# UNIVERSITY OF CALICUT

**SYLLABUS**
for
**UNDER GRADUATE PROGRAMME**
in
# BOTANY

Effective from 2019 admission

# UG PROGRAMME IN BOTANY

## PREFACE

The revised Curriculum for Undergraduate Programme of B.Sc. Botany focuses on imparting knowledge in basic and applied aspects of Botany. Due importance is given to fundamental and modern aspects of Botany, spanning many specialties and interests. An attempt has been made to make the study of Botany interesting and enjoyable, and to keep up with the speed with which technology advances. Formulation of the syllabubs has been done by revamping the existing syllabus, with an understanding that the syllabus is addressing the 'digital native' generation.

The revised syllabus of B.Sc. Botany has been prepared in a participatory manner, after discussions with experts in the subject and by pooling suggestions fromtheteaching community. As far as possible, the suggested modifications have been incorporated in the syllabus. During the preparation of the syllabus, the existing syllabus, UGC model curriculum, syllabi of other universities,syllabi of $XI^{th}$& $XII^{th}$ standardsand M.Sc. Botany syllabus of Calicut University have also been referred to. Care has been taken to ensure that the syllabus is compatible with the syllabi of other universities at the same level.

Concern for ever increasing pollution, biodiversity destruction and climate change is at its highest than ever. Keeping these issues in view, revision of the curriculum at the undergraduate level is done focusing towardscreating awareness on these aspects.

## AIMS AND OBJECTIVES OF THE PROGRAMME

- The fundamental objective of the curriculum is to impart effective science education at the undergraduate level, exposing students to recent trends and developments in the subject.
- Creating scientific temper is another major objective of this curriculum. Incorporating research components along with a sound academic foundation enables students to develop independent creative thinking. Sufficient emphasis is given for training in laboratory skills and instrumentation. The curriculum is meant to inspire creativity and combine passion with critical thinking skills in students who one day will be the citizens working to convert the world to more sustainable systems.
- Another major thrust given here is to develop an environmental concern in all activities of the students.'Go green' has been taken as the motto of the syllabus. Thisemphasizes on creating awareness of the urgent need to conserve nature without destruction of natural resources.

**PROGRAMME OUTCOMES (POs)**

1. **Critical Thinking**: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.
2. **Problem Solving**: Understand and solve problems of relevance to society to meet the specified needs using the knowledge, skills and attitudes acquired from humanities/ sciences/mathematics/social sciences.
3. **Effective Communication**: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.
4. **Effective Citizenship**: Demonstrate empathetic social concern and equity centered national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
5. **Environment and Sustainability**: Understand the issues of environmental contexts and sustainable development.
6. **Self-directed and Life-long Learning**: Acquire the ability to engage in independent and life-long learning in the broadest context of socio-technological changes

**PROGRAMME SPECIFIC OUTCOMES (PSOs)**

1. **Scope and importance of Botany**: Understand scope and importance of Botany
2. **Environmental concern**: Create awareness on natural resources and their importance in sustainable development, analyze the importance of biodiversity conservation, estimate biodiversity loss and develop conservation strategies.
3. **Scientific temper**: Develop scientific temper and undertake scientific projects.
4. **Practical applications**: Identify and classify plants according to the principles of plant systematics, apply techniques like plant propagation methods, organic farming, mushroom cultivation, preparation of biofertilizers, biopesticides etc.
5. **Awareness on life processes**: Understand plant life processes, biomolecules, and basic hereditary principles.

**FIRST SEMESTER B. Sc. BOTANY DEGREE PROGRAMME**
**CORE COURSE 1**
**ANGIOSPERM 11111221, REPRODUCTIVE BOTANY AND PALYNOLOGY**
**Code: BOT1B01T**

## COURSE OUTCOMES (COs)

By the end of the course, students are expected to:

1. Demonstrate the ability to differentiate plant organs by observing anatomical features.
2. Understand the non-living inclusions of plants and their significance
3. Differentiatetissues and their functions.
4. Illustrate primary and secondary (normal and anomalous) structures of plant organs.
5. Explain various developmental details of angiosperms
6. Realize the significance and applications of palynology.

## DISTRIBUTION OF TEACHING HOURS (18 hrs/Semester = 1hr/week)

| Sl no | Subject | Theory | Practical | Total |
|---|---|---|---|---|
| 1 | Angiosperm Anatomy | 22 | 27 | 49 |
| 2 | Reproductive Botany & Palynology | 14 | 9 | 23 |
| **Total** | | **36** | **36** | **72** |

## QUESTION PAPER PATTERN & SUBJECT WISE DISTRIBUTION OF MARKS

| Type of questions | Plant Anatomy | Reprod. Bot.& Palynology | Total marks |
|---|---|---|---|
| 2 marks (total 12) | 8 | 4 | Ceiling 20 |
| 5 marks (total 7) | 4 | 3 | Ceiling 30 |
| 10 marks (total 2) | 1 | 1 | 1x10 = 10 |
| **TOTAL** | | | **60** |

## ANGIOSPERM ANATOMY

**Module - I. (5 hrs)**

1. Cell Wall - Structure and development; Growth of Cell wall; cell wall materials (**2** hrs)
2. Non-living inclusions (**3** hrs)

a. Reserve food materials: carbohydrates, proteins, fats & oils. Carbohydrates: sugars &starch; Starch grains-structure, types with examples; Proteins- Aleurone grains with examples; Fats & oils examples.

b. Secretory materials

c. Waste materials - Nitrogenous – alkaloids, Non-nitrogenous- gums, resins, tannins, organic acids, essential oils; Mineral crystals - Calcium oxalate, Druses, Raphides, Calcium carbonate –cystoliths with examples

**Module-II (5 hrs)**

1. Tissues: Definition –Types

**a**. Meristematic tissues - classification. (**2** hrs)

i. Theories on apical organization - Apical cell theory, Histogen theory, Tunica corpus theory

ii. Organization of shoot apex and differentiation of tissues(protodern, procambium and ground meristem).

iii. Organization of root apex in dicots- common types with three sets of initials- in monocots: Maize type with four sets of initials

**b**. Mature tissues: definition classification- simple complex and secretory (**3**hrs)

i. Simple tissues:structure occurrence and function.

ii. Complex tissues: Xylem & Phloem-structure, origin, phylogeny and function

iii. Secretory tissues: glands, glandular hairs, nectaries, hydathodes, schizogenous and lysigenous ducts, resin ducts, laticifers –articulated and non-articulated

**Module – III (4 hrs)**

1. Vascular bundles - Origin and types - conjoint, collateral, bi-collateral, open closed, radial, concentric - amphicribral and amphivasal. (**2** hrs)
2. Primary structure of root, stem & leaf (brief account only) (**2** hrs)

**Module- IV (8 hrs)**

1. Normal secondary growth in Dicot stem and Dicot root. Formation of vascular cambial ring - structure and activity of cambium – storied and non-storied, fusiform and ray initials; Formation of secondary wood, secondary phloem, vascular rays, growth ring, heart wood, sapwood. (**3**hrs)
2. Extra stelar Secondary thickening in stem and root - Periderm formation. Structure - phellogen, phellem, phelloderm, bark, lenticels - structure & function. (**2** hrs)
3. Anomalous secondary growth - general account with special reference to the anomaly in Dicot stem – *Boerhaavia*, *Bignonia* and Monocot stem- *Draceana* (**3**hrs)

***PRACTICAL (ANGIOSPERM ANATOMY)***

1. Identification at sight the different types of tissues and vascular bundles.
2. Primary structure of stem, root and leaf of Dicots and Monocots
   a. Dicot stem : normal –Eupatorium; bi-collateral – *Cephalandra*
   b. Dicot root – Pea
   c. Monocot stem - Bamboo
   d. Monocot root – *Musa*
   e. Dicot leaf – *Ixora*
   f. Monocot leaf – Grass
3. Secondary structure of Dicot stem and root – *Vernonia*

4. Anomalous secondary thickening in *Boerhaavia*, *Bignonia*and *Draceana*

***REFERENCES (ANGIOSPERM ANATOMY )***


1. Cuttler, EG. (1969). Plant Anatomy - Part I Cells & Tissue. Edward ArnoldLtd., London.
2. Cuttler, E.G. (1971). Plant Anatomy, Part III Organs Edward Arnold Ltd., London.
3. Eames, A. J. & L H Mac Daniels (1987)An Introduction to Plant Anatomy. Tata Mac Grew Hill Publishing Company Ltd. New Delhi.
4. Esau K. (1985) Plant Anatomy (2nd ed.) Wiley Eastern Ltd. New Delhi.
5. Fahn A (2000) Plant Anatomy. Permagon Press.
6. Pandey B.P. (2001) Plant Anatomy, S. Chand & Co. Delhi.
7. Tayal M.S (2012) Plant Anatomy. Rastogi Publishers, Meerut.
8. Vasishta P.C. (1974) Plant Anatomy, Pradeep Publication, Jalandhar


## REPRODUCTIVE BOTANY & PALYNOLOGY

1. Introduction to angiosperm embryology with special reference to Indian embryologists (**1**hr)
2. Microsporogenesis:structure and function of wall layers,development of male gametophyte, dehiscence of anther (**3** hrs)
3. Megasporogenesis: development of female gametophyte, embryosac- development and types- monosporic: *Polygonum* type, bisporic:*Allium* type, tetrasporic: *Adoxa* type. (**3** hrs).
4. Pollination,fertilization, barriers of fertilization, germination of pollen grains, double fertilization. (**2** hrs)
5. Structure of embryo dicot (*Cypsella*), monocot (*Sagittaria*) and endosperm types (**2** hrs)
6. Palynology: pollen morphology- structure of pollen wall, shape of pollen grains, apertural morphoforms, exine ornamentation; pollen allergy, economic and taxonomic importance (**3**hrs)

***PRACTICAL(REPRODUCTIVE BOTANY & PALYNOLOGY)***

1. *Datura* anther T.S. (mature).
2. Types of ovules: Orthotropous, Anatropous and Campylotropous (Slides only, drawing not required)
3. Dicot and monocot embryo of Angiosperms (Slides only, drawing not required)
4. Pollen morphology of *Hibiscus*, and pollinia of *Cryptostegia*/ *Calotropis* by acetolytic method
5. Viability test for pollen.
   a. *In vitro* germination using sugar solution. (cavity slide method)
   b. Tetrazolium test
   c. Acetocarmine test (Acetocarmine & Glycerine 1:1)

***REFERENCES (REPRODUCTIVE BOTANY & PALYNOLOGY)***


1. Agarwal S.B. (1984) Embryology of Angiosperms- a fundamental approach, Sahithya Bhavan, Hospital Road, Agra
2. Bhojwani S S & Bhatnagar S.P. Dantu PK (2015) The Embryology of Angiosperms.6th

edition, Vikas Publishing House (P) Ltd.
3. Davis C.L. (1965) Systematic Embryology of Angiosperms. John Wiley, New York.
4. Eames M.S (1960) Morphology of Angiosperms Mc Graw Hill New York.
5. Erdtman G (1952) Pollen Morphology and plant Taxonomy Part I. Almiquist & Wicksell Stockholm
6. Erdtman G (1969) Hand Book of Palynology. National Botanical Gardens Publication, Lucknow.
7. Johri BD (1984) (ed.) Embryology of Angiosperms Springer - Verlag, Berlin.
8. Maheswari P. 1985. Introduction to Embryology of Angiosperms - Mac Graw Hill, New York.
9. Nair PKK (1970). Pollen Morphology of Angiosperms Vikas Publishing House, Delhi.
10. Raghavan,V. (2000). Developmental Biology of Flowering plants, Springer, Netherlands.
11. Saxena M.R. (1993). Palynology –A treatise-Oxford, I.B.H. New Delhi
12. Shivanna KR & Johri.BM (1985) The Angiosperm Pollen, Structure and function. John Wiley & Sons Pte Ltd.
13. Shivanna KR & Johri.BM (1985) Pollen Biology: A Laboratory Manual, Springer Verlag NewYrok.
14. Shivanna, K.R. &. Rangaswami, N.S (1993) Pollen Biology Narosa Publishing House - Delhi.
15. Singh V., P.C. Pande & D.K. Jain (2001) Embryology of Angiosperms- Rastogi Publications, 'Gangothri' Sivaji road, Meerut-

**SECOND SEMESTER B. Sc. BOTANY DEGREE PROGRAMME**
**CORE COURSE- 2**
**MICROBIOLOGY, MYCOLOGY, LICHENOLOGY ANDPLANT PATHOLOGY**
**Code: BOT2B02T**

## COURSE OUTCOMES (COs)

By the end of the course, students are expected to:

1. Understand basics of microbial life and their economic importance.
2. Develop general awareness on the diversity of microorganisms, fungi and lichens.
3. Analyze the ecological role played by bacteria, fungi and lichens
4. Identify plant diseases and find out control measures
5. Realize the significance of plant diseases as far as crop production is concerned.

