicals (18 hours)**

Make micropreparations to study stelar structure and sporangia of the mentioned types. Identify at sight, noting the morphology.

**GYMNOSPERMS**

**(Theory: 14 hours; Practical: 8 hours)**

**Module 3**

1. Introduction, general characters, classification, origin and evolutionary significance **2 hours**
2. Study of morphology, anatomy and -male and female reproductive structures of *Cycas*, *Pinus* and *Gnetum* (development of sex organs not necessary). **12 hours**

**Practical (8 hours)**

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

## PALAEOBOTANY

(Theory: 8 hours)

### Module 4

1. Introduction, Study of geological time scale, formation of fossil, fossil types & technique of study, fossil as a fuel. **3 hours**
2. Detailed study of
  - a. Fossil Pteridophyte : *Rhynia*
  - b. Fossil Gymnosperm: *Williamsonia*
  - c. Fossil Angiosperm : *Palmoxyton*
3. Indian contribution to Palaeobotany **4 hours**  
**1 hour**

### Reference

1. Arnold H.N ,1967. *Introduction to Paleobotany*, Tata Mc Graw- Hill, New Delhi
2. Biswas & John B .M, 2004.*Gymnosperms*, Naresa Publishing house.
3. Bower F.O ,1935. *Primitive Land Plants*. Cambridge, London.
4. Chopra R.N and Kumar P. K ,1988. *Biology of Bryophytes*, Wiley Eastern Ltd, New Delhi.
5. Coutler J.M & Chamberlain C. J ,1958. *Morphology of Gymnosperms*. Central Book Depot Allahabad.
6. Dutta S.C, 1991, *An Introduction To Gymnosperms*, Kalyan Publishing Co. New Delhi.
7. Mamatha Rao, 2009, *Microbes and Non flowering plants- impact and application* Ane Boopks Pvt Ltd.
8. Rasheed A. 1999, *An Introduction to Pteridophyta*, Vikas Publishing House, New Delhi.
9. Rasheed A. 2000, *An Introduction To Bryophyta*, Vikas Publishing House, New Delhi.
10. Singh, Pande Jain 2007, *Diversity of Microbes and Cryptogam*, Rastogi Publications
11. Vashista B. R ,1993. *Bryophyta*,: S Chand & Co., New Delhi.
12. Vashista B. R ,1993.*Gymnosperms*, S Chand & Co., New Delhi.
13. Vashista B. R, 1993. *Pteridophyta*, S Chand & Co., New Delhi

<http://www.artdata.slu.se/guest/SSCBryo/SSCBryo.html>

<http://www.northernontarioflora.ca/links.cfm?val=bryophytes>

<http://bryophytes.plant.siu.edu/>

<http://worldofmosses.com/>

<http://www.unomaha.edu/~abls/>

<http://www.anbg.gov.au/bryophyte/index.html>

<http://www.bryoecol.mtu.edu/>

<http://www.mobot.org/MOBOT/tropicos/most/Glossary/glosefr.html>

[http://www.fairhavenbryology.com/Master\\_Page.html](http://www.fairhavenbryology.com/Master_Page.html)

<http://www.mygarden.ws/fernlinks.htm>

<http://www.anbg.gov.au/fern/index.html>

<http://www.bioimages.org.uk/HTML/T77.HTM>

[http://botany.csd.tamu.edu/FLORA/gallery/gallery\\_query.htm](http://botany.csd.tamu.edu/FLORA/gallery/gallery_query.htm)

<http://homepages.caverock.net.nz/~bj/fern/>

<http://www.home.aone.net.au/~byzantium/ferns/>

<http://www.northernontarioflora.ca/links.cfm?val=pteridophytes>

[http://www.fiu.edu/~chusb001/giant\\_equisetum.html](http://www.fiu.edu/~chusb001/giant_equisetum.html)

<http://www.mygarden.ws/fernlinks.htm>

[http://www.nrm.se/en/menu/researchandcollections/departments/cryptogamicbotany/collections/pteridophytes.652\\_en.html](http://www.nrm.se/en/menu/researchandcollections/departments/cryptogamicbotany/collections/pteridophytes.652_en.html)

<http://www.amerfernsoc.org/>

<http://www.gymnosperms.org/>

<http://www.plantapalm.com/vce/toc.htm>

<http://www.cycad.org/conservation.htm>

**B.Sc. BOTANY PROGRAMME**

**Semester IV**

**Course-4**

**BOT4COR04**

**ANATOMY, MICRO TECHNIQUE AND REPRODUCTIVE BOTANY OF ANGIOSPERMS**

**(Theory: 54 hours; Practical: 36 hours) (Theory Credit 3, Practical Credit1)**

**Course Objectives**

1. This course aims to impart an insight into the internal structure and reproduction of the most evolved group of plants, the Angiosperm.
2. Understand the structural adaptations in plants growing in different environment.
3. Understand the life cycle pattern of Angiosperms.
4. Understand the morphology and development of reproductive parts.
5. Get an insight in to the fruit and seed development.

**ANATOMY OF ANGIOSPERMS**

**(Theory:27hours;Practical:9 hours)**

**Module -1: Study of cell wall and cellular inclusions**

**4 hours**

1. Gross structure of primary and secondary cell walls, simple and bordered pits, Structure and function of plasmodesmata
2. Sub microscopic structure of cell wall- cellulose, micelle, micro fibril and macro fibril, Different types of Cell wall thickening in tracheary elements
3. Extra cell wall thickening materials: - Lignin, cutin, suberin and callose
4. Origin of cell wall; Growth of Cell wall- Apposition and intussusceptions – cavities & ducts, schizogenous and lysigenous developments
5. Non-living inclusions in plant cell: - Reserve food materials -carbohydrate (starch), protein (Aleurone grain) and lipids (fats and oil). Excretory products-cystolith, raphide.
- 6.

**Module-2: Tissue system**

**10 hours**

1. Meristematic tissue- definition, structure, function and classification based on origin, position and plane of division
2. Apical organization and theories; Shoot apex- Apical cell theory, Histogen theory and Tunica-Corpus theory.
3. Root apex - Histogen theory, Korper- Kappe theory, Quiescent Centre Hypothesis
4. Permanent Tissue: - Structure and function of simple and complex tissues.
5. Distribution and function of mechanical tissues in plants
6. Plant fibres-economic importance
7. Secretory tissues:
  - a. External secretory tissue- glands (glandular hairs and digestive glands), hydathodes and nectaries
  - b. Internal secretory tissues- Resin and mucilage ducts-Gummosis, Kino veins, laticiferous tissue-latex cells and latex vessels.
8. Structure and Function in root, stem and leaves.
  - a. Epidermal Tissue System- Epidermis, Cuticle, Trichome, Stomata, Bulliform cells, Cork and Silica cells.
  - b. Ground Tissue System- Cortex, Endodermis, Pericycle, Pith and Pith rays.
  - c. Vascular Tissue System- Different types of vascular bundles and their arrangement in root and stem

**Module-3: Cambium and Secondary thickening**

**7 hours**

1. Vascular cambium: - Development, structure and function, Activity of cambium, role of cambium in budding, grafting and wound healing.
2. Normal secondary growth in dicot stem and root
3. Periderm: Structure and development- phellum, phellogen, phelloderm, bark, polyderm, rhytidome and lenticel.

**Module-4: Wood anatomy and Anomalous secondary thickening****6 hours**

1. Wood anatomy- basic structure, heart wood, sap wood, hard wood, soft wood, growth rings and dendrochronology, porous and non-porous wood, ring porous and diffuse porous wood, tyloses, knots
2. Wood rays: (Brief account)
3. Reaction wood- Tension wood and compression wood
4. Stem thickening in monocots (general account only)
5. Anomalous secondary growth in plants, Reasons for anomalous secondary growth in plants, Anomalous secondary growth in *Bougainvillea* stem, *Bignonia* stem and *Dracaena* stem.

**Module-5: Microtechnique****9 hours**

1. Definition, importance of microtechnique
2. Killing and fixing: - Purpose, Agents used:-
  - a. Killing agents – Formalin, Ethyl alcohol
  - b. Fixing agents - Carnoy's fluid, Farmers' fluid, FAA
3. Dehydration: Purpose, Agent used – Ethyl alcohol
4. Sectioning: Hand sections, Microtomy: rotary, sledge (application only)
5. Staining technique: Principle of staining
6. Stains: Safranin, Hematoxylin, Acetocarmine (preparation not required)
7. Vital stains: Purpose, Example: Evan's blue
8. Mordants: Purpose and examples
9. Single staining and Double staining (safranin and fast green combination, steps should be mentioned)
10. Mounting and Mounting Media, Purpose of mounting media, Glycerin, DPX, Canada balsam
11. Use of permanent whole mounts, permanent sections
12. Maceration
13. Smear and squash preparation

**Practical (27 hours)****Anatomy and Microtechnique**

1. Cell types and tissues
2. Non-living inclusions – starch grains, cystolith, raphides, aleurone grains
3. Primary structure of stem and root. Dicots and Monocots
4. Structure of leaf-Dicots and Monocots
5. Stomatal types: - anomocytic, anisocytic, paracytic, diacytic and grass type.
6. Secondary structure of dicot stem and root
7. Anomalous secondary structure of *Bougainvillea* stem, *Bignonia* stem and *Dracaena* stem
8. Familiarise the reagents and equipment used in microtechniques (killing and fixing agents, dehydrants, clearing agents, stains, embedding agents, mounting agents, microtome etc.)

**REPRODUCTIVE BOTANY OF ANGIOSPERM****(Theory: 18 hours ; Practical:9 hours)****Module: 6**

1. Introduction: - General account and interdisciplinary relevance of embryology
2. Floral morphology: - parts of flower; androecium-morphology and types of anthers; gynoecium- morphology and types of carpel and types of placentation (brief study only)
3. Structure and development of anther, microsporogenesis, development of male gametophyte, dehiscence of anther, structure of pollen, pollen germination, pollen tube growth and pollen viability.

4. Structure and development of ovule, megasporogenesis, embryosacs-monosporic (polygonum type), bisporic (Allium type) and tetrasporic (Peperomia type). Structure of mature embryo sac
5. Unit 5: Pollination mechanisms and agents of pollination; pollen stigma interaction; compatibility and incompatibility; syngamy and fusion; apomixis.
6. Development of endosperm and embryo in Dicots and Monocots.
7. Polyembryony and its types; Development and general structure of fruits and seed-Dicot and Monocot seeds.

### **Practicals :( 9 hours)**

#### **Reproductive Botany of Angiosperms**

1. Identification of C.S. of anther, embryo sac and embryo with slides or photographs
2. Identification of various anther types-monothealous, dithealous
3. Identification of placentation types.
4. Observation of pollen and locating pollen pore
5. Pollen germination study

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<http://www.uic.edu/classes/bios/bios100/labs/plantanatomy.htm>

**RESEARCH METHODOLOGY, BIOSTATISTICS, BIOPHYSICS AND INFORMATICS.****Course objectives:**

1. Understand the methodology of research.
2. Understand the fundamentals of statistical analysis.
3. Understand the applications of computer in biology.

**(Theory 54 hours, Practical 36 hours)****(Theory Credit 3, Practical credit 1)****RESEARCH METHODOLOGY****(Theory:14 hours: Practical:6 hours)****Module 1: Introduction****5 hours**

1. Need for research, types of research; Research and scientific method, Criteria of good research. Generation of a research problem, interpretation of results.
2. Research design - Need, features and significance of a good design. Basic principles of experimental design.
3. Sources of reference - (a) Library, journals: Indexing journals, abstracting journals, research journals, review journals, e-journals. Impact factor of journals, Digital library and e-Books b) Other sources of references: (i) Reprints, Internet, open access initiative, INFLIBNET, INSDOC, Google Scholar.