## DISTRIBUTION OF TEACHING HOURS (18 hrs/Semester = 1hr/week)

| Sl no | Subject | Theory | Practical | Total |
|---|---|---|---|---|
| 1 | Microbiology | 12 | 9 | 21 |
| 2 | Mycology | 12 | 14 | 26 |
| 3 | Lichenology | 4 | 4 | 8 |
| 4 | Plant Pathology | 8 | 9 | 17 |
| **Total** | | **36** | **36** | **72** |

## QUESTION PAPER PATTERN & SUBJECT WISE DISTRIBUTION OF MARKS

| Type of questions | Microbiology | Mycology | Lichenology | Pathology | Total |
|---|---|---|---|---|---|
| 2 marks (total 12) | 3 | 4 | 2 | 3 | Ceiling 20 |
| 5 marks (total 7) | 3 | 2 | 1 | 1 | Ceiling 30 |
| 10 marks (total 2) | 2 | | | | 1x10 = 10 |
| **TOTAL** | | | | | **60** |

## MICROBIOLOGY

1. Introduction to Microbiology
   (**1**hr)
2. Bacteria –Classification based on morphology and staining, Ultra structure ofbacteria; Bacterial growth, Nutrition, Reproduction. (**5** hr)
3. Viruses – Classification, architecture and multiplication, Bacteriophages, TMV, retroviruses- HIV, Viriods, Prions.
   (**3**hrs)
4. Microbial ecology – Rhizosphere and Phyllosphere. (**1** hr)
5. Industrial microbiology –alcohol, acids, milk products single cell proteins (**1** hr)
6. Economic importance of bacteria, Vaccines: importance, mechanism. (**1** hr)

***PRACTICAL (MICROBIOLOGY***)

1. Simple staining
2. Gram staining – Curd, root-nodules

3. Culture and isolation of bacteria using nutrient agar medium (demonstration only)

***REFERENCES (MICROBIOLOGY)***


1. Alain Durieux (2009) Applied Microbiology, Springer International Edition
2. Dubey R.C. & D.K. Maheswari (2000) A Textbook of Microbiology, Chand & Co, New Delhi.
3. Frazier W.C. (1998) Food Microbiology, Prentice Hall of India, Pvt. Ltd.
4. Hans g Schlegel. (2012) General Microbiology-Cambridge University Press. Low Priced Indian Edition, Replica Press Pvt. Ltd
5. Kumar H.D. & S. Kumar. (1998) Modern Concepts of Microbiology Tata McGraw Hill, Delhi.
6. Pelzar M.J., E.C.S. Chan & N.R. Kreig. (1986) Microbiology McGraw Hill, New York.
7. Prescott, L.M., Harley J.P., Klein D. A. (2005) Microbiology, McGraw Hill, India. 6$^{th}$edition.
8. Rangaswami, R & C.K.J. Paniker. (1998) Textbook of Microbiology, Orient Longman.
9. Ross, F.C. (1983) Introductory Microbiology. Charles E. Merill Publishing Company.
10. Schlegel (2008). General Microbiology. Cambridge University press India Pvt Ltd
11. Sharma P.D. (2004). Microbiology and Plant Pathology Rastogi Publication.
12. Tortora, G.J., Funke, B.R., Case. C.L. (2007). Microbiology. Pearson Benjamin Cummings, San Francisco, U.S.A. 9th edition.


## MYCOLOGY

1. General characters and phylogeny of the kingdom Fungi, the concept of anamorph and teleomorph. (**2** hrs)
2. General characters, distribution, and biology of the following groups of fungi (**8** hrs)
   a) Mastigomycotina. Type: *Pythium*
   b) Zygomycotina. Type: *Rhizopus*
   c) Ascomycotina. Type:, *Xylaria, Aspergillus*
   d) Basidiomycotina. Types: *Agaricus, Puccinia*
3. Economic importance of fungi: medicinal, industrial, agricultural. Fungi as model organisms for research.
   (**1** hr)
4. Ecological importance of fungi: different modes of nutrition (pathogenic/parasitic, saprobic, symbiotic)
   (**1** hr)

***PRACTICAL (MYCOLOGY)***

1. Micropreparation – Lactophenol cotton blue – Slides of the above mentioned types.

***REFERENCE (MYCOLOGY)***


1. Alexopoulos C.J., Mims, C.W. and Blackwell, M. (1996) IntroductoryMycology, 4$^{th}$ Edn. John Wiley and Sons, New York.
2. Alexopoulos, C.J. and Mims C.W. (1979) Introductory Mycology, 3$^{rd}$ Edition,John Wiley

and Sons, New York.
3. Jim Deacon (2007) Fungal Biology, 4th edition, Blackwell publishing, Ane Books Pvt Ltd
4. Mehrotra R.S. and Aneja K.R. (1990)An Introduction to Mycology, Wiley,Eastern Limited, New Delhi.
5. Sethi, I.K. and Walia, S.K. (2011) Text book of Fungi and Their Allies, Macmillan Publishers India Ltd.

## LICHENOLOGY

1. Introduction: Type of Interaction between the components symbiosis –mutualism. (**1** hr)
2. Classification, growth forms, Structure, Reproduction, Economic importance. Type: *Usnea* (**2**hrs)
3. Toxicology, Lichens as food, Bioremediation, Ecological indicators, Pollution indicators, Lichen in Soil formation and pioneers of Xerosere. (**1** hr)

### *PRACTICAL (LICHENOLOGY)*

1. Identification of different forms of Lichens.
2. *Usnea* : structure of thallus, fruiting body

### *REFERENCES(LICHENOLOGY)*

1. Gilbert, O. (2004) Lichen Hunters. The Book Guild Ltd. England
2. Kershaw, K.A. (1985) Physiological Ecology of Lichen Cambridge University Press.
3. Mamatha Rao, (2009) Microbes and Non-flowering plants. Impact andapplications.Ane Books, New Delhi.
4. Sanders, W.B. (2001) Lichen interface between mycology and plantmorphology. Bioscience, 51: 1025-1035.

http://www.lichen.com
http://www.newscientistspace.com

## PLANT PATHOLOGY

1. Introduction – Concepts of plant disease, pathogen, causative agents, symptoms (**1** hr)
2. Symptoms of diseases: spots, blights, wilts, rots, galls, canker, gummosis, necrosis, chlorosis, smut, rust, damping off. (**1** hr)
3. Control measures: Chemical, biological and genetic methods, quarantine measures.(**1** hr)
4. Brief study of Plant diseases in South India (Name of disease, pathogen, symptom and control measures need to be studied) (**5** hrs)
    1. Citrus Canker
    2. Mahali disease of arecanut,
    3. Blast of paddy,
    4. Quickwilt of pepper,
    5. Mosaic disease of tapioca,
    6. Bunchy top of banana.
    7. Grey leaf spot of coconut.

***PRACTICAL (PLANT PATHOLOGY)***

Identification of the disease, pathogen, symptoms and control measures of thefollowing:(drawing not required)

a. Citrus canker
b. Mahali disease
c. Tapioca mosaic disease
d. Blast of Paddy
e. Quick wilt of pepper
f. Bunchy top of Banana
g. Grey leaf spot of coconut

***SUBMISSION (PLANT PATHOLOGY)***

Students are expected to submit five properly identified Pathology specimens /herbarium during the Practical Examination of Paper-I held at the end of Fourth semester. Diseases mentioned in the syllabus or any locally available common diseases of crop plants can be selected for submission.

***REFERENCES (PLANT PATHOLOGY)***


1. Agros, G.N. (1997) Plant Pathology ($4^{th}$ ed) Academic Press.
2. Bilgrami K.H. & H.C. Dube. (1976) A textbook of Modern Plant Pathology.International Book Distributing Co. Lucknow.
3. Mehrotra, R.S. (1980) Plant Pathology – TMH, New Delhi.
4. Pandey, B.P. (1999) Plant Pathology. Pathogen and Plant diseases. Chand & Co., New Delhi.
5. Rangaswami, G. (1999) Disease of Crop plants of India Prentice Hall of India Pvt. Ltd.
6. Sharma P.D. (2004) Plant Pathology Rastogi Publishers.

**FIFTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME**
**CORE COURSE -6**
**GYMNOSPERMS, PALAEOBOTANY,PHYTOGEOGRAPHY AND EVOLUTION**
**Code: BOT5B06 T**

## COURSE OUTCOMES (COs)

By the end of the course, students are expected to:

1. Understand the role of gymnosperms as a connecting link between pteridophytes and angiosperms
2. Appreciate the process of organic evolution.
3. Realize the importance of fossil study
4. Recognize the phytoeographic zones of India.

## DISTRIBUTION OF TEACHING HOURS (18 hrs/Semester = 1hr/week)

| Sl no | Subject | Theory | Practical | Total |
|---|---|---|---|---|
| 1 | Gymnosperms | 9 | 18 | 27 |
| 2 | Palaeobotany | 9 | 9 | 18 |
| 3 | Phytogeography | 18 | 9 | 27 |
| 4 | Evolution | 18 | - | 18 |
| **Total** | | **54** | **36** | **90** |

## QUESTION PAPER PATTERN & SUBJECT WISE DISTRIBUTION OF MARKS

| Type of questions | Gymno. | Palaeobot. | Phytogeo. | Evolution | Total |
|---|---|---|---|---|---|
| 2 marks (total 12) | 4 | 2 | 3 | 3 | Ceiling 20 |
| 5 marks (total 7) | 2 | 1 | 2 | 2 | Ceiling 30 |
| 10 marks (total 2) | 2 | | | | 1x10 = 10 |
| **TOTAL** | | | | | **60** |

## GYMNOSPERMS

1. Introduction, General characters and classification of Gymnosperms (Sporne, 1965) (**1** hr)
2. Distribution, morphology, anatomy, reproduction, life cycle and affinities of the following types (Developmental details not required): *Cycas*,*Pinus* and *Gnetum*(**6**hrs)
3. Evolutionary trends in Gymnosperms; Affinities of Gymnosperms with Pteridophytes and Angiosperms(**1** hr)
4. Economic importance of Gymnosperms.(**1** hr)

### *PRACTICAL (GYMNOSPERMS)*

1. *Cycas*- Habit, coralloid root, T.S. of coralloid root, T.S. of leaflet, T.S. of rachis, male cone and L.S. of male cone , microsporophyll, megasporophyll, T.S. of microsporophyll, L.S. of ovule and seed.
2. *Pinus*- branch of unlimited growth, spur shoot, T.S. of stem and needle, malecone and female cone, L.S. of male cone and female cone, seed.

3. *Gnetum*- Habit, stem T.S., leaf T.S., male and female cones, L.S. of ovule, seed.

***REFERENCES(GYMNOSPERMS)***


1. Chamberlain C.J. (1935)Gymnosperms –Structure and Evolution, ChicagoUniversity Press.
2. Coutler J.M. and C.J. Chamberlain, (1958) Morphology of Gymnosperms.Central Book Depot.Allahabd.
3. Sporne K.R. (1967)The Morphology of Gymnosperms, Hutchinson and Co. Ltd.London.
4. Sreevastava H.N. (1980) A Text Book of Gymnosperms. S. Chand and Co. Ltd.,NewDelhi.
5. Vasishta P.C. (1980) Gymnosperms. S. Chand and Co., Ltd., New Delhi.


## PALAEOBOTANY

1. Introduction and objectives (½hr)
2. Fossil formation and types of fossils (**1** hr)
3. Geological time scale- sequence of plants in geological time (**2** hr)
4. Fossil Pteridophytes-*Rhynia*, *Lepidodendron*and *Calamites* (**2** hr)
5. Fossil gymnosperms- *Williamsonia* (**1** hr)
6. Important Indian Paleobotanical Institutes. (**1** hr)
7. Indian Palaeobotanists: Birbal Sahni and Savithri Sahni (**1** hr)
8. Applied aspects of Palaeobotany- exploration of fossil fuels (½ hr)

***PRACTICAL (PALAEOBOTANY)***

1 Fossil Pteridophytes - *Rhynia* stem, *Lepidodendron*, and *Calamites*

2 Fossil gymnosperms- *Williamsonia*

(Drawings may be replaced with photos in the record)

***REFERENCES (PALAEOBOTANY)***


1. Andrews H.N. (1961) Studies in Paleobotany. John Wiley and Sons Inc., NewYork.
2. Arnold C.A. (1947) Introduction to Paleobotany, Tata McGraw Hill, New Delhi.
3. Shukla, A.C. & S.P. Misra, (1975) Essential of Palaeobotany, Vikas PublishingHouse, Pvt. Ltd., Delhi.
4. Sreevastava H.N., (1998) Palaeootany, Pradeep Publishing Company, Jalandhan. Sewart,
5. Taylor, T.N. Paleobotany. An Introduction to Fossil Plant Biology. Mc GrawHill, New York.
6. Steward A.C. (1935)Fossil Plants Vol. I to IV. Watson J. An introduction to study of fossil plants. Adams and Charles BlackLtd. London.

## PHYTOGEOGRAPHY

1. Definition, concept, scope and significance of phytogeography.(**2** hrs)
2. Patterns of plant distribution - continuous distribution and discontinuous distribution, vicarism, migration and extinction(**3** hrs)
3. Continental drift -Evidences and impact.(**3** hrs)
4. Glaciation: Causes and consequences.(**2** hrs)
5. Theory of land bridges.(**2** hrs)
6. Endemic distribution, theories on endemism, age and area hypothesis. (**3** hrs)
7. Phytogeographical zones (phytochoria)of India.(**3** hrs)

***PRACTICAL(PHYTOGEOGRAPHY)***

1 Mark the phytogeographic zones of India.

***REFERENCES (PHYTOGEOGRAPHY)***


1. Ronald Good, (1947)The Geography of Flowering Plants. Longmans, Green and Co, New York
2. Armen Takhtajan, (1986) Floristic Regions of the World. (translated by T.J. Crovello & A. Cronquist). University of California Press, Berkeley.
3. P. D. Sharma, (2009) Ecology and Environment, Rastogi Publications,Meerut


## EVOLUTION

1. Theories on Origin of Universe, Earth and Origin of life. Condensation and Polymerization; Protenoids and Prions – Oparin's concept;Miller's experiment.(**3** hrs)
2. Evolution of prokaryotic and eukaryotic cells. Archaebacteria, Early fossilizedcells. (**2** hrs)
3. Theories on origin and evolution of species: Darwinism; Neo-Darwinism and itsobjection; Arguments and support for Darwinism, Modern concept of evolution.(**3** hrs)
4. Evidences of organic evolution from Morphology, Anatomy, Embryology, Palynology, Genetics and MolecularBiology. (**3** hrs)
5. Genetic Constancy and Creation of Variability: Cell divisions and geneticconstancy; – Genetic variability by recombination, Chromosomal variations,Gene mutations, Selection and genetic drift. (**4** hrs)
6. Speciation: Isolating mechanism, Modes of speciation: sympatric andallopatric (**3** hrs)

***REFERENCES (EVOLUTION)***


1. Crick F.(1981) Life itself: Its origin and Nature. Simon and Schuster, NewYork.
2. Drake J.W.(1970)The molecular basis of mutation. Holden – Day – SanFrancisco.
3. Dott R.H. R.L. Batten, (1981) Evolution of the earth 3rd edn. McGraw HillNew York.
4. Fox S.W. and Dose, K. (1972) Molecular evolution and the origin of life. W.H.Freeman & Co., San Francisco.
5. Gould S.J. (1977) Ontogeny and Phylogeny. Harvard Univ. Press,Cambridge, Mass.
6. Jardine N., D. Mc Kenzie(1972) Continental drift and the dispersal andevolution of organisms. Nature, 234.20-24.

7. Miller, S.L. (1953) A production of aminoacids under possible primitive earthconditions. Science, 117., 528-529.
8. Strickberger, (1990) Evolution, Jones and Bastlett Publishers International,England.

**FIFTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME**
**CORE COURSE-7**
**ANGIOSPERM MORPHOLOGYAND SYSTEMATICS**
**Code: BOT5B07 T**

## COURSE OUTCOMES (COs)

By the end of the course, students are expected to:

1. Appreciate the diverse morphology of angiosperms.
2. Identify and classify plants based on taxonomic principles
3. Make scientific illustrations of vegetative and reproductive structures of plants
4. Develop the skill of scientific imaging of plants
5. Realize the importance of field study

## DISTRIBUTION OF TEACHING HOURS (18 hrs/Semester = 1hr/week)

| Sl no | Subject | Theory | Practical | Total |
|---|---|---|---|---|
| 1 | Angiosperm Morphology | 14 | 9 | 23 |
| 2 | Systematics | 40 | 27 | 67 |
| **Total** | | **54** | **36** | **90** |

## QUESTION PAPER PATTERN & SUBJECT WISE DISTRIBUTION OF MARKS

| Type of questions | Angio. Morphology | Systematics | Total |
|---|---|---|---|
| 2 marks (total 12) | 4 | 8 | Ceiling 20 |
| 5 marks (total 7) | 2 | 5 | Ceiling 30 |
| 10 marks (total 2) | 2 | | 1x10 = 10 |
| **TOTAL** | | | **60** |

## ANGIOSPEM MORPHOLOGY

1. Technical description of a flowering plant (brief)(**2** hrs)
2. Inflorescence: racemose, cymose and specialised (cyathium, hypanthodium, coenanthium verticillaster, thyrsus) (**3** hrs)
3. Flower: Flower as a modified shoot, detailed structure of flowers, floral parts –their arrangement, relative position, cohesion and adhesion - symmetry of flowers.(**4** hrs)
4. Fruits– simple, aggregate and multiple with examples; Seed structure - dicot and monocot - albuminous and exalbuminous, aril, caruncle; Dispersal of fruits and seeds - types and adaptations.(**5** hrs)

### *PRACTICAL (ANGIOSPEM MORPHOLOGY)*

1. Identify the types of inflorescence and fruits mentioned in the syllabus.
2. All the types mentioned under inflorescence and fruits must be represented in the photo album.(All drawings in records are replaced by photo album submission).

### *REFERENCES (ANGIOSPEM MORPHOLOGY)*

1. Gangulee, H.C., J.S. Das & C. Dutta. (1982) College Botany ($5^{th}$ Ed.)New Central Book Agency, Calcutta.

2. George, H.M. Lawrence. (1951) Introduction to Plant Taxonomy.Mac Millan comp. Ltd., New York.
3. Simpson, M. G. (2006) Plant Systematics. Elsevier Academic Press, London
4. Sporne, K.R. (1974) Morphology of Angiosperms. Hutchinson University Press London

**SYSTEMATICS**

**Module-I**(**6** hrs)

1. Components of systematics: identification, description nomenclature and classification; objectives and importance of systematics (**2** hrs)
2. Systems of classification: Artificial – Linnaeus; Natural – Benthem and Hooker; Phylogenetic – Hutchinson; Angiosperm Phylogeny Group system (**4** hrs)

**Module – II** (**14** hrs)

1. Detailed study (systematic position, distribution, common members, diagnostic features, description from habit to fruit and economic importance of the following families.
   Annonaceae, Malvaceae, Meliaceae, Fabaceae with sub families, Myrtaceae, Cucurbitaceae, Rubiaceae, Asteraceae, Apocynaceae, Solanaceae, Acanthaceae, Lamiaceae, Euphorbiaceae, Liliaceae, Orchidaceae and Poaceae.

**Module- III** (**8** hrs)

1. Taxonomic structure – Hierarchy; Concepts of taxa: Species – Biological,Phenetic and Phylogenetic; Genus; Family. (**2** hrs)
2. Taxonomic character – concept, primitive and advanced characters, sources,comparative morphology, vegetative, reproductive, Macro and micromorphology, modern trends in taxonomy, cytotaxonomy, chemotaxonomy, numericaltaxonomy, molecular taxonomy and phylogenetics.(**4** hrs)
3. Contributions of eminent Taxonomists viz Hendrich van Rheed,William Roxburg, Robert Wight, J. S. Gamble and EK Janaki Ammal. (**2** hrs)

**Module – IV**(12 hrs)

1. Plant Nomenclature – Limitations of common name, ICN- Principles (introduction only); Typification (holotype, isotype, syntype paratype and lectotype); Priority – merits and demerits; Effective and valid publication; Author citation.(**3** hrs)
2. Plant identification – Keys; indented and bracketed, construction and applications.(**2** hrs)
3. Taxonomic information resources – Herbarium preparation and maintenance, Herbarium types: International- Kew (K); National-Central national herbarium (CAL), MH Coimbatore, Virtual herbarium, Botanic Gardens: RBG, Kew, IGB, Kolkotta; TBGRI and Malabar Botanical Garden and Institute for Plant Sciences, Kozhikode. (**4** hrs)
4. Taxonomic literature- Floras, e-Flora, Monographs, Revisions, Journals and online resources & Databases.(**3** hrs)

***PRACTICAL (SYSEMATICS)***

1. Students are expected to work out at least two members of each family mentioned in the

syllabus and make suitable diagrams (floral diagram and floral formula not needed).Describe them in technical terms and identify up to species using the Flora. Orchidaceae may be excluded from practical examination scheme.

2. Students shall be able to prepare artificial key to segregate any five given plants. This must be recorded.
3. Familiarization of herbarium techniques (Demonstration only).
4. Mounting of a properly dried and pressed specimen of any wild plant from any one of the families mentioned in the syllabus, with proper herbarium label (to be submitted in the record book).
5. Every student shall submit original images of plants, at least one from each family mentioned in the syllabus, duly certified by HoD, at the time of examination. The images of plants should be properly identified and they should carry details like systematic position, GPS location, date, name and reg. no. of the student etc. Separate images clearly showing habitat, habit, inflorescence type, single flower, floral parts etc. of each plant should be represented. Web sourced and outsourced images should not be used. The images can be submitted along with the photo album containing images of inflorescence and fruits mentioned under morphology. Individuality should be strictly maintained while preparing the photo album.
6. It is compulsory that every student has to undertake field study trips of 3 -5 days to study vegetation of ecologically different areas, under the guidance of teachers. Visits to standard Herbaria, Organizations/ Institutes involved in exploring plant resources, Botanical museums etc. may be conducted as part of study tour. Local habitats like sacred groves, rice fields, wetlands, forests, grasslands etc. also can be selected for field trips. Avoid visit to tourist places with meager plant diversity and of having only entertainment value. Submit a field visit report countersigned by the Head of the department during the practical examination.
7. If a student fails to undergo the study tour he /she may not be permitted to attend the examination.

***REFERENCES (SYSEMATICS)***


1. Bharati Bhattacharyya (2009) Systematic Botany, Narosa Publishing House Pvt. Ltd., New Delhi.
2. Burkill, I.H. (1965) Chapters on the History of Botany in India, Delhi.
3. Clive A. Stace (1991) Plant Taxonomy and Biosystematics, Cambridge University Press.
4. Davis, P.H. & V.H. Heywood, (1963) Principles of Angiosperm Taxonomy. Oliver & Boyd Ltd., London.
5. Gurucharan Singh, (2012) Plant Systematics - Theory and Practice. Oxford & IBH, New Delhi.
6. Jeffrey, C. (1968)An introduction to Plant Taxonomy, London.
7. Mondal A.K. (2009) Advanced Plant Taxonomy, New Central Book agency Pvt.Ltd. KolKota.
8. Nicholas J. Turland *e al*.(2018) International Code of Nomenclature for algae, fungi, and plants- Shenzhen Code (printed/ electronic version) Koeltz Botanical Books
9. Pandey, S.N. & S.P. Misra. (2008) Taxonomy of Angiosperms. Ane Books India, New

Delhi.
10. Radford, A.E. (1986) Fundamentals of Plant Systematics. Harper & Row Publishers, New York.
11. Sambamurthy A.S.S. (2005) Taxonomy of Angiosperms, I.K. International Pvt. Ltd, New Delh.
12. Sharma, B.D. *et al*. (Eds.) (1996) Flora of India vol. I. Botanical Survey of India, Calcutta.
13. Simpson, M.G. (2006) Plant Systematics. Elsevier Academic Press, London
14. Sivarajan, V.V. (1991) Introduction to Principles of Plant Taxonomy. Oxford & IBH, New Delhi.
15. Stuessy, T.F.(1990) Plant Taxonomy–The systematic evaluation of Comparative data. Columbia University Press, New York.

**FIFTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME**
**CORE COURSE- 8**
**TISSUE CULTURE, HORTICULTURE, ECONOMIC BOTANY AND ETHNOBOTANY**
**Code: BOT5B08 T**

## COURSE OUTCOMES (COs)

By the end of the course, students are expected to:

1. Critically evaluate the advantages of tissue culture and horticulture over conventional methods of propagation.
2. Apply various horticultural practices in the field.
3. Experiment on the subject and try to become entrepreneurs.
4. Identify the economically important plants.