**Module 2: Preparation and Presentation of Research work****9 hours**

1. Preparation of Project proposal- (a) Title, Introduction, literature review and abstract (b) Aim and scope (c) Present status (d) Location of experiments (e) Materials and methods (f) Justification (g) Expected outcome (h) Time schedule (g) Estimated date of completion (h) budget (i) References (j) Funding agencies.
2. Presentation and publication of research outcomes
  - a. Preparation of a dissertation - (i) Consolidation and analysis of data, photographs, illustration, tables and graphs (ii) Preparation of the outline (iii) Preparation of manuscript - introduction, review of literature, materials and methods, results, discussion, bibliography (methods of citing references, style manuals, arrangement of references), summary (iv) Guidelines for a scientific presentation- Preliminary pages - title page, certificates, acknowledgements, and contents page.
  - b. Research ethics, plagiarism and detection by software's *s-ithenticate* and *turniton*

**Practical (6 hours)**

1. Prepare a project proposal.
2. Prepare an outline of dissertation.
3. Prepare a list of references.
4. Present a project in the class with the help of LCD projector and submit the CD for evaluation.
5. Prepare the Final Project as per this paper.

**BIOSTATISTICS****(Theory 12 hours, Practical 12 hours)****Module 3:****12 hours**

1. Introduction, statistical terms and symbols
2. Sample:- concept of sample, sampling methods,
3. Collection and representation of data, graphic representation of data( Line graph, bar diagram, Pie diagram & Histogram)
4. Measures of central tendency:- mean, mode, median
5. Measures of dispersion:- mean deviation, standard deviation.
6. Distribution patterns:- normal distribution, binomial distribution
7. Test of hypothesis : t-test - introduction, uses, procedure. chi-square test - introduction, uses, procedure



**Practicals: (12 hours)**

1. Collect numerical data and find out the central tendencies and prepare different types of graph mentioned in the syllabus
2. Familiarize with situations requiring t-test, chi-square test

**BIOPHYSICS****(Theory 12 hours, Practical 8 hours)****Module 4:****12 hours**

1. Microscopy:- Working of simple, compound, and electron microscopes, phase contrast, fluorescent, confocal (Application only)
2. Principles and applications of colorimeter, spectrophotometer and centrifuge, Beer-Lambert's Law.
3. Separation methods :- chromatography ; thin layer , paper, column (principle and applications only) , electrophoresis ;(Principle and applications only)
4. pH:- concept of pH, methods to measure pH ; pH paper and pH meter, Buffers (Brief account only)

**Practicals: ( 8 hours )**

1. Preparation of 0.1M sodium phosphate buffer (pH 6 and 7)
2. Measurement of pH using pH meter
3. Paper chromatography of plant pigments (demonstration)
4. Electrophoresis of nucleic acids (demonstration)
5. Column chromatography of plant pigments (demonstration)
6. Determination of the concentration of a given solution of  $\text{CuSO}_4$  using colorimetry

**INFORMATICS****(Theory 16 hours, Practical 10 hours)****Module5 :****6 hours**

1. **Overview of the Information Technology** -Internet as a knowledge repository, e-mail, search engines (Google, ), study of educational sites and Video Channels related to life sciences (DNAi, Scitable. Khan Academy, MIT Open Course Ware), Academic search techniques, (PubMed, Google Scholar, Science direct and INFLIBNET) Introduction to the use of information technology in teaching and learning

2. **Use of computers**

**10 hours**

The basic concept of operating system (DOS, WINDOWS and Ubuntu) MS Office Package (Study of MS Word, Excel and PowerPoint)

- a. DOS – The basic concept of operating systems (Study of commands not required).
- b. MS-WINDOWS:- logging to windows, organizing files and folders, copying, moving, deleting and saving documents, installing software, installing hardware.
- c. Ubuntu.
- d. MS-WORD:- word processing using WORD, editing tools ( cut , copy, paste, ) formatting tools ( font, paragraph) use of spell check, inserting tables (draw), inserting graphs and pictures
- e. MS-EXCEL:- Creating a worksheet, data entry, sorting (ascending and descending), use of statistical tools in EXCEL (SUM, MEAN, MODE, MEDIAN), preparation of graphs (bar diagram, pie chart and line graph)
- f. MS-POWERPOINT:- Creating a presentation, Inserting tables, charts and pictures into slides, Use of animation tools

**Practicals: (10 hours)**

1. Gather information and pictures on a given topic using the internet. Make a list of the sites visited for the purpose
2. Prepare a project report using MS-WORD based on the information and pictures gathered from the internet.

3. Prepare a worksheet using a set of data collected and find out the SUM, MEAN, MEDIAN and MODE using EXCEL
4. Prepare suitable tables/ charts/graphs based on the data using EXCEL.5.
5. Prepare a powerpoint presentation based on the 1 & 2 exercises

**Reference:**

1. Anderson J, Durston B H, Poole, 1970. *Thesis and assignment writing*. Wiley eastern.
2. Bedekar V H ,1982. *How to write assignment and research papers, dissertations and thesis*. Kanak publications.
3. Bercy R, 1994. *The research project, how to write it*. Rutledge, London.
4. Cotteril R, 2002. *Biophysics an Introduction* .John Wiley and Sons.
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**B.Sc. BOTANY PROGRAMME**

**Semester V**

**Course 6**

**BOT5 COR 06**

**PLANT BREEDING, HORTICULTURE AND PLANT PATHOLOGY**

**(Theory: 54 hours; Practical: 36 hours)**

**(Theory Credit 3, Practical Credit 1)**

**Course objectives:**

1. Understand the methods of crop improvement.
2. Understand the fundamentals of horticulture.
3. Understand the common plant diseases and control measures.

**PLANT BREEDING**

**(Theory: 20 hours; Practical: 9 hours)**

**Module 1 :**

**3 hours**

1. Introduction and objectives of plant breeding.
2. Plant introduction- procedure of plant introduction, quarantine regulations, acclimatization- agencies of plant introduction in India, major achievements..

**Module 2 :**

**17 hours**

1. Selection- mass, pureline, clonal- genetic basis of selection-achievements.
2. Hybridization- procedure- intergeneric, interspecific and intervarietal hybridization with examples- composite and synthetic varieties- heterosis in plant breeding, inbreeding depression; genetics of heterosis and 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.
3. Mutation breeding- methods- achievements in India; breeding for pest, disease and stress resistance.
4. Modern tools for plant breeding; Genetic Engineering and products of genetically modified crops.

**Practicals: (9 hours)**

1. Emasculation and bagging
2. Comparison of percentage of seed germination and the effect of any one chemical on the rate of elongation of radicle in any three crop seeds

**HORTICULTURE**

**(Theory: 20 hours; Practical: 18 hours)**

**Module 3: Introduction**

**4 hours**

1. Definition, history, classification of horticultural plants, disciplines of horticulture; Garden tools and implements.
2. Irrigation methods- surface, sub, drip and spray irrigations, mist chambers- advantages and disadvantages.

**Module 4: Propagation**

**8 hours**

1. 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 seed propagation.
2. Vegetative propagation- organs used in propagation- natural and artificial vegetative propagation; methods- cutting-soft wood cutting and hard wood cutting, layering-mound layering and air layering, grafting-wedge grafting, tongue grafting and splice grafting. budding- patch budding and T-budding; advantages and disadvantages of vegetative propagation.

**Module 5: Gardening**

**8 hours**

1. Gardening- ornamental gardens, indoor gardens, kitchen gardens- terrestrial and aquatic gardens- garden adornments; garden designing- garden components- lawns, shrubs and trees, borders, hedges, edges, walks, drives- famous gardens of India.
2. Landscape architecture- home landscape design, parks.

3. Physical control of plant growth- training and pruning; selection of plant for bonsai, bonsai containers and method of bonsai formation.

**Practicals: (18 hours)**

1. Tongue or wedge or splice grafting, budding ('T' and patch), air layering
2. Identification of different garden tools and their uses
3. List out the garden components in the photograph of the garden given
4. Preparation of potting mixture in the given proportion

**Reference:**

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<http://www.mendelweb.org/>  
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<http://learn.genetics.utah.edu/>  
[http://www.ornl.gov/sci/techresources/Human\\_Genome/genetics.shtml](http://www.ornl.gov/sci/techresources/Human_Genome/genetics.shtml)  
<http://www.brooklyn.cuny.edu/bc/ahp/MGInv/MGI.Inv.html>  
<http://www.accessexcellence.org/RC/genetics.php>  
<http://flybase.org/>  
<http://genethics.ca/>  
[http://morgan.rutgers.edu/MorganWebFrames/How\\_To\\_Use/HTU\\_frameset.html](http://morgan.rutgers.edu/MorganWebFrames/How_To_Use/HTU_frameset.html)

## PLANT PATHOLOGY

(Theory 14 hours; Practical: 9 hours)

### Module 6:

14 hours

1. History of plant pathology, Classification of plant diseases on the basis of causative organism and symptoms , Host parasite interaction , Defense mechanism in host, Mechanism of infection, transmission and dissemination of diseases.
2. Control of plant diseases –
  - a. Prophylaxis-quarantine measures, seed certification
  - b. Therapeutic – physical therapy , chemotherapy.
  - c. Biological control
3. Study of following diseases with emphasis on symptoms, disease cycle and control
  - a. Bunchy top of Banana.
  - b. Bacterial blight of Paddy.
  - c. Root wilt of Coconut.
  - d. Abnormal leaf fall of Rubber
4. Fungicides - Bordeaux mixture, Tobacco Neem decoction, preparation. (Brief account only)

### Practicals: (9 hours)

Students are expected to:

1. Identify the diseases mentioned in the syllabus with respect to causal organisms and symptoms
2. Submit herbarium preparations of various stages (3 stages) of any one of the diseases mentioned.
3. Students should be trained to prepare the fungicide – Bordeaux mixture, Tobacco decoction.

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2. Ainsworth G.C ., Sparrow K.F & Sussman A.S (eds) 1973. *The Fungi an advanced Treatise* ,Vol. 4 a & 4b, a Taxonomic review with keys , academic press New York.
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<http://www.in2.dk/fungi/imageintroTxt.htm>

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**B.Sc. BOTANY PROGRAMME**

**Semester V**

**Course 7**

**BOT5 COR 07**

**GENETICS AND EVOLUTION**

**(Theory 54 hours; Practical 36 hours)**

**(Theory Credit 3, Practical Credit1)**

**Course Objectives**

4. Understand the basic principles of inheritance
5. Understand the nuclear and extranuclear inheritance pattern of genes
6. Understand Mendelian and Post Mendelian genetics
7. Understand the mechanism of sex determination
8. Understand the concept of evolution and forces that drives evolution

**GENETICS**

**(Theory: 36hours; Practical:18 hours)**

**Module 1 Mendelian Genetics**

**1. Pre Mendelian and Post Mendelian Genetics:**

- a. Pre Mendelian era: Concept of pangenesis, Preformation theories-homunculus, ovists and spermists, Contributions of Nehemiah Grew and Kolreuter.
- b. Allele, traits, phenotype, genotype, monohybrid cross, dihybrid cross, test cross, back cross.
- c. Mendelian Genetics-Basic principles of inheritance, Mendelian ratios. **14 hours**

**2. Extensions of Mendelian Genetics:**

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 color in summer squash (12:3:1); complementary genes- flower color in *Lathyrus* (9:7). **6 hours**

**Module 2**

1. **Multiple allele** - General account: co dominance- ABO blood group in man; self sterility in *Nicotiana*. Quantitative characters- polygenic inheritance, kernel color in wheat; ear size in maize. **2hours**
2. **Linkage and Crossing over** - Definition, significance- linkage and independent assortment. Complete and incomplete linkage. Crossing over-general account, two point test cross; three point test cross, determination of gene sequences; double crossover, interference and coincidence; mapping of chromosomes. **2hours**

**Module 3 Sex determination**

1. Sex determination- sex chromosomes and autosomes- chromosomal basis of sex determination; XX-XY, XX-XO mechanism; sex determination in higher plants (*Melandrium album*); genic balance theory of sex determination in *Drosophila*.
2. Sex linked inheritance- eye color in *Drosophila*, Haemophilia in man; Y-linked inheritance.
3. Extra nuclear inheritance- general account- maternal influence- plastid inheritance in *Mirabilis*, cytoplasmic male sterility in plants, kappa particle in *Paramecium*. **6 hours**

**Module 4**

1. **Population genetics:** Genotype frequency, gene frequency, panmictic population, Population genetics-Hardy Weinberg law, Significance. **3 hours**
2. **Bacterial recombination:** Genetic recombination - Conjugation (F+ x F-) and (Hfr x F-), transformation & transduction-Generalized and specialized. **3 hours**

**EVOLUTION**

**(Theory : 18hrs)**

**Module 5:**

1. Origin of life – A brief account of theories of origin of life (Abiogenesis, Biogenesis and Cosmozoic theories).  
Biochemical evolution of life - Urey and Miller experiment, synthesis of organic molecules on early earth, abiotic synthesis of macromolecules, protobionts, self-Replicating RNA, primitive cell, photosynthesis and the oxygen revolution. **4 hours**
2. Evidence of evolution –Fossils, dating of fossils, molecular clocks, plant fossils, pleogeography, history of life on earth, geological time scale. **3 hours**

### **Module 6 Theories and Process of evolution**

**11 hours**

1. Theories of evolution -  
Lamarckism, Darwinism (A brief account of Darwin's voyage, Darwin's finches and adaptive radiation) and mutation theory of De Vries .  
Modern synthetic theory, concept of species, sub species, sibling species and deme.
2. Hardy-Weinberg equilibrium, Mutation, migration, natural selection and genetic drift.
3. Process of evolution
  - a. Sources of variation -gene mutation, chromosome mutation, recombination, role of hybridisation and polyploidy in evolution.
  - b. Natural selection – adaptation, differential reproduction. Stabilizing, directional, and disruptive selection
  - c. Isolation – isolating mechanisms (geographic and reproductive isolation).
  - d. Speciation – allopatric and sympatric speciation.
  - e. Patterns of evolution – sequential and divergent evolution. Microevolution and macroevolution.
4. Human evolution – Brief account of human evolution, Cultural evolution of man. Evolution and society.