## DISTRIBUTION OF TEACHING HOURS (18 hrs/Semester = 1hr/week)

| Sl no | Subject | Theory | Practical | Total |
|---|---|---|---|---|
| 1 | Tissue culture | 18 | 12 | 30 |
| 2 | Horticulture | 18 | 12 | 30 |
| 3 | Economic Botany | 9 | 9 | 18 |
| 4 | Ethnobotany | 9 | 3 | 12 |
| **Total** | | **54** | **36** | **90** |

## QUESTION PAPER PATTERN & SUBJECT WISE DISTRIBUTION OF MARKS

| Type of questions | Tissue cult | Horticultur | Econ. Bot | Ethnobot. | Total |
|---|---|---|---|---|---|
| 2 marks (total 12) | 5 | 5 | 1 | 1 | Ceiling 20 |
| 5 marks (total 7) | 3 | 2 | 1 | 1 | Ceiling 30 |
| 10 marks (total 2) | 1 | 1 | - | - | 1x10 = 10 |
| **TOTAL** | | | | | **60** |

## TISSUE CULTURE

**Module-1**(**12** hrs)

1. Plant tissue culture – Principles and techniques; Cellular totipotency; *invitro* differentiation – de differentiation and re-differentiation.(**2** hrs)
2. Tissue culture medium – Basic components in tissue culture medium – Solidand liquid medium; Murashige and Skoog medium – composition andpreparation.(**2** hrs)
3. Aseptic techniques in *in vitro* culture – sterilization – different methods –sterilization of instruments and glassware, medium, explants; workingprinciple of laminar air flow and autoclave.(**2** hrs)
4. Preparation of explants– surface sterilization, inoculation, incubation,subculturing. (**2** hrs)
5. Micropropagation - Different methods – apical, axillary bud proliferation,direct and indirect organogenesis and somatic embryogenesis.(**2** hrs)
6. Different phases of micropropagation – multiple shoot induction, shootelongation, *in vitro* and *in vivo* rooting hardening, transplantation and field evaluation; advantages and

disadvantages of micropropogation, somaclonal variation.(**2** hrs)

**Module – II (8 hrs)**

1. Methods and Applications of tissue culture:
    1. Shoot tip and meristem culture
    2. Somatic embryogenesis and synthetic seed production
    3. Embryo culture
    4. Protoplast isolation culture and regeneration – transformation andtransgenics
    5. Somatic cell hybridization, cybridization.
    6. *In vitro* secondary metabolite production — cell immobilization,bioreactors
    7. *In vitro* production of haploids – anther and pollen culture
    8. *In vitro* preservation of germplasm

***PRACTICAL (TISSUE CULTURE)***

1. Preparation of nutrient medium – Murashige and Skoog medium using stock solutions,
2. Familiarize the technique of preparation of explants, surface sterilization,inoculation and subculturing.
3. Preparation of synthetic seeds
4. Demonstration of anther culture

***REFERENCES (TISSUE CULTURE)***


1. Gamborg, O.L. & G.C. Philips (Eds.) (1995). Plant Cell, Tissue and Organ Culture: Fundamental Methods. Narosa Pulishing House, New Delhi.
2. Razdan MK (1995) Introduction to Plant Tissue Culture. Oxford & IBH publishing Co. Pvt. Ltd.
3. Reinert & Bajaj. Plant Cell, Tissue and Organ Culture.
4. Edwin F. George,Michael A. Hall and Geert-Jan De Klerk. (2008) Plant propagation by tissue culture Volume 1. The Background. Springer,P.O. Box 17, 3300 AA Dordrecht. The Netherlands.
5. Madhavi Adhav (2010) Practical book of Biotechnology and PlantTissue culture
6. Bhojwani, San Saran, Danu, Prem Kumar (2013) Tissue Culture : An Introductory Text


## HORTICULTURE

**Module - I.(5 hrs)**

1. Introduction, scope and significance; branches of horticulture.(**1** hrs)
2. Soil- components of soil, types of soil.(**1** hrs)
3. Fertilizers – Chemical, organic, biofertilizer, compost.(**1** hrs)
4. Pots & potting – earthen, fibre, polythene bags, potting mixture, potting, repotting, top dressing. (**1** hrs)
5. Irrigation – Surface, sprinkle, drip and gravity irrigation.(**1** hrs)

**Module –II (7 hrs)**

1. Seed propagation –seed quality tests, seed treatment, essential condition for successful propagation – raising of seed beds, transplanting techniques.(**3** hrs)
2. Vegetative propagation: (**4** hrs)
    1. Cutting (stem, roots)
    2. Grafting (approach, cleft)
    3. Budding (T-budding, patch)
    4. Layering (simple, air).

**Module - III**.**(6 hrs)**

1. Gardening – site selection; propagating structure: green house, poly house, moist chamber, net frame – Garden tools and implements.(**1** hr)
2. Indoor gardening – selection of indoor plants, care and maintenance of indoor plants, Bonsai – Principle, creating the bonsai.(**1** hr)
3. Outdoor gardening; landscaping- goals, types.(**1** hr)
4. Cultivation and post-harvest management of vegetables and ornamental plants.(**1** hr)
5. Protection of horticultural plants: Precautions to avoid pests and diseases,biopesticides. (**1** hr)
6. Mushroom cultivation – Oyster mushroom(**1** hr)

***PRACTICAL (HORTICULTURE)***

1. Preparation of nursery bed and polybag filling.
2. Preparation of potting mixture – Potting, repotting.
3. Field work in cutting, grafting, budding, layering **(**drawing not required).
4. Familiarizing gardening tools and implements. (drawing not required)
5. Establishment of vegetable garden/ Visit to a horticulture station.
6. A brief report of item no. 5 may be recorded.

***REFERENCES (HORTICULTURE)***


1. Andiance and Brison. (1971). Propagation Horticultural Plants.
2. Chanda, K.L. and Choudhury, B. Ornamental Horticulture in India.
3. George Acquaah, (2005) Horticulture: Principles and Practices. Pearson Education, Delhi.
4. Hudson, T. Hartmann, Dale K. Kester, Fred T. Davies, Robert L. Geneve, Plant Propagation, Principles and Practices.
5. Katyal, S.C., Vegetable growing in India, Oxford, New York.
6. Kolay, A.K. Basic Concepts of Soil Science. New Age International Publishers, Delhi.
7. Naik, K.C., South Indian Fruits and their Culture.
8. Nishi Sinha: Gardening in India, Abhinav Publications, New Delhi.
9. Prakash, R and K. Raj Mohan, Jaivakrishi (Organic farming), State Institute of Languages, Trivandrum.
10. Prasad, S., and U. Kumar. Green house Management for Horticultural Crops, Agrobios, Jodhpur.


**ECONOMIC BOTANY**

Study the different category of economically important plants their Binomial, Family and Morphology of useful part, products and uses:(**9** hrs)

1. Cereals and Millets – Rice, Wheat, Maize and Ragi
2. Pulses and legumes – Green gram, Bengal gram, Black gram,
3. Sugar – Sugar cane
4. Fruits – Apple, Pine Apple, Papaya, Banana, Mango, Guava, Jack, Grapes, Sapota.
5. Vegetables – Carrot, Beet Root, Corm, Potato, bitter gourd, Cucumber, Snake gourd, Ladies finger, Cabbage, *Amaranthus*,
6. Ornamentals – Rose, *Anthurium*, Jasmine.
7. Masticatories – Betel vine, Betel nut, Tobacco.
8. Beverages – Coffee, Tea, Cocoa.
9. Fibre – Coir, Cotton, Jute.
10. Timber – Teak, Rose wood, Jack, Ailanthus.
11. Fats and oils – Coconut, Gingelly, Sun flower.
12. Latex – Rubber
13. Gums and Resins – Dammar, Gum Arabic, Asafetida
14. Spices – Pepper, Ginger, Cardamom, Clove, Nutmeg, Allspice, Cinnamon
15. Medicinal – *Adhatoda, Catharanthus, Phyllanthus, Rauvolfia, Aloe,*

***PRACTICAL (ECONOMIC BOTANY)***

1. Students shall be able to identify plants or plant products (raw or processed) studied in theory and shall be able to write Botanical names, Family and morphology of useful parts of source plants.
2. Students need not make any illustrations but make a table in the recordgiving the details of the items mentioned in the theory syllabus.

***REFERENCES (ECONOMIC BOTANY)***


1. Bendre Kumar 2000: Economic Botany' Rastogi Publcations, Shivaji road, Meerut.
2. Jain. S. K. 1981. Glimpses of Indian Economic Botany. Oxford.
3. Kochhar, S.L. (2011). Economic Botany in the Tropics, MacMillan Publishers India Ltd., New Delhi. 4th edition.


**ETHNOBOTANY**

1. Introduction, scope and significance (**1** hr)
2. Major tribes of South India. Importance of Traditional Botanical Knowledge, TBGRI model of Benefit Sharing. (**2** hrs)
3. Ethnobotanical significance of the following: (**6** hrs)
    1. *Aegle marmelos*
    2. *Ficus religiosa*
    3. *Curcuma longa*
    4. *Cynadon dactylon*
    5. *Ocimum sanctum*
    6. *Trichopus zeylanica*

***PRACTICAL (ETHNOBOTANY)***

Students are expected to identify the plants mentioned in the Ethnobotany syllabus and it must be given as a table showing Common name, Binomial, Family and Ethnobotanical significance in the record book. (Drawing not required)

***REFERENCES (ETHNOBOTANY)***


1. Baker. H.g. (1970) Plant and Civilization.
2. Jain. S. K. (1995). A Manual of Ethnobotany. Scientific Publishers, Jodhpur.
3. Cotton, C.M. (1996) Ethnobotany – Principles and Applications. Wiley and Sons.

**FIFTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME**

**CORE COURSE-9:**

**CELL BIOLOGY AND BIOCHEMISTRY**

**Code: BOT 5 B 09 T**

## COURSE OUTCOMES (COs)

By the end of the course, students are expected to:

1. Appreciate the ultra-structure of a plant cell.
2. Enumerate the functions of each cell organelle.
3. Explain the structure of biomolecules.
4. Draw the structure of biomolecules.

## DISTRIBUTION OF TEACHING HOURS (18 hrs/Semester = 1hr/week)

| Sl no | Subject | Theory | Practical | Total |
|---|---|---|---|---|
| 1 | Cell Biology | 27 | 9 | 36 |
| 2 | Biochemistry | 27 | 27 | 54 |
| **Total** | | **54** | **36** | **90** |

## QUESTION PAPER PATTERN & SUBJECT WISE DISTRIBUTION OF MARKS

| Type of questions | Cell Biology | Biochemistry | Total |
|---|---|---|---|
| 2 marks (total 12) | 6 | 6 | Ceiling 20 |
| 5 marks (total 7) | 4 | 3 | Ceiling 30 |
| 10 marks (total 2) | 1 | 1 | 1x10 = 10 |
| **TOTAL** | | | **60** |

## CELL BIOLOGY

**Module – I.**(**14**hrs)

1. Architecture of cells. Prokaryotic and Eukaryotic cells.(**1** hr)
2. Structure and function of the following: Cell membrane (fluid mosaic model), Endoplasmic reticulum, Golgi complex, mitochondria, chloroplast, Lysosomes, Glyoxisomes Ribosomes, Cytoskeleton, Cytosol, Vacuole (**5** hrs)
3. Nucleus - Nuclear membrane; Nuclear pore complex; organization of interphase Nucleus; Euchromatin and heterochromatin; Nucleolus.(**4** hrs)
4. Chromosomes - Morphology, classification, Centromere and Telomere, Chemical Composition and organization.(**4** hrs)

**Module-II**(**13** hrs)

1. Special types of chromosomes– Polytene chromosomes, lampbrush chromosomes (**1** hr)
2. Cell division - cell cycle - Mitosis & Meiosis – significance- molecular control of cell division(**5** hrs)
3. Chromosomal changes - structural aberrations: deletion, duplication, inversion, translocation - their meoitic consequences and significance(**3** hrs)
4. Numerical aberration - Defintion - Basic chromosome number (Genomic Number) Aneuploidy, Haploidy and Polyploidy - their meiotic behaviour and significance.(**4** hrs)

***PRACTICAL(CELL BIOLOGY)***

1. Mitosis - Acetocarmine squash preparation of Onion root tip.
2. Calculation of mitotic index
3. Demonstration of meiosis in Rhoeo/Chlorophytum/ Maize and identification of different stages of Meiosis.

***REFERENCE (CELL BIOLOGY)***


1. Arumugham. N. (2014) Cell Biology. Sara Publication, Nagercoil.
2. Avinash Upadhyaya & Kakoli Upadhayayo (2005). Basic Molecular Biology. Himalaya Publishers.
3. De Robertis. E.D.P., & De Robertis E.M.S. (1998) Cell and Molecular Biology -Lea & Febiger.
4. Geoffery M. Cooper & Robert E. Haufman. (2007)The cell - a molecular approach. A.S.S. Press Washington, U.S.A.
5. Lewis. J. Kleinsmith & Valerie M. Kish (1995) Principles of Cell & Molecular Biology.
6. Lewin B. (2017) GenesXII. Oxford University press.
7. Lodish. H. *et. al*., (2000) Molecular Cell Biology, Freeman & Company.
8. Powar C.B. (1988) Essentials of Cytology, Himalaya Publishing House.
9. Rastogi S.G. Cell Biology. Tata Mc Graw Hill Publishing Company New Delhi
10. Rastogi. V.B. (2008) Fundamentals of Molecular Biology, Ane Books India.


**BIOCHEMISTRY**

1. Macromolecules-building block biomolecules - metabolic intermediates-precursors). (**2** hrs)
2. Carbohydrates. Classification; structure and functions of simple sugars and compound carbohydrates.(**5** hrs)
3. Lipids. Classification. Complex lipids, Simple lipids and derived lipids; Fatty acids saturated and unsaturated, triacyl glycerols, phospholipids, sphingolipids. (**4** hrs)
4. Amino acids, peptides and proteins. Amino acids: classification based on polarity; zwitterions, Dipeptides.(**3** hrs)
5. Proteins: Primary, secondary, tertiary and quaternary structures of proteins. Native conformation and biological functions of proteins. Denaturation and renaturation.(**3** hrs)
6. Nucleotides: structure, Functionsofnucleotidesandnucleotidederivatives.(**4**hrs)
7. Secondary metabolites. A brief account of secondary metabolites, physiological roles. Significance: ecological importance.(**2** hrs)
8. Enzymes Classification (IUB), Mechanism of enzyme action, optimization of weak interactions in the transition state. Co-enzymes, inhibition, regulation: allosteric enzymes, covalently modulated enzymes. Isoenzymes. (**4** hrs)

***PRACTICAL (BIOCHEMISTRY)***

1.Qualitative tests for monosaccharides, and reducing non reducing oligosaccharides, starch, amino acids and protein.

1. Molisch's test for all carbohydrates
2. Benedict's test for reducing sugars
3. Barfoed's test for monosaccharides
4. Seliwanoff's test for ketoses
5. Fearson's test (methyl amine test) for reducing disaccharides
6. Iodine test for starch
7. Ninhydrin test for amino acids and protein
8. Xanthoproteic test for amino acids with aromatic R-groups
9. Millon's test for tyrosine
10. Hopkins- Cole test for tryptophan
11. Biuret test for peptide linkage and proteins

2. Quantitative estimation of protein by Biuret method. (Demonstration only)
3. Quantitative estimation of DNA and RNA by colorimetric/ spectrophotometric method (Demonstration only)
4. Colorimetric estimation of reducing sugars in germinating seeds (Demonstration only)

***REFERENCES (BIOCHEMISTRY)***


1. David L; Nelson and Michael M Cox (2000).Lehninger. Principles of Biochemistry. 3rd edition. Macmillon, Worth U.K.
2. Sadasivam and Manickam, (2007) Biochemical methods. New Age International Publishers. New Delhi.
3. Secondary plant products, vol.8. Encyclopedia of Plant Physiology (1980) Springer – Verlag, Berlin
4. Goodwin Y.W., and Mercer E.I. (2003) Introduction to Plant Biochemistry. 2nd edition. CBS Publishers and distributors.
5. Donald Voet and Judith Voet. (2004). Biochemistry. 3rd Edition. Wiley International Edition.
6. Keith Wilson and John Walker.( 2008). Principles and techniques of Biochemistry and Molecular Biology. 6th edition. Cambridge University Press.
7. Trevor Palmer. (1991) Enzymes- Biochemistry, Biotechnology and Clinical Chemistry. Norwood Publishing, Chichester.

**SIXTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME**

**CORE COURSE- 10**

# GENETICSANDPLANTBREEDING

**Code: BOT 6 B 10 T**

## COURSE OUTCOMES (COs)

By the end of the course, students are expected to:

1. Appreciate the facts behind heredity and variations.
2. Understand the basic principles of inheritance.
3. Solve problems related to classical genetics.
4. Predict the pattern of inheritance.
5. Understand various plant breeding techniques.
6. Realize the role of plant breeding in increasing crop productivity.

**DISTRIBUTION OF TEACHING HOURS (18 hrs/Semester = 1hr/week)**

| Sl no | Subject | Theory | Practical | Total |
|---|---|---|---|---|
| 1 | Genetics | 36 | 27 | 63 |
| 2 | Plant breeding | 18 | 9 | 27 |
| **Total** | | **54** | **36** | **90** |

**QUESTION PAPER PATTERN & SUBJECT WISE DISTRIBUTION OF MARKS**

| Type of questions | Genetics | Plant breeding | Total |
|---|---|---|---|
| 2 marks (total 12) | 8 | 4 | Ceiling 20 |
| 5 marks (total 7) | 4 | 3 | Ceiling 30 |
| 10 marks (total 2) | 2 | | 1x10 = 10 |
| **Total** | | | **60** |

## GENETICS

**Module – I**(**23** hrs)

1. Introduction- Mendel's life history (brief), Mendelian experiments:Monohybrid cross and dihybrid cross, Mendelian ratios, Laws of inheritance; Back cross, test cross.(**5** hrs)
2. Modified Mendelian ratios:
   a. Allelic interactions: dominant – recessive, Incomplete dominance – flowercolor in Mirabilis;Co dominance – Coat colour in cattle, Blood group inhuman beings; Lethal genes – Sickle cell anemia in Human beings. Modified dihybrid ratios by incomplete dominance of one pair of gene (3:6:3:1:2:1) and both pairs (1:2:1:2:4:2:1:2:1). (**6** hrs)
   b. Interaction of genes: Non epistatic - Comb pattern inheritance in poultry(9:3:3:1): Epistasis: dominant - Fruit colour in summer squashes; Recessive epistasis - Coat color in mice; Complementary gene interaction- flowercolor in *Lathyrus*. (**6** hrs)
3. Multiple alleles- general account: ABO blood group in man, Self sterility in *Nicotiana,* Coat colour in Rabbits.(**3** hrs)
4. Quantitative inheritance / polygenic inheritance / continuous variation-Skin color in human beings, Ear size in maize. (**3** hrs)

**Module –II**(**13** hrs)

1. Linkage and crossing over- importance of linkage, linkage and independentassortment. Complete and incomplete linkage. Crossing over general account, 2 point and 3 – point crossing over, cytological evidence of genetic crossing over. Determination of gene sequences; interference andcoincidence; mapping of chromosomes.(**7** hrs)
2. Extra nuclear inheritance- general account- maternal influence- plastidinheritance in *Mirabilis*, Shell coiling in snails. (**3** hrs)
3. Population genetics; Hardy –Weinberg law and equation(**3** hrs)

***PRACTICAL (GENETICS)***

1. Students are expected to work out problems related to the theory syllabus. One problem each from all the types mentioned should be recorded.
   a. Monohybrid cross
   b. Dihybrid cross
   c. Test cross and back cross
   d. Determination of genotypic and phenotypic ratios and genotype of parents
   e. Non epistasis
   f. Complementary gene interaction
   g. Epitasis: dominant and recessive
   h. Polygenic interaction
   i. Multiple allelism
   j. Chromosome mapping
   k. Calculation of Coincidence and interference

***REFERENCE (GENETICS)***


1. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction to Genetic Analysis. W. H. Freeman and Co., U.S.A. 10th edition.
2. Gunther, S. Spend & Richard Calender (1986) - Molecular Genetics CBSPublishers Delhi.
3. Gupta, P.K. (2018 -19) Genetics. Revised edition. Rastogi Publications, Meerut
4. John Ringo (2004) Fundamental Genetics Cambridge University Press.
5. John Ringo (2004). Fundamental Genetics Cambridge University Press.
6. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. Benjamin Cummings. U.S.A. 9th edition.
7. Lewin B. (2000) Genes VII Oxford University Press.
8. RastogiV.B. (2008) Fundamentals of Molecular Biology, Ane Books, India.
9. Sinnot, W.L.C. Dunn & J. Dobzhansky (1996) Principles of Genetics. Tata Mc Graw Hill Publishing Company Ltd., New Delhi.
10. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics. John Wiley and Sons Inc., U.S.A. 5th edition.
11. Verma, P.S. & Agarwal (1999) Text book of Genetics. S. Chand & Co., New Delhi.


## PLANT BREEDING

**Module-I**(**4** hrs)

1. Definition and objectives of Plant breeding – Organization of ICAR and its role in plant breeding.(**2** hrs)

2. Plant Genetic Resources - Components of Plant Genetic Resources.(**2** hr)

**Module-II**(**14** hrs)

1. Breeding techniques (**12** hrs)

    1. Plant introduction: Procedure, quarantine regulations, acclimatization- agencies of plant introduction in India, major achievements.
    2. Selection -mass selection, pureline selection and clonal selection, genetic basis of selection, significance and achievements.
    3. Hybridization – procedure; intergeneric, interspecific and intervarietal hybridization with examples; composite and synthetic varieties.
    4. Heterosis breeding - genetics of heterosis and inbreeding depression.
    5. Mutation breeding – methods - achievements.
    6. Polyploidy breeding
    7. Breeding for disease and stress resistance

2. Modern tools for plant breeding: Genetic Engineering and products of genetically modified crops (brief mentioning only).(**2** hrs)

***PRACTICAL (PLANT BREEDING)***

1. Techniques of emasculation and hybridization of any bisexual flower.
2. Floral biology of Paddy, any one Pulse and Coconut tree.
3. Visit to a plant breeding station and submission of its report.

***REFERENCES (PLANT BREEDING)***


1. Allard. R.W. (1960). Principles of Plant breeding, John Wiley & Sons, Inc, New York.
2. Chaudhari. H.K. Elementary Principles of Plant breeding, Oxford & IBH Publishers.
3. Singh, B.D. (2005). Plant Breeding: Principles &methods, Kalyani Publishers, New Delhi.
4. Sinha U.& Sunitha Sinha (2000) Cytogenetics, Plant breeding & Evolution, Vikas Publishing House.
5. Swaminathan, Gupta & Sinha (1983) Cytogenetics of Crop plants Macmillan India Ltd.

**SIXTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME**
**CORE COURSE- 11**
**BIOTECHNOLOGY, MOLECULAR BIOLOGY AND BIOINFORMATICS**
**Code: BOT 6 B 11 T**

## COURSE OUTCOMES (COs)

By the end of the course, students are expected to:

1. Analyze the role of biotechnology in daily life
2. Understand the basic aspects of bioinformatics.
3. Explain the concepts in molecular biology

**DISTRIBUTION OF TEACHING HOURS (18 hrs/Semester = 1hr/week)**

| Sl no | Subject | Theory | Practical | Total |
|---|---|---|---|---|
| 1 | Biotechnology | 18 | 12 | 30 |
| 2 | Molecular Biology | 18 | 12 | 30 |
| 3 | Bioinformatics | 18 | 12 | 30 |
| **Total** | | **54** | **36** | **90** |

**QUESTION PAPER PATTERN & SUBJECT WISE DISTRIBUTION OF MARKS**

| Type of questions | Biotechnology | Molecular Biol. | Bioinformatics | Total |
|---|---|---|---|---|
| 2 marks (total 12) | 4 | 4 | 4 | Ceiling 20 |
| 5 marks (total 7) | 2 | 2 | 3 | Ceiling 30 |
| 10 marks (total 2) | 2 | | | 1x10 = 10 |
| **Total** | | | | **80** |

## BIOTECHNOLOGY

**Module –I**(**13** hrs)

1.Introduction, concept, history of biotechnology (**1** hr)

2.Recombinant DNA Technology: Gene cloning strategies – recombinant DNA construction –cloning vectors –plasmids pBR322, bacteriophage based vectors, Ti plasmids. Restriction endonucleases and ligases transformation and selection of transformants –using antibiotic resistances markers,southern blotting; PCR. (**7** hrs)

3.Different methods of gene transfer – chemically stimulated DNA uptake byprotoplast, electroporation, microinjection, biolistics. Agrobacterium mediate gene transfer gene library, gene banks. (**5** hrs)

**Module –II**(**5** hrs)

1. Applications of Biotechnology (**5** hrs)
   a. Medicine - Production of human insulin, human growth hormone and
   b. Forensics - DNA finger printing.
   c. Agriculture -Genetically modified crops –Btcrops, Golden rice,Flavr Savr

Tomato,Virus, herbicide resistant crops, Edible vaccines.

d. Environment- Bioremediation- use of genetically engineered bacteria-super bug.
e. Industry- Horticulture and Floriculture Industry, production of vitamins, amino acids and alcohol.