### **Genetics (36 hours)**

Students are expected to work out the problems in:

1. Monohybrid , dihybrid cross and back crosses, two point test cross, three point test cross.
2. All types of modified Mendelian ratios mentioned in the syllabus.

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<http://cls.casa.colostate.edu/TransgenicCrops>

[http://www.desicca.de/plant\\_breeding/](http://www.desicca.de/plant_breeding/)

[http://www.ars.usda.gov/main/site\\_main.htm?modecode=53-58-15-00](http://www.ars.usda.gov/main/site_main.htm?modecode=53-58-15-00)

<http://www.icrisat.org/>

<http://beta.irri.org/index.php/Frontpage.html>

<http://www.ncbi.nlm.nih.gov/omim/>

[http://www.biology.arizona.edu/mendelian\\_genetics/mendelian\\_genetics.html](http://www.biology.arizona.edu/mendelian_genetics/mendelian_genetics.html)

<http://www.mendelweb.org/>

<http://www.dnaftb.org/dnaftb/1/concept/>

<http://learn.genetics.utah.edu/>

[http://www.ornl.gov/sci/techresources/Human\\_Genome/genetics.shtml](http://www.ornl.gov/sci/techresources/Human_Genome/genetics.shtml)

<http://www.brooklyn.cuny.edu/bc/ahp/MGInv/MGI.Inv.html>

<http://www.accessexcellence.org/RC/genetics.php>

<http://flybase.org/>

<http://genethics.ca/>

[http://morgan.rutgers.edu/MorganWebFrames/How\\_To\\_Use/HTU\\_frameset.html](http://morgan.rutgers.edu/MorganWebFrames/How_To_Use/HTU_frameset.html)

**B.Sc. BOTANY PROGRAMME**

**Semester V**

**Course 08**

**BOT5 COR 08**

**ANGIOSPERM MORPHOLOGY, TAXONOMY AND ECONOMIC BOTANY**

**(Theory 54 hours; Practical: 36 hours)**

**(Theory Credit 3, Practical Credit1)**

**Course objectives:**

1. Acquaint with the aims, objectives, significance and interdisciplinary relevance of taxonomy.
2. Identify the common species of plants growing in Kerala and their systematic position.
3. Develop inductive and deductive reasoning ability in the systematics
4. Acquaint with the basic technique in the preparation of herbarium and its significance
5. Familiarizing the economic and ethnobotanical importance of plants

**Module 1: Morphology**

**9 hours**

1. Leaf Morphology (types, venation, phyllotaxy)
2. Morphology of flower
  - a. Parts of a flower- description of flower and its parts in technical terms.
  - b. Types of flower – Hypogyny, Perigyny and Epigyny, Symmetry of flowers.
  - c. Aestivation, types
  - d. Placentation, types
  - e. Floral Diagram and Floral Formula
3. Inflorescence and Fruit
  - a. Inflorescence:-
    - i. Racemose types: Simple Raceme, Corymb, Umbel, Spike, Spadix and Head
    - ii. Cymose types: Simple Cyme, Monochasial, Scorpioid and Helicoid, Dichasial and Polychasial.
    - iii. Special type: Panicle, Cyathium, Hypanthodium, Verticillaster, Thyrsus
  - b. Fruits: – Simple-Fleshy, Dry- dehiscent, indehiscent, Aggregate, Multiple (Sorosis and Syconus), schizocarp.

**Module 2: Systematic Botany**

**9 hours**

1. Aim, Scope and Significance of taxonomy
2. Types of Classification- Artificial (Eg. Linnaeus system, brief account), Natural – Bentham and Hooker (Detailed account) and Phylogenetic system (Engler and Prantle's system, brief account)
3. Binomial Nomenclature, ICBN- Brief account (Principles of ICBN should be included, ICN should be mentioned)
4. Interdisciplinary approach in Taxonomy- Cytotaxonomy and Chemotaxonomy.
5. Herbarium technique- Preparation of herbarium, their preservation, important herbaria, Botanical Gardens and BSI.
6. Modern trends in taxonomy: (brief study of the following) Molecular Systematics, Numerical Taxonomy, Angiosperm Phylogeny Group (APG), Taxonomy Online Resources

**Module 3: Angiosperm families, an overview**

**27 hours**

Study 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, Malvaceae, Rutaceae, Anacardiaceae, Leguminosae (Mimosaceae, Caesalpiniaceae and Fabaceae), Myrtaceae, Cucurbitaceae, Apiaceae, Rubiaceae, Asteraceae, Sapotaceae, Apocynaceae, Asclepiadaceae, Convolvulaceae, Solanaceae, Scrophulariaceae, Acanthaceae, Lamiaceae, Amaranthaceae, Euphorbiaceae, Orchidaceae, Liliaceae, Arecaceae, Poaceae

#### **Module- 4: 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

- a. Cereals: Rice, Wheat
- b. Millets: Ragi
- c. Pulses: Green gram, Bengal gram, Black gram
- d. Sugar yielding plants: Sugarcane
- e. Fruits: Apple, Pineapple, Orange, Mango and Banana
- f. Vegetables: Bitter gourd, Ladies finger, Carrot and Cabbage.
- g. Timber yielding plants: Teak wood and Rose wood
- h. Beverages: Tea, Coffee
- i. Fibre yielding plants: Coir, Jute, Cotton
- j. Oil yielding plants: Ground nut, Gingely
- k. Rubber yielding plants: Para rubber
- l. Gums and Resins: White dammar, Gum Arabic, Asafoetida
- m. Spices: Cardamom, Pepper, Clove, Ginger
- n. Insecticide yielding Plants: Tobacco and Neem
- o. Medicinal plants: *Adhatoda*, Turmeric, Neem, *Catharanthus*, *Ocimum sanctum*, *Rauvolfia serpentina*, *Withania somnifera*

#### **Module 5: Ethnobotany**

**3 hours**

1. Ethnobotany: scope and significance.
2. Tribes of Kerala (Kani, Kurichya, Mudhuva)
3. Traditional plant based knowledge (brief study)
4. Study of the following plants used in daily life by tribal and village folks for Food, Shelter and Medicine
  - a. Food: *Artocarpus*, *Corypha*, *Phoenix*
  - b. Shelter: *Bambusa*, *Ochlandra* and *Calamus*
  - c. Medicine: *Curcuma*, *Trichopus zeylanicus* and *Alpinia galanga*

#### **Practical: (36 hours)**

1. Identify the following:
  - a. Leaves: types, venation and phyllotaxy
  - b. Inflorescence - mentioned in the syllabus
  - c. Fruits - mentioned in the syllabus
2. Acquaintance with campus flora
3. Identify the families mentioned in the syllabus by noting their key, vegetative and floral characters.

4. 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.
5. Study the finished products of plants mentioned in the syllabus of economic botany with special reference to the morphology, botanical name and family.
6. Prepare herbarium of 15 plants with field notes.
7. Conduct field work for a minimum of 5 days under the guidance of a teacher
8. Identify and describe the ethno botanical uses of the items mentioned in the syllabus.

## 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.
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22. Jain S K 2004, *A Manual Of Ethnobotany*, Scientific Publishers, India
23. Verma .V. *Text book of Economic Botany* ,Ane Book Pvt. Ltd.
24. Pandey&Misra 2008 *Taxonomy of Angiosperms*. Ane Book Pvt. Ltd.

### Online References/Resources for Taxonomy

Sl. No.	Resource	URL
1	Digital Flowers	<a href="http://www.life.illinois.edu/help/digitalflowers/">http://www.life.illinois.edu/help/digitalflowers/</a>

2	Families of Flowering plants Delta-intKey Digital Key with description	<a href="http://delta-intkey.com/angio/index.htm">http://delta-intkey.com/angio/index.htm</a>
3	APG Poster	<a href="http://www2.biologie.fu-berlin.de/sysbot/poster/poster1.pdf">http://www2.biologie.fu-berlin.de/sysbot/poster/poster1.pdf</a>
4	APG	<a href="https://en.wikipedia.org/wiki/Angiosperm_Phylogeny_Group">https://en.wikipedia.org/wiki/Angiosperm_Phylogeny_Group</a>
5	The Plant List	<a href="http://www.theplantlist.org/">http://www.theplantlist.org/</a>
6	International Plant Name Index (IPNI)	<a href="http://www.ipni.org/">http://www.ipni.org/</a>

**PLANT GENETIC RESOURCES**

(Theory 72 hours)

(Theory Credit 4)

**Objectives:**

1. Acquaint the student with the history and evolution of crop plants, and their diversity.
2. Familiarize the student with the available plant genetic wealth and the measures adopted for the conservation of these resources.
3. Help the student to identify the crop plants and their wild relatives.
4. Help the student to explore the potentialities of various underutilized plants to project as the future food prospects.
5. Understand the significance of modern technology to locate the distribution of endangered species.

**Module 1**

1. Historical developments in crop botany. Centres of origin and diversity of crop plants, primary and secondary centres, Vavilovian concept. **4 hours**
2. Exploration and collection of genetic resources- importance of wild relatives of crop plants and their genetic diversity in crop improvement. **3 hours**
3. Conservation of genetic resources. (i) in situ: biosphere reserves, national parks and wild life sanctuaries; (ii) ex situ- (a) in vivo: botanic gardens, field gene banks; (b) in vitro: seed banks ( short term, medium term and long term storage of seeds), tissue culture storage and cryopreservation **5 hours**

**Module 2**

1. Role of Governmental and non-governmental organizations in Plant Genetic Resources Management: Governmental Organisations- Regional – TBGRI and KFRI; National - BSI and NBPGR; International - IPGRI (IBPGR) and ICRISAT. **5 hours**
2. Non Governmental Organisations – Herbal gardens and Nurseries. **4 hours**

**Module 3**

1. Major threat to the genetic resources: human interference and deforestation, over exploitation of resources.
2. Endemism and Hot Spots. Documentation of endangered and threatened plants- red data book.
3. Remote sensing: principle – concept of remote sensing and components of remote sensing. Application of remote sensing in conservation of endangered plants and habitat studies. WCU- role and activities. **7 hours**

**Module 4**

1. Ethnobotany its significance and scope with respect to food, shelter and medicine.
2. Ethnobotany in relation to conservation of genetic resources: mythology and conservation of eco-systems, sacred groves and their role in the conservation of gene pool; taboos for conservation of selected plant species. **7 hours**

**Module 5**

1. Important food, medicinal and aromatic plants of Kerala state – taxonomy, cultivation and uses of rice, tapioca, elephant foot yam, cow pea, bitter gourd, ginger, black pepper, nutmeg, cardamom, coffee, vasaka, Aloe and lemon grass. **16 hours**
2. Plantation crops – scope and importance of plantation crops; taxonomy, cultivation and useful products of rubber, cashew, coconut and tea. **6 hours**
3. Importance of fruits: classification of fruits, role of fruits in Indian economy, taxonomy and cultivation of banana, pineapple and mango. **4 hours**

### Module 6

1. Underutilised plants and its importance for future food requirements. Botany and uses of the following under exploited edible plants.
2. Vegetables; winged bean, sword bean, cluster bean, ridge gourd, bottle gourd, little gourd, lesser yam, Chinese potato.
3. Fruits; *Artocarpus heterophyllus*, *Artocarpus hirsutus*, Anona, Rambutan, rose apple.
4. Mushroom cultivation and spawn production – paddy straw, oyster and button mushroom. **11 hours**

### Suggested additional topics

- Study the origin and diversity of various crop plants.
- Plant Introduction and its importance in creating genetic diversity.
- Ethnobotany in relation to crop improvement.
- Linking it with food, shelter, cloth and medicine to human.