***PRACTICAL (BIOTECHNOLOGY)***

1. Extraction of DNA from plant tissue.
2. Study of genetic engineering tools and techniques using photographs/diagram(Southern blotting, DNA finger printing, PCR)

***REFERENCES (BIOTECHNOLOGY)***


1. Brown TA (2006) Gene cloning and DNA anlaysis; Blackwell scientific publishers
2. Chawla HS (2000) Introduction to Plant Biotechnology
3. Das,H.K.(Ed) (2005).TextbookofBiotechnology(2nded)WileyIndia(Pvt.),Ltd. New Delhi.
4. Gupta, P.K. (1996) Elementary Biotechnology. Rastogi & Company, Meerut.
5. Hammond, J., Megary, P *et al. (*2000) Plant Biotechnology. Springerverlag.
6. Ignacimuthu S (1997) Plant Biotechnology, New Hampshire Science Publishers
7. Lewin B (2004) Genes VIII. Oxford University Press
8. Purohit SS (2003) Agricultural Biotechnology, Agrobios (India)
9. Sobti RC & Pachauri SS (2009) Essentials of Biotechnology; Ane Books, New Delhi.


## MOLECULAR BIOLOGY

1. Nucleic acids - DNA – the genetic material; the discovery of DNA as the genetic material; bacterial transformation (Griffith's & Avery's experiments); Hershey and Chase experiment; Structure of DNA, Watson & Crick's Model, Types of DNA-(A,B,Z); Replication: semi conservative replication– Meselson and Stahl's experiment; Molecular mechanism of Replication, RNA- structure, types and properties. (**6** hrs)
2. Gene action - One gene - one enzyme hypothesis, one cistron one polypeptide hypothesis; concept of colinearity; modern concept of gene-cistrons, recons and mutons(**2** hrs)
3. Genetic code - Characters of genetic code(**2** hrs)
4. Central dogma protein synthesis; Transcription, post-transcriptional modification of RNA, translation; Teminism.(**3** hrs)
5. Gene regulation in prokaryotes - operon concept, (Lac operon, trp. operon) (**1** hr)
6. Gene regulation in eukaryotes (brief account)(**1** hr)
7. Mutation-spontaneous and induced; causes and consequences. Types of mutagens and their effects. Point mutations- molecular mechanism of mutation-Transition, Transversion and substitution(**3** hrs)

***SUBMISSION (MOLECULAR BIOLOGY)***

Visit a research station with well-equipped biotechnology / Molecular biology lab and submit a duly certifieddetailed report of the same during the practical examination.

***REFERENCES (MOLECULAR BIOLOGY)***


1. Brown T A. (2003) Genomes. John Willey and Sons.
2. Hawkins, J D. (1996) Gene Structure and Expression. Cambridge University Press
3. Lewin Benjamin. (2017) Gene XII. Oxford University Press
4. Malathi, V. (2010). Essentials of Molecular Biology, Pearson Education Inc.
5. Russell, P. J. (2010). Genetics- A Molecular Approach. Benjamin Cummings, U.S.A. 3rd edition.
6. Waseem Ahmad, (2009). Genetics and Genomics. Pearson Education Inc.
7. Watson J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M., Losick, R. (2007). Molecular Biology of the Gene, Pearson Benjamin Cummings, CSHL Press, New York. 6th edition.


## BIOINFORMATICS

**Module-I**(**3** hrs)

1. IT in teaching, learning and research: Web page designing and web hosting. Academic web sites, e-journals, Open access initiatives and open access publishing, education software, academic services - INFLIBNET, NICNET, BRNET.
2. E-wastes and green computing.
3. Futuristic IT - Artificial intelligence, virtual reality, bio-computing.

**Module- II** (**5** hrs)

1. Introduction to Bioinformatics, brief history, scope and relevance, wet lab to web lab
2. Basics of Genomics, Proteomics and comparative genomics
3. Biological data bases:
   Nucleotide sequence database – EMBL, Gen Bank, DDBJ.
   Protein database – SwissProt, PDB.
   Organismal database /Biodiversity database – Species 2000 /Humangenome database
4. Information retrieval from Biological database, sequence alignmenttypes and tools: pair wise sequence alignment multiple sequence alignment, BLAST, Clustal W

**Module- III**(**6** hrs)

1. Genomics: DNA sequencing,Sangers procedure, automation of DNA sequencing, genome sequence assembly.
2. Genome projects – Major findings and relevance of the following genome projects – Human, Arabidopsis thaliana, Rice, Haemophilus influenza.
3. Proteomics : Protein sequencing- automation of sequencing, protein structure prediction and modelling (Brief account only)

**Module- IV**(**4** hrs)

A brief account on

1. Molecular phylogeny and phylogenetic trees.
2. Molecular visualization – use of Rasmol.
3. Molecular docking and computer aided drug design.

***PRACTICAL (BIOINFORMATICS)***

1. Familiarizing with the different data bases mentioned in the syllabus.
2. Molecular visualization using Rasmol.
3. Blast search of nucleotide sequences.

***REFERENCE (BIOINFORMATICS)***


1. Jin Xiong (2006): Essential Bioinformatics, Cambridge University Press, Replika Press Pvt. Ltd.
2. Ghosh Z. and Bibekanand M. (2008) Bioinformatics: Principles and Applications. OxfordUniversity Press.
3. Pevsner J. (2009) Bioinformatics and Functional Genomics. II Edition. Wiley-Blackwell.
4. Campbell A. M., Heyer L. J. (2006) Discovering Genomics, Proteomics and Bioinformatics. _II Edition. Benjamin Cummings.

**SIXTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME**

**CORE COURSE-12:**

**PLANT PHYSIOLOGY AND METABOLISM**

**Code: BOT6B12 T**

**COURSE OUTCOMES (COs)**

By the end of the course, students are expected to:

1. Identify the physiological responses of plants
2. Analyze the role of external factors in controlling the physiology of plants.
3. Explain the metabolic processes taking place in each cell.
4. Appreciate the energy fixing and energy releasing processes taking place in cells

**DISTRIBUTION OF TEACHING HOURS (18 hrs/Semester = 1hr/week)**

| Sl no | Subject | Theory | Practical | Total |
|---|---|---|---|---|
| 1 | Module 1 | 9 | 36 | 45 |
| 2 | Module II | 6 | | 6 |
| 3 | Module 1II | 15 | | 15 |
| 4 | Module 1V | 9 | | 9 |
| 5 | Module V | 15 | | 15 |
| **Total** | | **54** | **36** | **90** |

**QUESTION PAPER PATTERN & SUBJECT WISE DISTRIBUTION OF MARKS**

| Type of questions | Mod. 1 | Mod. I1 | Mod. I1I | Mod. IV | Mod. V | Total |
|---|---|---|---|---|---|---|
| 2 marks (total 12) | 2 | 2 | 3 | 2 | 3 | Ceiling 20 |
| 5 marks (total 7) | 1 | 1 | 2 | 1 | 2 | Ceiling 30 |
| 10 marks (total 2) | 2 | | | | | 1x10 = 10 |
| **TOTAL** | | | | | | **60** |

**Module - 1.**

1. Plant cell and Water. Water as a solvent, cohesion and adhesion. Diffusion, osmosis, imbibition, plant cell as an osmotic system, osmotic pressure, osmotic potential, turgor pressure, wall pressure, water potential and its components(**4** hrs)
2. Transpiration. Types and process. Mechanism of guard cell movement. $K^+$ ion mechanism. Why transpiration? Antitranspirants.(**3** hrs)
3. Absorption of water by transpiration pull and cohesion of water molecules. Radial movement of water through root. Soil-plant-atmosphere continuum of water.(**2** hrs)

**Module-II**

1. The ascent of sap; Transpiration pull and cohesion of water molecules. Merits and demerits of cohesion-tension theory.(**2** hrs)
2. Plants and inorganic nutrients. Macro and Micro nutrients. Uptake of mineral elements. Difference between passive uptake and active uptake. Simple and facilitated diffusion. Active uptake. Carrier concept. Evidences. (**4** hrs)

**Module - III**

1. Photosynthesis in higher plants: Photosynthetic apparatus. Electromagnetic radiation. Absorption of light. Fluorescence and phosphorescene. Organization of light harvesting

antenna pigments. Photochemical and chemical phases of photosynthesis and its evidences. Red drop and Emerson enhancement effect. Two pigment systems, components. Photosynthetic electron transport and photophosphorylation. Assimilatory powers- ATP and NADPH. Photosynthetic carbon reduction cycle (PCR), RUBISCO, C3, C4, and CAM pathways. Ecological significance of C4, and CAM metabolism. Photorespiration. (**8** hrs)

2. Biological nitrogen fixation, symbiotic nitrogen fixation in leguminous plants. Biochemistry of Nitrogen fixation, Ammonia assimilation, assimilation of nitrate. Biosynthesis of amino acids.(**4** hrs)
3. Translocation and distribution of photo assimilates. Mechanism of phloem transport. Phloem loading and unloading; pressure flow hypothesis. (**3** hrs)

**Module - IV**

1. Plant growth and development. Auxins, gibberellins, cytokinins, abscisic acid and ethylene, their physiological roles. Photoperiodism and vernalization.(**3** hrs)
2. Plant movements-phototropism, gravitropism. Nyctinastic and seismonatic movements. (**3** hrs)
3. Photomorphogenesis: Phytochrome: chemistry and physiological effects. (**2** hrs)
4. Seed dormancy and germination. (**1**hr)

**Module – V**

1. Intermediary metabolism: anabolism, catabolism, amphibolic pathways and anapleurotic reactions. (**3** hrs)
2. Catabolism of hexoses. Glycolysis: Two phases of glycolysis. Overall balance sheet. Fate of pyruvate under aerobic and anaerobic conditions. Citric acid cycle: Formation of acetate, Reaction of citric acid cycle, Anapleurotic reactions of citric acid cycle. Amphibolic nature of citric acid cycle. (**5** hrs)
3. Oxidation of fatty acids. β oxidation of saturated fatty acids in plants.(**2** hrs)
4. Oxidative phosphorylation: Electron transport reactions in mitochondrion. Electron carriers, redox potential, electron carriers functioning as multienzyme complexes, ATP synthesis. Chemiosmotic hypothesis, cyanide-resistant respiration, factors affecting respiration. (**5** hrs)

***PRACTICAL***

Students should familiarize experiments and details must be recorded. (Drawing not required)

1. Fruit ripening/Rooting from cuttings (Demonstration).
2. Relation between water absorption and transpiration.
3. Separation of leaf pigments by paper chromatography/ column chromatography/TLC.
5. Effects of light intensity on photosynthesis by Wilmot's bubbler.
4. Thistle funnel osmoscope
5. Ganong's Potometer
6. Ganong's light-screen
7. Ganong's respirometer
8. Kuhne's fermentation vessel
9. Mohl's half-leaf experiment

10. Absorbotranspirometer
11. Demonstration of gravitropism using Klinostat.

***REFERENCES***


1. Frank B. Salisbury and Cleon W. Ross (2002). Plant Physiology 3rd edition. CBS publishers and distributers.
2. Noggle G. R and.Fritz G J (1983) Introductory Plant Physiology Prentice Hall.
3. Goodwin Y.W., and Mercer E.I. (2003) Introduction to Plant Biochemistry. 2nd edition. CBS Publishers and distributors.
4. Hopkins WG (1999). Introduction to Plant Physiology, 2nd edition, John Wiley A Sons, Inc. U.S.A. 4th edition
5. Hopkins, W.G. and Huner, A. (2008). Introduction to Plant Physiology. John Wiley and Sons.
6. Lincoln Taiz and Eduardo Zeiger (2002). Plant Physiology 2nd edition. Sinauer Associates, Inc. Publishers. Sunderland, Massachusetts
7. Taiz, L., Zeiger, E., MØller, I.M. and Murphy, A (2015). Plant Physiology and Development. Sinauer Associates Inc. USA. 6th edition.


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**SIXTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME**
**CORE COURSE-13:**
**ENVIRONMENTAL SCIENCE**
**Code: BOT6 B13 T**

## COURSE OUTCOMES (COs)

By the end of the course, students are expected to:

1. Realize the importance of ecological studies.
2. Develop environmental concern in all their actions.
3. Try to reduce pollution and environmental hazards.
4. Spread awareness of the need of conservation of biodiversity and natural resources.
5. Analyzethe reasons for climate change and find out ways to combat this.