### References

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20. Sivarajan V.V. and Indira Balachandran 1998. *Ayurvedic Drugs and their Plant Sources*, Oxford and IBH pub.
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24. Peter K.V. & Z. Abraham 2007. *Biodiversity in Horticultural Crops Vol.1*, Daya Publishing House. New Delhi.
25. Panda B.C. 2008. *Remote Sensing- Principles and Applications*, Viva Books. New Delhi



**HORTICULTURE AND NURSERY MANAGEMENT****(Theory 72 hours)****(Theory Credit 4)****Course objectives**

1. Understand the importance of horticulture in human welfare.
2. Understand the propagation and cultural practices of useful vegetable, fruit and garden plants.
3. Understand the impact of modern technologies in biology on horticultural plants.
4. Understand the basic concepts of landscaping and garden designing.
5. Inculcate interest in landscaping, gardening and flower and fruit culture.

**HORTICULTURE****48 hours****Module 1****10 hours**

1. Introduction to horticulture- definition, history, classification of horticultural plants, disciplines of horticulture.
2. Soil- formation, composition, types, texture, pH and conductivity.
3. Garden tools and implements.
4. Preparation of nursery bed; manures and fertilizers- farm yard manure, compost, vermicompost, biofertilizers;-chemical fertilizers NPK; time and application of manures and fertilizers, foliar spray.
5. Irrigation methods- surface, sub, drip and spray irrigations- advantages and disadvantages-periodicity of irrigation.

**Module 2****10 hours**

1. Propagation of horticultural plants- by seeds- Seed development and viability, seed dormancy, seed health, seed testing and certification, growing seedlings in indoor containers and field nurseries, seed bed preparation, seedling transplanting; advantages and disadvantages of seed propagation.
2. Vegetative propagation- organs used in propagation- natural and artificial vegetative propagation; methods- cutting, layering, grafting and budding; advantages and disadvantages of vegetative propagation; micropropagation.

**Module 3****10 hours**

1. Gardening- ornamental gardens, indoor gardens, kitchen gardens- terrestrial and aquatic gardens- garden adornments; garden designing- garden components- lawns, shrubs and trees, borders, hedges, edges, drives, walks, topiary, trophy, rockery- famous gardens of India. Landscape architecture- home landscape design, urban planning, parks, landscaping and public buildings, industrial and highway landscaping.
2. Physical control of plant growth- training and pruning- selection of plant, bonsai containers and method of bonsai formation.

#### **Module 4**

1. Commercial floriculture- jasmine, orchid, anthurium, rose, gladiolus; production of cut flowers, quality maintenance, packing, marketing. Flower arrangements-basic styles- upright and slanting-japanese Ikebana, dry flower arrangement. **6 hours**
2. Olericulture- Types of vegetable growing-home gardens and market gardens; cultivation practices of leafy vegetable (Amaranthus), tuber (Potato), fruit (Tomato), flower (Cauliflower). **4 hours**
3. Pomology- Cultivation of fruit crops-mango, banana and pine apple- preparation of land, spacing, planting, irrigation, hormones, harvest and storage. Factors affecting duration of storage. Principles of preservation-temporary and permanent- agents for fruit preservation. Preparation of pickles, jams, jellies and squashes using locally available fruits. **4 hours**

#### **Module 5**

**4 hours**

1. Garden friends -honey bees, ladybirds, frogs, spiders, earthworms, centipedes and millipedes. Garden foes- pests, pathogenic fungi, bacteria, virus. Control measures- pesticides and fungicides; neem tobacco decoction. Hazards of chemical pesticides; equipments used in controlling horticultural pests-sprayers, dusting equipments-sterilization, fumigation.
2. Weeds- annual, perennial; weed control-prevention, eradication - hand weeding, tillage, burning, mowing, biological control, use of herbicides- selective and non selective-mechanisms involved in herbicidal actions.

#### **NURSERY MANAGEMENT**

**24 hours**

#### **Module 6**

**6 hours**

1. Nursery-definition, types; management strategies- planning, layout, budgeting-production unit, sales unit.
2. Plant growing structures- green houses, fernery, orchidarium, arboretum.

#### **On hand training**

**18 hours**

1. Preparation of potting mixture of known combination and potting in earthen pots / poly bags.
2. Preparation of nursery beds.
3. Preparation of compost / vermicompost using different substrates.
4. Working knowledge and identification of garden tools and implements.
5. Practical knowledge in different plant propagation techniques listed in syllabus.
6. Cultivation of a vegetable / ornamental plant / fruit crop listed in the syllabus.
7. Practice of different pruning operations (top dressing, shaping and topiary) in the following plants (1) Bougainvillea (2) Phyllanthus.
8. Visit a well established nursery and submit report.

#### **Reference:**

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<http://www.ars.org/>

<http://www.oces.okstate.edu/kay/horticulture>

<http://www.aos.org>

<http://www.aos.org//AM/Template.cfm?Section=Home>

<http://www.horticultureworld.net/>

<http://www.back-to-basics.net/>

<http://www.rhs.org.uk/>

## AGRIBASED MICROENTERPRISES

(Theory 72 hours)

(Theory Credit 4)

**Course objectives**

1. A basic information about the business opportunities in plant sciences.
2. Inform the student about sustainable agriculture and organic farming.
3. Inculcate an enthusiasm and awareness about ornamental gardening, nursery management and mushroom cultivation.

**Module 1****9 hours****Organic farming and composting techniques**

1. Organic manures and fertilizers. Composition of fertilizers – NPK content of various fertilizers. Common organic manures – bone meal, cow dung, poultry waste, oil cakes, organic mixtures and compost.
2. Preparation of compost –aerobic and anaerobic- advantages of both; vermicompost – preparation, wormiwash. Biofertilizers – definition, types – *Trichoderma*, *Rhizobium*, PGPR. Biopesticides – Tobacco and Neem decoction. Biological control. Sustainable agriculture.

**Module 2.****18 hours****Horticulture and Nursery management.**

1. Soil components. Preparation of potting mixture. Common Garden tools and implements. Methods of plant propagation – by seeds – advantages and disadvantages. Vegetative propagation – advantages and disadvantages. Natural methods of vegetative propagation. Artificial methods – cutting, grafting, budding and layering. Use of growth regulators for rooting. Micropropagation by tissue culture.
2. Gardening – Types of garden – ornamental, indoor garden, kitchen garden, vegetable garden for marketing. Rockery and artificial ponds. Ornamental garden designing – garden components – flower beds, borders, hedges, edges, drives and paths, garden adornments. Lawn - preparation by seeds, by transplanting seedling and by turfing. Annuals, Biennials, Shrubs, Trees, Cycads and Palms. Bonsai preparation. Pruning of plants. Types of Nurseries – Management aspects and Maintenance.
3. Plant growth structures – advantages of green house, polyshed, fernery and orchidarium.
4. Packaging of fruits, vegetables, nursery products and flowers.

**Module 3.****9 hours****Food spoilage and preservation techniques.**

1. Causes of spoilage.
2. Preservation techniques – asepsis, removal of microorganisms, anaerobic conditions and special methods – by drying, by heat treatment, by low temperature storage and by chemicals (Food Additives).
3. Preparation of wine, vinegar and dairy products( Milk peda, Khoa, Ice cream and Paneer)

**Module 4.****9 hours****Mushroom cultivation and Spawn production.**

1. Significance of Mushrooms, General outline of life cycle.
2. Types of mushrooms - button mushroom, oyster mushroom and milky mushroom, poisonous mushroom – methods of identification.
3. Spawn – isolation and preparation. Cultivation of oyster and milky mushrooms – using paddy straw and saw dust by polybag.
4. Farm design and control of pests and diseases. Value added products from mushroom – pickles, candies, dried mushrooms.

**Module.5.****9 hours****Plant tissue culture and micropropagation**

1. Protoplasm- basic structure and function of plant cell
2. Concept of totipotency- differentiation and dedifferentiation. Infra structure of a tissue culture laboratory .Solid and liquid media- composition and preparation. Sterilization- dry, wet and filter sterilization.
3. Explant- inoculation and incubation techniques. Callus induction- organogenesis and embryogenesis. Transplanting, hardening, package and transportation of tissue cultured plantlets.

**On Hand Training (18 hours)**

1. Prepare a chart showing the NPK composition of minimum 6 manures and fertilizers.
2. Identification and familiarization of the following organic manures- cow dung (Dry), Coconut cake, Vermicompost, neem cake, Organic mixture, Bone meal.
3. Preparation of potting mixture.
4. Make a Vermicompost pit /pot in the campus/ house of the student.
5. Familiarization of common garden tools and implements.
6. Estimation of germination percentage of seeds
7. Demonstrate the effect of a rooting hormone on stem cutting.
8. Demonstration of T budding, epicotyle grafting and air layering on live plants
9. Familiarization of garden components from photographs
10. Preparation of vinegar / dairy product (Any two) in class or home
11. Familiarization of different mushrooms and preparation of a polybag of *Pleurotus* using straw/sawdust
12. Visit to a well established tissue culture lab, nursery and mushroom cultivation unit.

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**B.Sc. BOTANY PROGRAMME**  
**Semester VI      Course 9      BOT6COR10**

**PLANT PHYSIOLOGY AND BIOCHEMISTRY**

**(Theory 54: hours; Practical: 36 hours)**

**(Theory Credit 2, Practical Credit 1)**

**Course objectives:**

1. Understand the basic principles related to various physiological functions in plant life.
2. Familiarize with the basic skills and techniques related to plant physiology.
3. Understand the role, structure and importance of the bio molecules associated with plant life.
4. Familiarize with the recent trends in the field of plant physiology.
5. Familiarize with applied aspects of plant physiology in other fields like agriculture.

**PLANT PHYSIOLOGY**

**(Theory 36: hours; Practical: 27 hours)**

**Module 1 Water relation and Mineral Nutrition**

**10 hours**

**1. Water relation**

- a. Physical aspects of absorption-Diffusion, imbibition, osmosis.  
Concept of Water potential, matrix potential, pressure potential.
- b. Absorption of water-active & passive, Ascent of sap-cohesion adhesion theory.
- c. Transpiration-types-mechanism-theories-(starch-sugar, proton-K<sup>+</sup>ion exchange)-  
significance – anti-transpirants, Guttation. **7 hours**

**2. Mineral Nutrition and mechanism of absorption.**

- a. Essential and non essential elements- macro& micro- role- deficiency symptoms.
- b. Absorption of minerals- active & passive-ion exchange, carrier concept. **3 hours**

**Module 2 Photosynthesis and translocation**

**11 hours**

**1. Photosynthesis**

History - Photosynthetic pigments, photo excitation- Fluorescence, Phosphorescence - Absorption and action spectra, Red drop and Emerson enhancement effect, Concept of photo systems (photosystem I and II), Cyclic & Non Cyclic photophosphorylation, Carbon assimilation pathways-C<sub>3</sub>, C<sub>4</sub>, CAM- Photorespiration –factors affecting photosynthesis.

**2. Translocation**

Pathway-phloem transport-mechanism-pressure flow-phloem loading and unloading.

**Module 3 Respiration**

**8 hours**

Aerobic and Anaerobic, Glycolysis, Krebs cycle, Electron transport system & Oxidative phosphorylations, ATPases - chemi osmotic hypothesis-RQ –significance-factors affecting respiration.β oxidation

**Module 4 Growth, Development and Stress Physiology**

**1. Physiology of growth and development**

**6 hours**

- a. Physiological effects and practical application of hormones-Auxins, Giberillins, Cytokinins, ABA, ethylene.
- b. Physiology of flowering–Phytochrome.
- c. Photoperiodism-vernalisation. **4 hours**

**2. Stress physiology**

Abiotic stress - plant responses to water, salt and temperature stresses-  
Biotic stress – pathogens. **2 hours**

**Practicals (27 hours)**

### Core Experiments

1. Determination of osmotic pressure of plant cell sap by plasmolytic method.
2. Compare the stomatal indices of hydrophytes, xerophytes and mesophytes.
3. Separation of plant pigments by thin layer chromatography (TLC) and paper chromatography.
4. Measurement of photosynthesis by Willmott's bubbler/any suitable method.
5. Quantitative estimation of plant pigments using colorimetry.

### 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<sub>2</sub> in photosynthesis.
5. Simple respiroscope
6. Respirometer and measurement of R.Q.
7. Fermentation.
8. Measurement of transpiration rate using Ganong's Potometer/ Farmer's Potometer.

## BIO-CHEMISTRY

(Theory 18: hours; Practical: 9 hours)

### Module 5 Water, Solutions & pH

2 hours

Physical and chemical properties of water, Acid and bases, pH definition, significance, measurement, pH indicators, buffer action, significance of buffers in biological systems.

### Module 6 Chemistry of biological molecules

16 hours

1. **Carbohydrates**- structure and role of mono-di & poly-saccharides-common sugars seen in plants (dihydroxy acetone, glyceraldehyde, ribose, glucose, mannose, galactose, lactose, sucrose, cellobiose, cellulose and starch) **4 hours**
2. **Proteins**-peptide bond-essential and non essential amino acids-primary, secondary, tertiary and quaternary structure (brief account only)-physiologically important proteins. **3hours**
3. **Lipids** - general features and their roles - fatty acid types and structure - fatty acid derivatives- fats and oils, structure and functions - compound lipids. **3 hours**
4. **Enzymes**  
Nomenclature, characteristics mechanism and regulation of enzyme action, enzyme kinetics, factors affecting enzyme action. **6 hours**

### Practicals: (9 hours)

1. General test for carbohydrates- Molisch's test, Benedicts's tests, Fehling's test.
2. Colour test for starch – Iodine 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: peroxides, dehydrogenase.
6. Quantitative estimation of protein using colorimetry.

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- <http://4e.plantphys.net/>
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- <http://www.ab.ipw.agr.ethz.ch/~yfracheb/flex.htm>
- <http://www.life.illinois.edu/govindjee/photoweb/subjects.html#ps>
- <http://www.plant-hormones.com/>

**B.Sc. BOTANY PROGRAMME**  
**Semester VI      Course 10      BOT6 COR 11**  
**ECOLOGY AND ENVIRONMENTAL SCIENCE**

**(Theory: 54 hours; Practical: 36 hours)      (Theory Credit 3, Practical Credit1)**

**Course Objectives:**

1. To acquaint the students with the basic principles of Ecology and Environmental Science and help them to understand the structure and function of the Ecosystems.
2. To make the students aware about the concept of Population and Community Ecology and the need for Biodiversity Conservation.
3. To impart basic knowledge about natural resources and equip them to think about new approaches for the wise use of ecosystems and natural resources
4. To impart basic knowledge about present state of environment .
5. To make the students to understand various rules, regulations and movements to protect environment

**Module 1 Principles of Ecology and Environmental science**

**10 hours**

**Introduction to Environmental Science**

1. Defining Environment
2. The Multidisciplinary Nature of Environmental Science
3. Relevance and Scope of Environmental Studies
4. Culture, Heritage and Environment: An introduction to Culture and Ecology

**Ecosystems**

1. Structure and function of ecosystem: Ecosystem components- abiotic and biotic, Productivity - primary and secondary-gross and net productivity. Decomposition in nature, homeostasis in ecosystem
2. Ecological energetics: energy flow, trophic levels, food chain and food web, ecological pyramids
3. Nutrient cycles: Biogeochemical cycles of C, N and S.
4. Ecosystem types (forest, grass land , deserts and wet lands)

**Module 2 Population and Community ecology**

**12 hours**

1. Biodiversity: Definition, Levels of biodiversity, India as a mega biodiversity country, Biogeographic Zones of India
2. Population: size, density, natality, mortality.
3. Community characteristics: Species diversity and species richness, dominance, growth forms and structure, trophic structure.
4. Association of communities: plant association, ecotypes, ecotone, edge effect, ecological indicators. keystone species
5. Ecological succession: types of succession, process - migration, ecesis, colonization, stabilization and climax community; hydrosere, xerosere, lithosere.
6. Endemism: Definition-types-factors. Hotspot of endemism-hotspots in India. Western Ghats as the hottest spot and its conservation efforts.

7. Species - ecosystem interaction: Habitat, ecological niche, microclimate Ecological factors affecting plant growth and response
  - a. Climatic factors: temperature and pressure; water - precipitation, humidity, soil water holding capacity; light - global radiation.
  - b. Topographic factors: altitude and aspects
  - c. Edaphic factors - profile and physical and chemical properties of soil
  - d. Biotic factors: interaction
8. Adaptation of plants to environment: Water (Xerophytes, Hydrophytes), Temperature (thermo periodicity, vernalization), light (photoperiodism, heliophytes, sciophytes), salinity (halophytes, mangroves).

### **Module 3 Natural Resources**

**8 hours**

1. Types of resources-renewable and non renewable
2. Energy resources: Bioenergy
3. Water resources: Surface and ground water, drinking water sources, dams-benefits and problems, conflict over water, Water harvesting,
4. Food and Health Care Resources: Concepts of Agro-biodiversity and Centres of Origin, Major food crops in India. Traditional Knowledge in Health Care and Medicinal Plant Wealth of India.
5. Non Food Resources: Timber and other Non Wood Forest Products (NWFP), Mining products (Sand, Rock and Clay)

### **Module 4 Environment and Development**

**24 hours**

#### **Global Environmental Changes**

1. Introduction to Global environment scenario
2. **Drivers of change:** Population explosion, urbanisation, industrialisation, infrastructure development, agricultural practices
3. **Pressure:** Overexploitation of resources, Land use changes (encroachment, reclamation), Solid and Liquid Waste, Industrial Waste, Agricultural Waste, Hydraulic interventions, Invasive weeds.

**4 hours**

#### **State of Environment**

1. **Environmental Pollution:**
  - a. Definition and general introduction
  - b. Air pollution: Causes and sources, types of pollutants-particulates-aerosol, mist, dust, smoke, fume, plume, fog, smog. Acid rain, Effect of air pollution on plants and animals, Air quality monitoring
  - c. Water pollution: Sources and types of pollutants. Water quality standards and assessment. Cycling of heavy metals, hydrocarbons. Eutrophication, Ground water pollution, Control measures

- d. Soil pollution: Causes and sources-waste dumps, municipal wastes, agrochemicals, mining, control measures
- e. Noise pollution: Sources, standards and measurements, effect on health, control techniques.
- f. Thermal pollution: Sources, effects and control measures.
- g. Nuclear hazards: Sources, impacts and safety measures.

**2. Land use Changes:**

- a. Encroachment, Reclamation, Mining,
- b. Habitat Loss, Biodiversity depletion, Invasive species

**8 hours**  
**6 hours**

**Environmental Impacts**

**1. Biodiversity Loss:**

Species extinction - Red data book

**2. Food Security/Poverty:**

Agriculture and Aquaculture production and productivity- Drought, irrigation water availability, diseases; availability of natural food resources - fish, wild edible plants

**3. Climate change**

- a. Global warming and green house gases
- b. Ozone layer depletion,

**4. Impact on Human Health**

- a. Availability of potable water
- b. Disease outbreaks due to air, water, soil, and noise pollution
- c. Lifestyle diseases due to changes in food habits
- d. Mental health due to loss of natural habitats and noise
- e. Human loss due to floods, drought and other natural disasters

**5. Impacts on Infrastructure Development**

- 6. Resource depletion, Obstruction in navigation (wetlands)

**Environmental Responses**

**6 hours**

**1. Institutions for Environmental Research and Conservation:**

Brief mention on International Union for Conservation of Nature and Natural Resources (WCU), MoEFCC, CSIR, ICAR, NEERI, BNHS, SACON, CSE, KSCSTE and CED

**2. Environmental Laws, Policies and Protocols:**

- a. Global Conservation efforts: Rio Earth Summit; Agenda 21; Inter Governmental Panel for Climate Change (IPCC) Kyoto protocol; COP 15 (15<sup>th</sup> Conference of the Parties under the U N Framework Convention on Climate Change)
- b. Environmental Laws and Policies India and Kerala: Brief accounts on Environment (protection) Act, 1986; Air (Prevention and control of pollution) Act, 1981; Water (Prevention and control of pollution) Act, 1974; Wildlife

(protection) Act, 1972; Forest (Conservation) Act, 1980; Biodiversity Act, 2002;  
Kerala Conservation of Paddy

c. Land and Wetland Act, 2008.

**3. NGO Movements and Individual Contributions:**

- a. Brief mention on WWF, Green Peace, Chipko
- b. Introduce personalities like Salim Ali, Sunderlal Bahuguna, Madhav Gadgil, Anil Agarwal, Medha Patkar, Sunitha Narayan, John C. Jacob, Sugathakumari and Prof. M K Prasad.

**4. Wise Use of Ecosystems and Natural Resources**

- a. Ecotourism and other initiatives under Joint Forest Management (JFM)
- b. Household Waste Management and Organic Farming

**PRACTICALS ( 36 hours )**

1. Visiting an ecosystem (grasslands/forest/wetland/urban) and make an assessment of species diversity, abundance, and frequency of plant species by quadrat method.
2. Preparation of the list of Rare and threatened (R&T), invasive alien species in the ecosystem visited (no collection of specimens)
3. Identification of anatomical, morphological, physiological adaptation of plants to the environment (Xerophytic, Hydrophytic, Epiphytic, Halophytic).
4. Identification of major environmental issues and sources of pollution in an area (pond, road side, market, Industrial area, paddy field, plantation etc.
5. Identification and preparation of the list of exotic plants in the locality.
6. Estimation of CO<sub>2</sub>, Cl, and salinity of water samples (Titrimetry)
7. Determination of pH of soil and water
8. Study of the most probable number (MPN) of coliform bacteria in water samples
9. Collection and recording of rain data by using simple rain gauge.
10. Visit to a Ecotourism site managed by Vana Samrakshana Samithi (VSS) under JFM program of Kerala Forest and Wildlife Department, familiarization of activities and making a report. Eg. Paniyeli Poru
11. Visit to a model urban home garden, familiarization of activities and making a report

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**B.Sc. BOTANY PROGRAMME**  
**Semester VI Course 11 BOT6COR12**  
**CELL AND MOLECULAR BIOLOGY**

**(Theory: 54 hours; Practical: 36 hours) (Theory Credit 3, Practical Credit1)**

**Course objectives**

1. Understand the Ultra structure and functioning of cell in the sub microscopic and molecular level.
2. Get an idea of origin, concept of continuity and complexity of life activities.
3. Familiarization of life process.
4. Understand the basic and scientific aspect of diversity.
5. Understand the cytological aspects of growth and development.
6. Understand DNA as the basis of heredity and variation.

**CELL BIOLOGY (Theory: 27hours)**

**Module 1 Introduction**

**9 hours**

1. Historical account of cell Biology –Cell theory and Protoplasm theory
2. The physio-chemical nature of plasma membrane (Unit membrane and Fluid mosaic model) and cytoplasm, cyclosis, Eukaryotic versus Prokaryotic cell, Animal cell versus Plant cell.
3. The ultra structure of plant cell and function of the following organelles-Endoplasmic reticulum, Plastids, Mitochondria, Ribosomes, Dictyosome, Microbodies, lysosomes. Vacuole and cell sap, Cytoskeleton (brief account only) Nucleus- structure and functions of Nucleolus, Nuclear membrane, Nucleoplasm and Chromatin.