## DISTRIBUTION OF TEACHING HOURS (18 hrs/Semester = 1hr/week)

| Sl no | Subject | Theory | Practical | Total |
|---|---|---|---|---|
| 1 | Module 1 | 14 | 9 | 25 |
| 2 | Module II | 13 | 9 | 16 |
| 3 | Module II1 | 14 | 9 | 25 |
| 4 | Module 1V | 13 | 9 | 24 |
| **Total** | | **54** | **36** | **90** |

## QUESTION PAPER PATTERN & SUBJECT WISE DISTRIBUTION OF MARKS

| Type of questions | Module 1 | Module 1I | Module 111 | Module 1V | Total |
|---|---|---|---|---|---|
| 2 marks (total 12) | 3 | 3 | 3 | 3 | Ceiling 20 |
| 5 marks (total 7) | 2 | 2 | 2 | 1 | Ceiling 30 |
| 10 marks (total 2) | 2 | | | | 1x10 = 10 |
| **TOTAL** | | | | | **60** |

## ENVIRONMENTAL SCIENCE

### Module - I

1. Ecosystem: Definition, abiotic and biotic factors, trophic structure, Foodchain and food web, Ecological pyramids, Energy flow, Productivity ofecosystems.(**4** hrs)
2. Biogeochemical cycles (Carbon, Nitrogen, Phosphorous)(**3** hrs)
3. Plant adaptations: Adaptations in Hydrophytes, Xerophytes, Halophytes,Epiphytes and Parasites.(**3** hrs)
4. Plant Succession: Definition – Primary and Secondary succession; Autogenic and allogenic succession; Mechanism of plant succession–Xerosere and Hydrosere (**4** hrs)

### Module-II

1 Biodiversity and Conservation: Definition; Biodiversity - Global and Indian Scenario; Megadiversity nations and hotspots: Biosphere reserves;Biodiversity centres in India. (**5** hrs)

2 Threats to biodiversity; Endangered and endemic plant species – Red databook - Exotic

and indigenous plant species – Keystone species – Flagshipspecies.(**4** hrs)

3 Conservation strategies *ex situ* and *in situ* methods. Organizations–IUCN, UNEP & WWF; (NBPGR) Biodiversity Board of Kerala (KSBDB).(**4** hrs)

**Module-III**

1 Pollution: Sources and types of pollution – air, water, soil, thermal and noise;biodegradable and non-biodegradable pollutants; biomagnification; BOD. (**4** hrs)

2 Global environmental changes – climatic changes – global warming andgreenhouse gases, acid rains, el-nino,efforts of world organizations in theregulation of greenhouse gases emission.(**5** hrs)

3 Management of environmental pollution – conventional and phytotechnologicalapproaches – solid wastes management including e-wastes-environmentallegislations in India (Prevention and Control of Pollution act, 1981). (**5** hrs)

**Module- IV**

1 Major ecosystems of the Biosphere; Sea;Estuarine ecosystem; Lenticecosystem: lake, Pond; Lotic ecosystem: river; Desert; Forest; Grass land.(**5** hrs)

2 Techniques in plant community studies – Quadrat and transect methods– species area curve– density, frequency, abundance, dominance of populations– importance value index – construction of phytographs. (**8** hrs)

***PRACTICAL***

1. Construct a food web from the given set of data, (Representative of a natural ecosystem). (Drawing not required).
2. Construct ecological pyramids of number, biomass and energy from the given set of data (Representative of a natural ecosystem). (Drawing not required).
3. Study of plant communities: Determination of density, abundance, dominance,frequency by quadrat method.
4. Demonstration of determination of Dissolved Oxygen by Winkler's method.
5. Study of morphological and anatomical characteristics of plant groups: Hydrophytes, Xerophytes, halophytes, epiphytes, parasites.(Drawing not required).
6. Estimation of solid waste generated by a domestic system (biodegradable and nonbiodegradable)and its impact on land degradation.

***REFERENCES***


1. Beeby A. & Brennan A.M. (2004) First Ecology. Ecological Principles andEnvironmental Issues. Oxford University Press.
2. Cunninghan W.P. and M.A. Cunningham (2003). Principles of Environmental Science: Inquiry and Applications. Tata McGraw Hill Pub. N.D.
3. Dash M.C. (1993). Fundamentals of Ecology. Tata McGraw Hill Publishing Company Ltd. New Delhi.
4. Dix J.H. (1989). Environmental Pollution. Atmosphere, Land, Water and Noise. Wiley

Chichester.
5. Khitoliya R.K. (2007). Environmental Pollution – Management and Control for Sustainable development S. Chand and Company Ltd., New Delhi.
6. Mishra D.D (2008). Fundamental Concepts in Environmental Studies. S. Chand & Co., New Delhi.
7. Mishra S.P. & S.N. Pandey (2008). Essential Environmental Studies. Ane Books Pvt. Ltd. Thiruvananthapuram.
8. Odum E.P. (1983). Basics of Ecology. Saunders International UN Edition.
9. Shukla R.S. & P.S. Chandel (2005). A Text Book of Plant Ecology S. Chand & Co. Ltd. New Delhi.
10. Wise, D.L.(2005)Global Environmental Biotechnology. Ane Books. Thiruvananhapuram.
11. Bharucha E. (2005) Text Book of Environmental Studies for UG courses. University Press (India) Private Limited Hyderabad.
12. Diamond, J., T.J. Case (1986). Community ecology. Harper & Row, New York.
13. Futuyma P.J., Slatkin M. (1983) Co-evolution. Sinauer Associates, Sunderland Mass.
14. Krebs, C.J. (1985). Ecology 3rd edn. Harper & Row New York.
15. Sharma, P.D. (2008-2009). Ecology and Environment. Rastogi Publication.
16. Wilkinson, D.M. (2007). Fundamental Processes in Ecology: An Earth Systems Approach. Oxford University Press. U.S.A.

# ELECTIVE PAPERS

**SIXTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME**
**CORE COURSE-14: Elective-1: GENETIC ENGINEERING**
**Code: BOT6B14 T (E1)**

## COURSE OUTCOMES (COs)

By the end of the course, students are expected to:

1. Appreciate various techniques employed in genetic engineering.
2. Develop general awareness on genetically modified organisms.
3. Understandthe ethical, social and legal issues associated with genetic engineering.

## DISTRIBUTION OF TEACHING HOURS (18 hrs/Semester = 1hr/week)

| Sl no | Subject | Theory | Practical | Total |
|---|---|---|---|---|
| 1 | Module 1 | 12 | 36 | 48 |
| 2 | Module II | 15 | | 15 |
| 3 | Module II1 | 15 | | 15 |
| 4 | Module 1V | 12 | | 12 |
| **Total** | | **54** | **36** | **90** |

## QUESTION PAPER PATTERN

| Type of questions | No of questions | Total marks |
|---|---|---|
| 2 marks | 12 | Ceiling 20 |
| 5 marks | 7 | Ceiling 30 |
| 10 marks | 2 | 1x10 = 10 |
| **TOTAL** | **21** | **60** |

## GENETIC ENGINEERING

### Module -I

Introduction to gene cloning(**12** hrs)

1. DNA isolation; DNA isolation solutions, isolation buffer pH, concentration and ionic strength, DNase inhibitors, detergents used for isolation, methods for breaking the cells
2. Removal of proteins from cell homogenate; using organic solvents, Kirby method and Marmur method, using CTAB
3. Removal of RNA; using RNase A, RNase T1
4. Concentrating the isolated DNA; precipitating with alcohols, salts added along with alcohol
5. Determination of the concentration and purity of DNA; using UV spectrophotometry
6. Storage of DNA samples
7. Commercially available kits for genomic and plasmid DNA isolation
8. Preparation of genomic DNA from animal cells, plant cells and bacterial cells; protocol for small scale and large scale preparations
9. Isolation of plasmid DNA; protocol for small scale and large scale preparations

10. Isolation and purification of RNA; purification of total RNA, RNase inhibitors, preparation of cell material, preparation of glass wares, guanidinium hot phenol method, high salt lithium chloride method, isolation of poly A RNA

**Module-II**

Agarose Gel electrophoresis of DNA and RNA (**15** hrs)

1. Principles of electrophoresis,
2. Buffers used for electrophoresis of nucleic acids,
3. Gel concentration, sample concentration, sample loading solutions,
4. Gel staining,
5. Determination of molecular weight using molecular weight markers,special precautions and treatments required for electrophoresis of RNA,Elution of DNA from agarose gels; electroelution, using low-melting pointagarose.
6. Nucleic acid transfer and hybridization; Southern blot transfer, dot-blot transfer, plaque and colony transfer, Southern blot hybridization,Northern blot transfer and hybridization, in situ hybridization
7. Preparation of probes for hybridization, radioactive labeling, digoxigeninlabeling, nick translation, preparation of primer using PCR, RNA probes

**Module - III**

Principle of DNA cloning(**12** hrs)

1. Cloning vectors; essential features of a cloning vector, plasmid derived vectors, bacteriophage derived vectors, hybrid vectors, high capacity cloning vectors; BACs, PACs and YACs, Agrobacterium based vectors,shuttle vectors, expression vectors
2. Enzymes used in recombinant DNA technology; type II restrictionendonucleases, ligases, S1 nuclease, alkaline phosphatase, terminal transferase, DNA polymerase I, reverse transcriptase, exonuclease III,bacteriophages λ exonuclease,
3. Finding gene of interest; shot gun cloning followed by screening,construction and use of genomic DNA library and cDNA library, screening DNA libraries, chromosome walking, in silico gene discovery, cloning of the gene of interest, altering the gene of interest through sitedirected mutagenesis,
4. Preparation of recombinant DNA molecule, blunt ends and sticky ends,using tailing method, using polylinkers
5. Methods to transfer the recombinant DNA molecule into the cloning host;transformation, transfection, transduction, electroporation,microinjection, microprojectiles and DNA gun, Agrobacterium mediatedtransfer
6. Methods to select the recombinants; antibiotic markers, insertionalinactivation, replica plating, blue-white selection, use of reporter genes; GUS, luciferase and GFP genes

**Module -IV**

Transgenesis; introduction to transgenic organisms and their applications (**15** hrs)

1. Mechanism of gene transfer into eukaryotic cells, transfection methods; using polyethelene glycol, chemical transfection using lithium acetate, calcium phosphate, and DEAE-dextran, lipofection, electroporation, microinjection, DNA gun, fate of DNA transferred to

eukaryotic cells, random integrationtransgenesis – gain of function effects and loss of function effects, gene targeting,

2. Examples of transgenic crop plants and animals
3. Antisense and RNAi technology
4. Production of knock out models and their use
5. Applications of recombinant DNA technology
6. Ethical, Social and legal issues associated with recombinant DNA technology

***PRACTICAL****:*

Students should be given sufficient exposure to the experiments listed below either by visiting nearby biotechnology labs or showing video clippings of the same. Centers selecting this elective are supposed to procure the required facilities in the meantime.

Protocols of the listed experiments should be recorded.

1. Isolation of genomic DNA from plants and its quantification and purity checking using spectrophotometric method.
2. Agarose gel electrophoresis of the isolated plant genomic DNA, its visualization and photography.
3. Isolation of plasmid DNA from bacterium, and its quantification and purity checking using spectrophotometric method.
4. Agarose gel electrophoresis of the isolated plasmid DNA, its visualization and photography
5. Preparation of competent *E.coli* cells.
6. Preparation of recombinant plasmids,transformation of *E.coli* and selection of transformants.

Record of the practical works done together with the detailed report of the Biotechnology Laboratory visit should be duly certified and submitted for the valuation at the time of practical examination.

***REFERENCES***


1. Recombinant DNA , JD Watson, (1992) Scientific American Books
2. Recombinant DNA: genes and genomes – a short course, JD Watson et al., (2006) WH Freeman & Co.
3. Recombinant DNA technology and applications, Alex Prokop et al., (1997) McGraw Hill.
4. Principles of Gene Manipulation: An Introduction to Genetic Engineering, by R.W. Old andB001H6L956S.B. Primrose, (2000) Blackwell Scientific
5. Molecular Cloning: a Laboratory Manual. Sambrook J, Russel DW & Maniatis T. (2001) Cold Spring Harbour Laboratory Press.

**SIXTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME**
**CORE COURSE-14: ELECTIVE-2:**
**ADVANCED ANGIOSPERMSYSTEMATICS**
**Code: BOT 6 B 14 T (E2)**

## COURSE OUTCOMES (COs)

By the end of the course, students are expected to:

1. Develop deep knowledge in angiosperm systematics.
2. Demonstrate ability to identify and classify plants in a faster and better way.
3. Apply imaging technologies in plant systematics.