**Module 2 Chromosomes**

**15 hours**

1. Morphology of metaphase chromosome-Types of chromosome, Chromatin organization: - Nucleosome model – structure of nucleosome -heterochromatin and euchromatin, karyotype and ideogram, Special type of chromosomes –Giant chromosome-Salivary gland chromosomes and Lamp brush chromosomes. Supernumerary chromosome-B chromosome. Cell cycle and its different stages, mitosis and meiosis: (structure and function of synaptonemal complex) significance of mitosis and meiosis.
2. Change in number of chromosomes –Euploidy – Haploidy, Autopolyploidy and Allopolyploidy (*Solanum*, *Raphano brassica*) and Aneuploidy –Monosomy ( Cri du chat, Myelocytic leukemia) Trisomy (Patau syndrome, Edward syndrome) Nullisomy- (*Triticum*).Chromosomal abnormalities in man (Down's syndrome, Klinefelter's syndrome and Turner's syndrome)
3. Change in the structure of chromosomes – Deletion (Notch wing in *Drosophila*), Duplication (Bar eye in *drosophila*), Inversions and Translocations (Robertsonian translocation).

**Module 3 Mutation**

**5 hours**

1. Definition, Importance and types of Mutations- Spontaneous and induced. Mutagens- Physical (non-ionizing and ionizing radiations) and Chemical mutagens-Classification based on mode of action- (base analogues, alkylating agents, deaminating agents, acridine dyes, hydroxylating agents (brief description only).
2. Chromosomal and point mutations. Molecular mechanism of mutation – Frame shift mutations, Transition, Transversion and Substitution

## **MOLECULAR BIOLOGY (Theory: 27hours)**

### **Module 4: DNA and RNA**

**14 hours**

1. Identification of DNA as Genetic material: Transformation Experiment, Hershey and Chase Experiment-RNA as genetic material in some viruses
2. Watson and Crick model of DNA- Basic features, Chargaff rule, alternate forms of DNA – A & Z, structure and function of different types of RNA- tRNA, mRNA and rRNA
3. Replication of DNA - Meselson-Stahl experiment-semiconservative replication of DNA , DNA repair (photolyase) .

### **Module 5 Gene Expression**

**10 hours**

1. Gene expression - concept of gene, definitions, central dogma and reverse transcription - details of transcription in prokaryotes and eukaryotes - mRNA processing, Genetic code features- Wobble hypothesis-details of translation
2. Control of gene expression – Inducible and Repressible system- Operon model- lac operon and trp operon.

### **Module 6 Genetics of Cancer**

**3 hours**

1. Genetic basis of cancer - oncogenes - tumor suppressor genes - metastasis

### **Practicals (36 hours)**

1. Make acetocarmine squash preparation of onion root tip to identify mitotic stages.
2. Study the Mitotic Index of onion root tip cells
3. Study of meiosis in any flower bud by smear preparation of PMC's
4. Demonstration of cyclosis
5. Identify and study photographs and diagrams of cell division anomalies like lagging chromosomes, chromosome bridge.
6. Aneuploidy, polyploidy. Study the chromosomal patterns/ Karyotype in auto-, allo-, and aneuploids
7. Work out elementary problems based on DNA structure, replication, transcription and translation (Minimum 15 problems)

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#### Cytology

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<http://www.cellsalive.com/index.htm>

<http://zygote.swarthmore.edu/>

<http://www.pathology.washington.edu/galleries/Cytogallery/main.php>

[http://biog-101-104.bio.cornell.edu/BioG101\\_104/tutorials/cell\\_division/CDCK/cdck.html](http://biog-101-104.bio.cornell.edu/BioG101_104/tutorials/cell_division/CDCK/cdck.html)

[http://www.pbs.org/wgbh/nova/baby/divi\\_flash.html](http://www.pbs.org/wgbh/nova/baby/divi_flash.html) Mol.biol

<http://www.hhmi.org/genetictrail/index.html>

<http://www.learner.org/interactives/dna/index.html>

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**B.Sc. BOTANY PROGRAMME**

**Semester VI**

**Course 12**

**BOT6COR13**

**BIOTECHNOLOGY AND BIOINFORMATICS**

**(Theory 54 hours; Practical: 36 hours) (Theory Credit 3, Practical Credit1)**

**COURSE OBJECTIVES**

1. Familiarize with the fundamental principles of biotechnology, various developments in biotechnology and potential applications.
2. Make aware that the life forms and activities can be exploited for human advancement.
3. Impart an introductory knowledge about bioinformatics to the students.

**BIOTECHNOLOGY**

**(Theory 36 hours; Practical 26 hours)**

**Module 1**

**18 hours**

1. Introduction – The concept of biotechnology, Old and New Biotechnology, landmarks in biotechnology, Biotechnology research institutes and companies in India (Brief account only)
2. Plant tissue culture – Principles and techniques. Cellular totipotency, *in vitro* differentiation – de differentiation and re-differentiation, callus induction, organogenesis and somatic embryogenesis.
3. Tissue culture medium – Basic components in tissue culture medium – Solid and liquid medium – suspension culture. Murashige and Skoog medium – composition and preparation. Aseptic techniques in tissue culture – sterilization – different methods – sterilization of instruments and glass wares, medium, explants; working principle of laminar air flow and autoclave; preparation of explants – surface sterilization. Inoculation, incubation, subculturing.
4. Micropropagation - Different methods – axillary bud proliferation, direct and indirect organogenesis and somatic embryogenesis. Different phases of micropropagation – hardening, transplantation and field evaluation Advantages and disadvantages of micropropagation. Somaclonal variation and application (brief study only).
5. *Methods and Applications* of tissue culture - Shoot tip and meristem culture Synthetic seed production, embryo culture, Protoplast isolation culture and regeneration – Somatic cell hybridization- cybrids. *In vitro* secondary metabolite production -- cell immobilization, bioreactors *In vitro* production of haploids – anther and pollen culture, *In vitro* preservation of germplasm.

**Module 2 Recombinant DNA Technology**

**12 hours**

1. Gene cloning strategies – recombinant DNA construction – cloning vectors – plasmids pBR322, bacteriophage based vectors-Lambda phage based, hybrid vectors-cosmid, *Agrobacterium* Ti plasmid based vector. Restriction endonucleases-Type I, II (Eco R1-, Alu I restriction sequence only) and III, exonucleases and ligases – transformation and selection of transformants – using antibiotic resistance markers, Southern, Northern and Western blotting (brief study only); PCR-Steps and Applications (Variants not required).
2. Different methods of gene transfer –I) Direct gene transfer methods- 1) chemically-PEG, CaCl<sub>2</sub> mediated transformation 2) Physical-electroporation, microinjection, biolistics II) Vector mediated-*Agrobacterium* mediated gene transfer, transduction-

Vector based on plant viruses-Caulimo virus, Gemini virus (brief account only).  
Genomic library, cDNA library

**Module 3 Application of Biotechnology** (brief account only) **3 hours**

1. Medicine - Production of human insulin, human growth hormone and vaccines, gene therapy, monoclonal antibodies, biopharming.
2. Forensics - DNA finger printing.
3. Agriculture - Genetically modified crops - Bt crops, Golden rice, Flavr Savr Tomato, Virus herbicide resistant crops, Edible vaccines.
4. Environment - Bioremediation- use of genetically engineered bacteria-super bug.
5. Industry - Horticulture and Floriculture Industry, production of vitamins, amino acids and alcohol.

**Module 4 Scope and relevance of the following technologies** **3 hours**

(Methodology not required)

1. Tissue Engineering technology, Embryonic stem cell culture, Animal cloning, Terminator technology.
2. Social and ethical issues, biosafety, biowar, patenting and IPR issues.

**Practicals ( 26 hours )**

1. Preparation of nutrient medium - Murashige and Skoog medium, sterilization, preparation of explants, inoculation.
2. Extraction of DNA from plant tissue.
3. Immobilization of whole cells or tissues in sodium alginate.
4. Study of genetic engineering tools and techniques using photographs/diagram (Agarose gel electrophoresis, pBR 322, EtBr, Agarose, SDS, Southern blotting, DNA finger printing, PCR, *Agrobacterium* as natural genetic engineer)
5. Visit a well equipped biotechnology lab and submit a report along with the practical record.

**BIOINFORMATICS**

**(Theory: 18 hours; Practical: 10 hours)**

**Module 5**

**9 hours**

1. Introduction to Bioinformatics, scope and relevance, genome, transcriptome, proteome.
2. Biological data bases -  
Nucleotide sequence database -ENA, Gen Bank, DDBJ.  
Protein sequence database - PDB, SWISS PROT  
Organismal database - *Saccharomyces* genome database, *Arabidopsis* genome database
3. Information retrieval from Biological database, sequence alignment types and tools: pair wise sequence alignment, multiple sequence alignment, use of BLAST, FASTA.

**Module-6**

**9 hours**

1. Genomics : DNA sequencing- Sanger's procedure-automation of DNA sequencing, Pyrosequencing, genome sequence assembly,
2. Genome projects - Major findings of the following genome projects - Human, *Arabidopsis thaliana*, Rice, *Haemophilus influenza*, Application of genome projects.
3. Proteomics : Protein sequencing- Edman degradation method, automation of sequencing, protein structure prediction and modeling (Brief account only)
4. Bioinformatics Software's and Tools A brief account on  
Molecular phylogeny and phylogenetic trees-MEGA.  
Molecular visualization - use of Rasmol.  
Molecular docking-AutoDock and computer aided drug design (CADD).

## Practicals

10 hours

1. Familiarizing with the different data bank mentioned in the syllabus.
2. Molecular visualization using Rasmol.
3. Blast search.

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25. Richard M. Twyman 2003 *Instant notes Bioinformatics* Viva Books, New Delhi.
26. Remawat K.G. 2006. *Plant Biotechnology* S. Chand & Company Ltd., New Delhi.
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## B.Sc. BOTANY PROGRAMME

Semester VI

Core - Choice Based Course-04

BOT6 COR 14

### AGRIBUSINESS

(Theory 54 hours)

(Theory Credit 3)

#### Course objectives

1. Inculcate and impart an idea about the business opportunities in the field of plant sciences.
2. Develop an entrepreneurial mindset among the Botany students.
3. Give an idea about the need of sustainable development , organic farming, olericulture and floriculture.
4. Harness the opportunities and potentials in the field of mushroom cultivation, processing technology and food sciences.

#### Module 1

16 hours

#### Entrepreneurship, Value added Food products & Processing techniques

- 1.Types, Basic qualities of an Entrepreneur. Financial assistance from Banks, Role of Institutions like MSME Training Institute, Khadi and Village Industries Board, Self Help Groups, Co-operative Sector, Kudumbasree projects and Microenterprises.
2. Preparation and Preservation Techniques. Causes of Spoilage of Food. Principles of preservation – asepsis, removal of microorganisms, anaerobic situation and special methods – drying, thermal processing – pasteurization, sterilization and canning – low temperature, use of chemical preservatives and food additives. Preparation of wine, vinegar,sauerkaraut, pickles, jam, jelly, syrups, sauce, dry fruits, dairy products – (cheese, butter, yoghurt, paneer), candies, chocolates, payasam, kondattum.
3. Processing of latex – Centrifuged latex products and galvanized rubber products. Processing, storage and marketing of Cocoa, Coconut (Copra ,Coir and Tender coconut), Rice (par boiled, raw rice and rice flour), Pepper, Cardamom, Ginger, Arrowroot, Tapioca, Cashew, Mango, Jack fruit, Guava, Grapes, Lemon, Papaya, Musa, Garcinia. Basic principles of preparation of Lehyam and Decoction.

#### Module 2

11 hours

#### Nursery Management, Organic farming and Composting Techniques.

1. Definition and importance, management aspects of nurseries, planning, budgetting, lay out and types of nurseries, maintenance of nurseries Preparation of potting mixtures, polybags. Plant Growth structures – green houses, hot beds, cold frames, shade houses, polyshed, mist chamber. Media for the propagation of nursery plants—soil, sand, peat, sphagnum moss, vermiculite, soil mixture. Preparation of nursery beds. Marketing- packaging and transporting of nursery products.
2. Organic manures and fertilizers, Composition of fertilizers. NPK content of various fertilizers and preparation of fertilizer mixtures. Common organic manures – bone meal, cow dung, poultry waste, oil cakes, organic mixtures and compost. Preparation of compost –aerobic and anaerobic- advantages and limitations. Vermicompost –

preparation - Vermiwash. – preparation. Biofertilizers – Definition and preparation of different types – Trichoderma, Rhizobium, PGPR, PSB, Mycorrhiza. Application of Biofertilizers. Biopesticides – Tobacco and Neem decoction. Biological control of diseases and pests. Organic traps – Natural dyes.

### **Module 3.**

**19 hours**

#### **Introduction to horticulture**

1. Definition, history, classification of horticultural plants, disciplines of horticulture; Garden tools and implements. Irrigation methods- surface, sub, drip and spray irrigations. 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 seed propagation. Vegetative propagation- organs used in propagation- natural and artificial vegetative propagation; methods- cutting, layering, grafting and budding; advantages and disadvantages of vegetative propagation.
2. **Olericulture – Types of vegetable growing**, Home gardening, Market gardening , Truck gardening, Vegetable garden for processing, gardens for seed production. Cultivation of The following with reference to planting, irrigation, spacing, aftercare and disease control: Cucurbitaceous (Ash gourd, Little gourd, Bitter gourd) and Solanaceous (Tomato, Brinjal, Chilly) vegetables, Ginger, Colocasia, Tapioca and Musa.
3. **Floriculture** - Problems and prospects of Floriculture in Kerala. Cultivation and scope of growing Anthurium, Orchids and Jasmine in Kerala.
4. **Ornamental Garden designing** - Use of different garden components. Lawn preparation by seeds, seedling and turfing. Maintenance of garden by Irrigation, Pruning, Repotting. Disease and Pest control.
5. **Flower arrangement**. Types - Western, Eastern (Japanese/ Ikebana) and Modern. Vases, Flower Holders and Floral Foam. Vase life of flowers and leaves. After care of flower arrangements – Bouquets. Packing and Maintenance of flowers and leaves.

### **Module 4**

**8 hours**

#### **Mushroom cultivation and Farming.**

Historical Account, Importance of Mushrooms, – Significance – Nutritive value. Edible and poisonous Mushrooms. Methods of identification of edible and poisonous mushrooms (*Agaricus*, *Pleurotus*, *Volvariella*, *Amanita* and *Inocybe*) Cultivation of *Agaricus*, *Pleurotus*, and *Volvariella* . Spawn production, storage and marketing. Growth of Mushrooms on Paddy Straw and Saw dust by Poly bag. Mushroom growing structures and maintenance of humidity. Pests and defects of mushrooms. Storage, Transporting and Marketing of Mushrooms.

#### **References**

1. Adams , M.R. and M.O. Moss, 1995 Food Microbiology. Panima Publishing.
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6. George J. Banwant, 2004 Basic Food Microbiology. CBS Publishers and Distributors.
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## B.Sc. BOTANY PROGRAMME

Semester VI

Core - Choice Based Course-05

BOT6 COR 14

### PHYTOCHEMISTRY AND PHARMACOGNOSY

(Theory 54 hours)

(Theory Credit 3)

#### Course objectives

1. Understand the structure and function of basic secondary metabolites in medicinal and aromatic plants.
2. Familiarize with the common separation and characterization techniques used in phytochemistry
3. Understand the basic officinal part present in the common medical plants and their use in ayurvedic formulations

#### Module 1.

2 hours

##### Introduction

Introduction to phytochemical approaches –morphological-organoleptic-microscopic- to study drug and aromatic plants

#### Module 2

4 hours

##### Extraction and characterisation techniques

1. Cold extraction- hot extraction—soxhlet-clevenger apparatus; Solvents - petroleum ether, chloroform, ethanol, water.
2. Separation technique-TLC, Column, HPLC.
3. Characterization technique-GC/MS, HPTLC, UV Spectra, IR Spectra.

#### Module 3.

10 hours

##### Study of the drug plants and their active principles

1. Alkaloids – introduction, properties, occurrence, structure, classification, functions, and pharmacological uses.
2. Triterpenoids. Introduction, properties, occurrence, classification, functions and pharmacological uses.
3. Phenolics. Quinone- benzoquinones, naphthoquinones, anthraquinones, and coumarins.

#### Module 4.

20 hours

##### Study of the following plants with special reference to

1. Habit, habitat and systematic position and morphology of the useful part.
2. Organoleptic, anatomical and chemical evaluation of the officinal part.
3. Phytochemistry and major pharmacological action of plant drugs.
4. Ayurvedic formulations using the plants.

*Tinospora cordifolia, Papaver somniferum, Aegle marmelos, Punica granatum, Plumbago rosea, Adhatoda vasica, Withania somnifera, Achyranthes aspera, Asparagus racemosus, Kaempheria galanga, Sida acuta, Carica papaya, Azadirachta indica, Glycyrrhiza glabra,*

*Phyllanthus niruri, Datura stramonium, Hemidesmus indicus, Aloe vera, Tylophora indica, Acorus calamus.*

**Module 5.**

**10 hours**

**Study of the following aromatic plants – volatile oils and methods of extraction**

*Vetiveria zizanioides, Cinnamomum zeylanica, Syzygium aromaticum, Santalum album, Eucalyptus, Ocimum basilicum, Rosa, Mentha piperita.*

**Module 6.**

**Pharmacognosy.**

**4 hours**

1. Introduction, tools for identifying adulteration
2. Methods in pharmacognosy- microscopy, phytochemical methods- study of starch grains of maize, wheat, rice, potato, curcuma

**Cultivation of drug and aromatic plants**

**4 hours**

1. Soil as growth medium: formation of soil, physical and chemical nature, soil organisms, soil fertility, soil types.
2. Fertilizers and manures: NPK, organic manures, green manure, farm yard manure, and vermicompost.
3. Plant protection methods- insect and pest control measures: physical, chemical biological methods.
4. Plant propagation methods.

Suggested additional topics

1. Basic principles in spectroscopy - UV, NMR, IR etc
2. Use of secondary metabolites for protection against pathogens , herbivores

**References**

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## B.Sc. BOTANY PROGRAMME

Semester VI

Core - Choice Based Course-06  
ECOTOURISM

BOT6 COR 14

(Theory 54 hours)

(Theory Credit 3)

### Objectives

1. Make the students to opt various ecotourism programmes as a self employment stream
2. Make the students to aware about the usefulness of ecotourism in the conservation of natural resources.
3. Help the students to assess various ecotourism programmes

### Module 1

4 hours

#### Eco-tourism

Definition, concept, introduction, history, relevance and scope.

### Module 2

4 hours

#### Key Principles and Characteristics of Ecotourism

Nature area focus, interpretation, environmental sustainability practice, contribution to conservation, benefiting local communities, cultural respect, customer satisfaction, responsible marketing.

### Module 3

10 hours

#### Components of Ecotourism

Travel, tourism industry, biodiversity, local people, cultural diversity, resources, environmental awareness, interpretation, stake holders, capacity building in ecotourism.

### Module 4

8 hours

#### Eco Tourism Terms

Adventure tourism, certification, commercialization chain, cultural tourism, canopy walkway, conservation enterprises, ecosystem, ecotourism activities, ecotourism product, ecotourism resources, ecotourism services, endemism, ecolabelling, ecotourism "lite", geotourism, greenwashing, stakeholders, sustainable development, sustainable tourism, leakages.

### Module 5

1. **Ecotourism Resources and Forms in India and Kerala** **10 hours**  
Major ecosystems, vegetation types and tourism areas in Kerala. Festivals and events, entertainment, overview, culture, famous destinations, sightseeing, historical monuments, museums, temples, national parks & wildlife sanctuaries, hill stations, waterfalls, rivers, reaches, wildlife watching and bird watching sites, agricultural sites, tribal areas, tribal museums, tribal arts, rural handicrafts, tribal medicines, archeological sites, adventure sports, sacred groves, mountains, etc.
2. **Forms of Ecotourism in India and Kerala:** **4 hours**

Eco regions, eco places, waterfalls in Kerala and India, eco travel, do's and don't on eco travel, eco trips. Potentials of ecotourism in Kerala. Community based ecotourism, ecotourism and NGO's

## **Module 6**

**10 hours**

### **1. Ecotourism Planning**

Background, objectives, strategy, design of activities, target groups, opportunities, capacity building, threats, expectations positive and negative impacts, strength and weakness, benefits and beneficiaries, stakeholders, linkages, economics, ecotourism auditing. Problems with ecotourism. Carrying capacity of ecotourism. ecotourism facilities – Green report card. Ecotourism management – issues

### **2. Livelihood security**

**4 hours**

Community, biodiversity conservation and development – Eco-development committees

## **References:**

1. A K Bhattacharya, 2005. *Ecotourism and Livelihoods*. Concept Publ. company, New Delhi.
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**B.Sc. BOTANY PROGRAMME**

**SEMESTER -I COMPLEMENTARY COURSE -I BOT1CMP01**

**CRYPTOGAMS, GYMNOSPERMS AND PLANT PATHOLOGY**

**(Theory: 36 hrs; Practical: 36 hrs)**

**Theory credit 2 Practical Credit 1**

**Course objectives**

1. Acquire fundamental knowledge in plant science and to make the student understand that Botany is an integral part of the human life and developments.
2. Foster and encourage an attitude of curiosity, appreciation and enquiry of various life forms of plants
3. Understand the identifying characters of the different types included in the syllabus
4. Understand the diversity of plants with respect to Algae, Fungi, Lichens, Bryophytes, Pteridophytes and Gymnosperms

**Module-1 CRYPTOGRAMS**

**27hours**

1. Algae (Phycology) Classification, main features of structure, and life history of the following groups

Cyanophyceae : *Nostoc*

Chlorophyceae : *Volvox*

*Oedogonium*

*Cladophora*

Phaeophyceae : *Ectocarpus*

Rhodophyceae : *Polysiphonia*

Economic importance of Algae (general account)

**10 hours**

2. Fungi (Mycology) :Classification, main features of structure, and life history of the following groups.

Phycomycetes : *Rhizopus*

Ascomycetes : *Peziza*

Basidiomycetes: *Puccinia*

Economic importance of Fungi (general account)

**8 hours**

- 5 Lichens (Lichenology): Classification and general account.

Type *Usnea* :

**2 hours**

6. Bryophytes (Bryology): General account of Bryophytes

Type: *Riccia*

**3 hours**

7. Pteridophytes (Pteridology): General account of Pteridophytes

Type: *Selaginella*

**4 hours**

**Module-2 GYMNOSPERMS****4 hours**

General account of Gymnosperms

Type: *Cycas***Module-3 PLANT PATHOLOGY****5 hours**

1. Classification of plant diseases on the basis of causative organism and symptoms
2. Study of the following diseases with name of disease, causative organism, symptoms and control measures:
  - a. Nut fall of Arecanut
  - b. Bacterial blight of Rice
  - c. Leaf mosaic of Tapioca

**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. Alexopoulou C. J. and Mims C. W. (1983) Introductory Mycology, 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. Bilgrami 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.
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16. Vasishta B. R. Bryophyta – S. Chand and Co. New Delhi

**B.Sc. BOTANY PROGRAMME**

**SEMESTER –II**

**COMPLEMENTARY COURSE –II BOT2CMP02**

**PLANT PHYSIOLOGY**

**(Theory: 36hrs; Practical: 36hrs)**

**(Theory credit 2; Practical Credit 1)**

**Course objectives**

To understand the mechanism of various physiological processes related to plant life.

**Module 1**

1. Water relations of plants: (a) Physical aspects of water absorption –imbibition, diffusion and osmosis. Plant cell as an osmotic system. Diffusion pressure deficit, water potential, plasmolysis (b) Mechanism of absorption of water. Active and passive absorption. **4 hours**
2. Transpiration – types, and mechanism of stomatal, opening and closing (proton K<sup>+</sup> exchange) significance and factors affecting transpiration, anti-transpirants, Guttation. **4 hours**
3. Stress Physiology – Water, salt and cold stress. **2 hours**

**Module 2**

Photosynthesis: Structure of chloroplast, photosynthetic Pigments, Red drop and Emerson's enhancement effect: Two pigments systems, light and dark reaction C<sub>3</sub> – C<sub>4</sub> and CAM mechanisms. Factors affecting Photosynthesis: External and Internal, photo respiration and its significance.

**Module 3**

1. Translocation of organic solutes: phloem transport, Phloem loading, Munch mass flow hypothesis. **3 hours**
2. Nitrogen Cycles, Nitrogen fixation. **2 hours**

**Module 4**

1. Dormancy of seeds, factors causing dormancy, techniques to break dormancy, photoblastism, germination – mobilization of food reserves, physiology of fruit ripening. **2 hours**
2. Growth and Movements: Sigmoid curve, measurement of growth. A brief account of natural and synthetic growth hormones. Physiologic effects and practical applications of growth hormones. Senescence and Abscission. Tropic and nastic movements. Photoperiodism and Vernalization. **5 hours**



## **Practical (36 hours)**

**Student should be trained to carry out or demonstrate the following experiments**

### **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<sub>2</sub> 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 Clinostat.
9. Effect of hormones on growth

### **References**

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2. Jain V. K., 2008. Fundamentals of Plant Physiology, S. Chand and Co.
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4. Kumar & Purohit Plant Physiology – Fundamentals & Applications, Agrobotanical Publishers
5. Malik C. P. 2002. Plant Physiology, Kalyani Publishers
6. Malik C. P. and Srivastava A. K- Text Book of Plant Physiology – Kalyani Publishers, New Delhi.
7. Mukherjee. S. & Ghosh A.K, 2005. Plant Physiology, Calcutta New Central Book Agency.
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 Co.
11. Sinha A.K 2004. Modern Plant Physiology, Narosa Publishing House, New Delhi.
12. Srivastava H. S., 2004. Plant Physiology & Biochemistry, Rasthogi Publications.
13. Verma S. K. & Mohit Verma, 2006. A Text book of Plant Physiology, Biochemistry & Biotechnology, S. Chand and Co.
14. Verma V. 2007. Text Book of Plant Physiology, Ane Books Pvt Ltd.
15. William G. Hopkins- Introduction to Plant Physiology – John Wiley & Sons, New York.

**B.Sc. BOTANY PROGRAMME**

**SEMESTER –III**

**COMPLEMENTARY COURSE –III**

**BOT3CMP03**

**ANGIOSPERM MORPHOLOGY, TAXONOMY, ECONOMIC BOTANY AND ETHNOBOTANY**

**(Theory 54 hours; Practical 36 hours)**

**(Theory credit 3 Practical Credit 1)**

**Course objectives**

1. Acquaint the student with the objectives and significance of Taxonomy.
2. Help the student to understand the systems of classification of angiosperms.
3. Help the student to identify the common angiosperm species of Kerala.
4. Familiarize the student with plants of immense economic and ethnobotanic importance.

**ANGIOSPERM MORPHOLOGY**

**14 hours**

**Module 1 Morphology**

1. Leaf Morphology (types, venation, phyllotaxy)

**Module 2 Flower and Fruit**

1. Morphology of flower
  - a. Parts of a flower- description of flower and its parts in technical terms.
  - b. Types of flower – Hypogyny, Perigyny and Epigyny, Symmetry of flowers.
  - c. Aestivation, types
  - d. Placentation, types
  - e. Floral Diagram and Floral Formula
2. Inflorescence:-
  - a. Racemose types: Simple Raceme, Corymb, Umbel, Spike, Spadix and Head
  - b. Cymose types: Simple Cyme, Monochasial, Scorpioid and Helicoid, Dichasial and Polychasial
  - c. Special type: Panicle, Cyathium, Hypanthodium, Thyrsus, Verticillaster
3. Fruits: – Simple-Fleshy, Dry- dehiscent, indehiscent, Aggregate, Multiple (Sorosis and Syconus), schizocarpic.

**TAXONOMY**

**Module 3 Systematics**

**15hours**

1. Importance of plant classification, types of classification, artificial, natural and phylogenetic system of classification (brief account with example), Bentham and Hooker's system of classification (detailed study)
2. Binomial nomenclature; ICBN principles (Mention about ICN)
3. Interdisciplinary approaches in taxonomy: cytotaxonomy, chemotaxonomy.
4. Modern trends in taxonomy: Brief account of molecular systematics, Angiosperm Phylogeny Group (APG system)
5. Herbarium techniques: Preparation and significance, importance of herbarium, Names of at least one International, National and State herbaria
6. Botanical garden, Significance of botanical gardens.

**Module 4 Angiosperm families:****15 hours**

Study of the following families of Bentham and Hooker's system of classification with special reference to major identifying characters and economic importance:

Annonaceae, Malvaceae, Rutaceae, Leguminosae (Fabaceae, Caesalpiniaceae and Mimosaceae) Apiaceae, Rubiaceae, Asteraceae, Apocynaceae, Lamiaceae, Euphorbiaceae, Orchidaceae, Arecaceae, Poaceae.

**ECONOMIC BOTANY****7 hours****Module 5 Economic Botany**

Classification of economic plants based on their uses. (Cereals, legumes and pulses, tuber crops, spices, beverages etc.) Study of the following economic plants with special reference to their botanical name, family, morphology of useful part, economic products and uses.

- |                           |                                                                                                                                                                                                              |
|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| a. Cereals and millets    | : Paddy, Wheat, Ragi                                                                                                                                                                                         |
| b. Pulses                 | : Green gram, Bengal gram.                                                                                                                                                                                   |
| c. Tuber crops            | : Tapioca, Potato                                                                                                                                                                                            |
| d. Spices                 | : Pepper, Cardamom, Clove                                                                                                                                                                                    |
| e. Beverages              | : Tea, Coffee.                                                                                                                                                                                               |
| f. Oil yielding plants    | : Coconut, Groundnut, Sunflower                                                                                                                                                                              |
| g. Fibre yielding plants  | : Cotton, Coir, Jute                                                                                                                                                                                         |
| h. Timber yielding plants | : Teak, Rose wood.                                                                                                                                                                                           |
| i. Latex yielding plants  | : Para rubber.                                                                                                                                                                                               |
| j. Bio pesticides         | : Neem, Tobacco                                                                                                                                                                                              |
| k. Ornamental plants      | : Rose, Orchids, Anthurium, Jasmine                                                                                                                                                                          |
| l. Medicinal Plant        | : <i>Adhatoda</i> , <i>Aloe</i> , Brahmi ( <i>Bacopa</i> ), <i>Catharanthus</i> ,<br><i>Eclipta</i> , Neem, <i>Ocimum sanctum</i> , <i>Phyllanthus amarus</i> , <i>Rauwolfia</i> , <i>Sida rhombifolia</i> . |

**ETHNOBOTANY****Module 6 Ethnobotany****3 hours**

Ethnobotany: Scope and significance

Ethno botanical significance of Bamboo, Turmeric and *Trichopus zeylanicus* (Botanical name, family, morphology of useful part and ethnobotanical uses should be included)

**Practical (36 hours)**

1. Students should study the morphological terms of leaves, stem, inflorescences and fruits mentioned in the syllabus
2. Students should be able to identify typical plants belonging to the families prescribed in the syllabus. They should be able to describe the floral parts in technical terms.
3. Students should study the botanical name, family, morphology of the useful part and the uses of the economically and ethnobotanically important plants listed in the syllabus.

**Reference**

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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. Jain S K 2004, *A Manual Of Ethnobotany*, Scientific Publishers, India
4. Kochhar, S.L. 1981. *Economic Botany in the Tropics*. Macmillan India Limited, Delhi.
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8. Simpson, B.S and M. Conner – Ogorzaly. 1986. *Economic Botany: Plants in Our World*. McGraw – Hill Book Company, New York.
9. Singh, G. 1999. *Plant Systematics – Theory and Practice*. Oxford & IBH, New Delhi.

*Online References/Resources for Taxonomy*

Sl. No.	Resource	URL
1	Digital Flowers	<a href="http://www.life.illinois.edu/help/digitalflowers/">http://www.life.illinois.edu/help/digitalflowers/</a>
2	Families of Flowering plants Delta-intKey Digital Key with description	<a href="http://delta-intkey.com/angio/index.htm">http://delta-intkey.com/angio/index.htm</a>
3	APG Poster	<a href="http://www2.biologie.fu-berlin.de/sysbot/poster/poster1.pdf">http://www2.biologie.fu-berlin.de/sysbot/poster/poster1.pdf</a>
4	APG	<a href="https://en.wikipedia.org/wiki/Angiosperm_Phylogeny_Group">https://en.wikipedia.org/wiki/Angiosperm_Phylogeny_Group</a>
5	The Plant List	<a href="http://www.theplantlist.org/">http://www.theplantlist.org/</a>
6	International Plant Name Index (IPNI)	<a href="http://www.ipni.org/">http://www.ipni.org/</a>

## B.Sc. BOTANY PROGRAMME

SEMESTER –IV

COMPLEMENTARY COURSE –IV

BOT4CMP04

### ANATOMY AND APPLIED BOTANY

(Theory 54 hours; Practical 36 hours)

(Theory credit 3; Practical Credit 1)

#### Course objectives

To help the student

1. Understand different types of plant tissues.
2. Understand the internal structure of different plant organs with reference to their functions.
3. Understand the process of normal and anomalous secondary thickening in plants.
4. Know the morphological and anatomical adaptations of plants growing in different habitats.
5. Understand the applications of botanical knowledge in the field of crop improvement for human prosperity.

#### ANATOMY

(Theory 30 hours; Practical 24 hours)

##### Module 1 Cell, Tissues and Cambium

1. Cell types, electron microscopic studies on plant cell – living and non living inclusions, cell wall – ultra structure of cell wall (brief account only) **4 hours**
2. Tissues: simple and complex; meristems, secretory tissues. **4 hours**
3. Cambium: origin, structure, function, role in budding and grafting. **2 hours**

##### Module 2 Primary and Secondary structure

1. Primary structure of stem and root in dicots and monocots. **3 hours**
2. Secondary thickening in dicot stem and dicot root; growth rings, heart wood and sap wood; hard wood and soft wood; ring porous wood and diffuse porous wood, Anomalous secondary thickening in *Bignonia*. **5 hours**
3. Anatomy of monocot and dicot leaf. **3 hours**

##### Module 3 Ecological Anatomy

**9 hours**

Study of the morphological and anatomical adaptations of the following groups;

1. Hydrophytes (*Nymphaea*)
2. Xerophytes (*Nerium*)
3. Epiphytes (*Vanda*)
4. Halophytes (*Avicennia/ Rhizophora*).

#### APPLIED BOTANY (Theory 24 hours; Practical 12hours)

##### Module 4 Plant breeding

1. Plant breeding: Objectives, sexual and asexual reproduction; apomixis, apogamy, apospory, amphimixis, parthenogenesis, parthenocarp, polyembryony. **5 hours**
2. Methods of plant improvement
  - a. Plant introduction, acclimatization plant quarantine.
  - b. Selection: Mass selection, pure line selection and clonal selection.

- c. Hybridization; intervarietal, interspecific and intergeneric; procedure of hybridization. **5 hours**
- 4. Special methods of plant breeding.
  - a. Mutation breeding.
  - b. Polyploidy breeding. **3hours**

**Module 5 Horticultural practices** **5 hours**  
Propagation through

1. Cutting
2. Layering
3. Budding
4. Grafting

**Module 6 Tissue culture** **6 hours**

1. Principles, techniques and applications
2. Culture media, asepsis
3. Callus, organogenesis
4. Somatic embryogenesis
5. Anther culture
6. Artificial seeds

**Practical (36 hours)**

1. Types of tissue – simple and complex.
2. Primary structure of stem and root of dicots and monocots.
3. Structure of dicot stem and dicot root after secondary thickening.
4. Anomalous secondary thickening in *Bignonia*.
5. Anatomy of monocot and dicot leaf.
6. Morphological and anatomical adaptations of Hydrophytes (*Nymphaea* petiole), Xerophytes (*Nerium* leaf), Epiphytes (Velamen root of *Vanda*), Halophyte (Pneumatophore and vivipary of *Avicennia* or *Rhizophora*).
7. Emasculation of pea or *Caesalpinia* flower.
8. ‘T’budding, approach grafting, air layering.
9. Demonstration of tissue culture techniques: culture media, callus induction and organogenesis..

**Reference.**

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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, Jalandhar.