## DISTRIBUTION OF TEACHING HOURS (18 hrs/Semester = 1hr/week)

| Sl no | Subject | Theory | Practical | Total |
|---|---|---|---|---|
| 1 | Module 1 | 12 | 36 | 48 |
| 2 | Module II | 22 | | 22 |
| 3 | Module II1 | 5 | | 5 |
| 4 | Module 1V | 15 | | 15 |
| **Total** | | **54** | **36** | **90** |

## QUESTION PAPER PATTERN

| Type of questions | No of questions | Total marks |
|---|---|---|
| 2 marks | 12 | Ceiling 20 |
| 5 marks | 7 | Ceiling 30 |
| 10 marks | 2 | 1x10 = 10 |
| **Total** | **21** | **60** |

## ADVANCED ANGIOSPERMSYSTEMATICS

### Module -I

1. Scope and importance of Taxonomy.(**2** hrs)
2. The history of taxonomy- Ancient classification; Evolution of differentconcepts in taxonomy. The herbalists; Early taxonomists; Linnaeus; PostLinnaean natural systems; Post Darwinian phylogenic; Modern Pheneticmethods (Numerical taxonomy); Modern Phylogenic methods (Cladistics).APG system of classification (**10** hrs)

### Module-II

The material basis of Systematics

1. Concept of character; Correlation of characters; character weighting;Character variation, isolation and speciation.(**4** hrs)
2. Sources of Taxonomic characters: Morphology, Anatomy, Palynology,Embryology, Cytology, Phytochemistry, Molecular Taxonomy. Role of theabove mentioned branches in taxonomic studies(**6** hrs)
3. Identification techniques: Taxonomic literature: Flora,Revision, monograph,use and construction of taxonomic keys. Herbarium: Definition, Stepsinvolved in preparation and

maintenance of herbarium,Herbarium consultation; General account of Regional and National herbaria with specialemphasis to Kew, CAL, MH, CALI.(**5** hrs)

4. Botanic gardens and their importance in taxonomic studies – ImportantNational and International Botanic Gardens – Royal Botanic Gardens, Kew; Indian Botanic Gardens, Calcutta; National Botanic Garden, Lucknow; JNTBGRI Thiruvananthapuram; MBGIPS Kozhikode.(**3** hrs)
5. Digital resources in taxonomy: Softwares, Databases, Online tools; use of TROPICOS, IPNI, Virtual herbaria, Digital flora/databases of Flora of Kerala.(**4** hrs)

**Module – III**

Plant Nomenclature(**5** hrs)

1. History of nomenclature – Polynomial and binomial systems
2. Brief outline of ICN
3. Major rules; Typification; Rule of priority; Effective and valid publication;author citation

**Module – IV**

Taxonomic review of selected families(**15** hrs)

Critical study of the following families with emphasis on identification of local members, economic importance, inter relationships and evolutionary trends: *Nymphaceae, Capparidaceae, Sterculiaceae, Rutaceae, Combretaceae, Lythraceae, Scrophulariaceae, Convolvulaceae, Bignoniaceae, Apocynaceae, Lamiaceae, Amaranthaceae, Urticaceae, Amaryllidaceae, Arecaceae, Cyperaceae*

***PRACTICAL:***

1. Identification of locally available plants belonging to the families mentioned under module - IV using local floras.
2. Familiarize local flora and study the preparation of taxonomic keys and taxon card for plants coming under the families in module IV.
3. Students must workout at least one member of the every families mentioned in module IV, and has to submit a photo album instead of record. The photo album must be based on APG system of classification and it should carry details like systematic position, GPS location, date, name and reg. no. of the student etc. Separate images clearly showing habitat, habit, inflorescence type, single flower, floral parts etc. of the plant should be represented.

***REFERENCES***


1. Heywood, V H & Moore, D M. (Eds) (1984) Current concepts in Plant Taxonomy
2. Lawrance, G H M. Taxonomy of vascular plants. Oxford & IBH
3. Sivarajan, V V. (1991) Introduction to principles of plant Taxonomy. Oxford & IBH.
4. Vasishta, P C. Taxonomy of Angiosperms. R. Chand & Co. New Delhi.
5. Singh, V & D K Jain. (1997) Taxonomy of Angiosperms. RAstogi Publications, Meerut.
6. Stace, C A. (1989). Plant Taxonomy and Biosystematics. Edward Arnold, London
7. Henry & Chandrabose.(1997) An aid to International code of Botanical Nomenclature. BSI.

**SIXTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME**
**CORE COURSE-14: Elective-3**
**GENETICS AND CROP IMPROVEMENT**
**Code: BOT 6 B 14 T (E3)**

## COURSE OUTCOMES (COs)

By the end of the course, students are expected to:

1. Understand various techniques employed for increasing crop productivity.
2. Identify diseases affecting crop plants.
3. Attain general awareness on various crop research stations of the country.

## DISTRIBUTION OF TEACHING HOURS (18 hrs/Semester = 1hr/week)

| Sl no | Subject | Theory | Practical | Total |
|---|---|---|---|---|
| 1 | Module 1 | 11 | 36 | 47 |
| 2 | Module II | 10 | | 10 |
| 3 | Module 1II | 4 | | 4 |
| 4 | Module 1V | 7 | | 7 |
| 5 | Module V | 22 | | 22 |
| **Total** | | **54** | **36** | **90** |

## QUESTION PAPER PATTERN

| Type of questions | No of questions | Total marks |
|---|---|---|
| 2 marks | 12 | Ceiling 20 |
| 5 marks | 7 | Ceiling 30 |
| 10 marks | 2 | 1x10 = 10 |
| **Total** | **21** | **60** |

## GENETICS AND CROPIMPROVEMENT

### Module -1.

Crop genetics - General account of origin, genetic variability, floral biology, breeding techniques and achievements in: Rice, Coconut, Rubber, Arecanut, Cashew and Pepper (**11** hrs)

### Module –II

1. Plant genetic resources- Definition; Classification of Plant Genetic resources. Activities– exploration, conservation, evaluation, documentationand utilization. (**2** hrs)
2. Agencies involved in plant genetic resources activities – NBPGR and IPGRI(**4** hrs)
3. International institutes for crop improvement – IRRI, ICRISAT,CIMMYT, IITA. Brief account on research activities and achievements of nationalinstitutes – IARI, CCMB, IISc, BARC,CPCRI,IISR,RRII,CTCRI,KFRI,TBGRI (**4** hrs)

**Module- III**

**1.** Methods of crop Improvement(**4** hrs)

1.Plant introduction
2.Selection - Principles, Selection of segregating populations, achievements
3. Hybridization – Interspecific hybridization; intergeneric – achievements. Genetics of back crossing, Inbreeding, Inbreeding depression, Heterosis and Heterobeltiosis

**Module - IV.**

1 Heteroploidy in crop improvement – achievements and future prospects –Significance of haploids and polyploids(**2** hrs)
2 Mutations in crop improvement – achievements and future prospects(**2** hrs)
3 Genetics of nitrogen fixation – Use of biofertilizers in crop improvement(**2** hrs)
4 Genetics of photosynthesis(**1** hr)

**Module- V.**

1. Breeding for resistance to abiotic stresses – Introduction,importance of abiotic and biotic stresses and its characteristics.(**10** hrs)

   1. Breeding for drought resistance:Genetics of drought resistance;Breeding methods and approaches; Difficulties in breeding for droughtresistance.
   2. Breeding for mineral stress resistance: Introduction, Salt affected soils, Management of salt affected soils: Salinity resistance –general account.

2. Breeding for resistance to biotic stresses. (**12** hrs)

   1. Disease resistance – History of breeding for disease resistance; Genetics of pathogenicity – Vertical and horizontal resistance; Mechanism of disease resistance; Genetics of disease resistance – Oligogenic, polygenic and cytoplasmic inheritance – Sources of disease resistance – Methods of breeding for disease resistance.
   2. Insect resistance – Introduction, Mechanism, Nature and genetics of insect resistance, Oligogenic,Polygenic and cytoplasmic resistance, sources of insect resistance,Breeding methods for insect resistance, Problems in breeding for insect resistance, Achievements, Breeding for resistance to parasitic weeds.

***PRACTICAL***

1. Visit a leading breeding station in South India and a detailed report should be included in the practical record. The record duly certified by HoD should be submitted at the time of practical examination.
2. Make illustrations on the floral biology of Rice, Cashew and *Solanum* spp.
3. Demonstration of hybridization in Rice, Cashew and *Solanum* and describe the procedure.

4. Study the variability under induced stress (salinity and moisture) of seedlings of rice and green gram and record the observations.

***REFERENCES***


1 Singh, B D. (2000) Plant Breeding: Principles and Methods. Kalyani Publishers, New Delhi.

2 Sharma, J R. (1994) Principles and Practice of Plant Breeding. Tata Mcgraw – Hill Publishing Company, New Delhi.

3 Benjamin Levin. (2007) Genes VIII.

4 Allard, R W. (1960) Principles of Plant Breeding. John Wiely & Sons, New York.

5 Chahal, G S & S S Gosal, (1994) Principles and procedures of Plant Breeding. Narosa Publishing House, New Delhi.

6 Chrispeels M J and Sadava, D E. (1994) Plants, Genes and Agriculture. Jones and Bartlet Publishers, Boston, USA.

# OPEN COURSES

**FIFTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME**
**OPEN COURSE - Choice -1: GENERAL BOTANY**
**Code: BOT 5 D 01**

## COURSE OUTCOMES (COs)

By the end of the course, students are expected to:

1. Have a general awareness on various branches of plant science
2. Develop environmental concern in all their activities.
3. Realize the importance of plants in everyday life.

## DISTRIBUTION OF TEACHING HOURS (18 hrs/Semester = 1hr/week)

| Sl no | Subject | Total |
|---|---|---|
| 1 | Module 1 | 4 |
| 2 | Module 2 | 6 |
| 3 | Module 3 | 6 |
| 4 | Module 4 | 12 |
| 5 | Module 5 | 7 |
| 6 | Module 6 | 7 |
| 7 | Module 7 | 12 |
| **Total** | | **54** |

## QUESTION PAPER PATTERN

| Type of questions | No of questions | Total |
|---|---|---|
| 2 marks | 12 | Ceiling 20 |
| 5 marks | 7 | Ceiling 30 |
| 10 marks | 2 | 1x10 = 10 |
| **Total** | | **60** |

**Module -1: Living World**

Living and Non Living: Plants and Animals; Classification of plants: Eichler's system, general characters of each group with one example. An introduction to the Life cycle of plants.

**Module - 2: Morphology of Angiosperms**

Typical angiosperm plant: Functions of each organ viz. Root, Stem, leaves, inflorescence, flowers, fruit and seed. Flower: Basic structure - essential and non essential parts, symmetry. Pollination, seed dispersal of fruits and seeds.

**Module - 3: Anatomy**

Definition, general structure, Cell division- mitosis and meiosis, significance, cell cycle. Tissues: simple , compound; structure and functions; Structure and functions of root, stem and leaves.

Monocot and Dicot stem- general features; Secondary thickening. Annual rings, heart wood and sap wood.

**Module- 4: Plant Physiology**

General account on methods of absorption of water and nutrients; Osmosis, Diffusion, Imbibition.Transport of water and nutrients; transpiration and its significance. Mineral nutrients: macro and micro; deficiency symptoms Symbiotic nitrogen fixation and its significance. Photosynthesis- Light and Dark reactions-brief description, Respiration and Growth Hormones.

**Module - 5: Genetics**

Heredity, variation; Mendelian experiments and principles.Exceptions of Mendelism, Structure and significance of DNA; Mutation. DNA: as the Genetic Material; Blood groupism in man; Sex determination in man.

**Module - 6: Plant Biotechnology**

Tissue culture - Principle and procedure; Transgenic plants: Scope and applications, BT Cotton, BT Brinjal, Golden Rice; Bioreactors and their significance.

**Module - 7 Environmental Science**

Ecosystem: Structure - Abiotic and Biotic Factors, Ecosystem, Types of plant interactions; Mutualism, Commensalism, Predation, Symbiosis, Parasitism, Competition. Biodiversity, Conservation, *In situ* and *Ex situ* methods, National Parks, Sanctuaries, IUCN, Threat Categories, Red list. Green House Effect, Ozone depletion, Deforestation and Reforestation, Alternative energy resources, Sustainable development and Utilization of resources.

***REFERENCES***


1. Pandey B.P. Plant Anatomy, S. Chand & Co. Delhi.
2. Tayal M.S Plant Anatomy. Rastogi Publishers, Meerut.
3. Vasishta P.C. (1974) Plant Anatomy, Pradeep Publication, Jalandhar
4. Gangulee, H.C., J.S. Das & C. Dutta. (1982) College Botany ($5^{th}$ Ed.) NewCentral Book Agency, Calcutta.
5. Gupta, P.K. Text Book of Genetics. Rastogi Publications, Meerut.
6. Verma, P.S. & Agarwal (1999) Text book of Genetics. S. Chand & Co., NewDelhi
7. John Ringo (2004) Fundamental Genetics Cambridge University Press
8. Chawla HS (2000) Introduction to Plant Biotechnology
9. Das,H.K.(Ed) (2005). TextbookofBiotechnology(2nded)WileyIndia(Pvt.),Ltd. New Delhi.
10. Dubey RC Introduction to Plant Biotechnology; S Chand & Co
11. Gupta, P.K. (1996) Elementary Biotechnology. Rastogi & Company, Meerut.
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14. Ahluvalia V.K. Malhotra S. (2009). Environmental Science. Ane Books – New Delhi.
15. Ambasht R.S. (1988)A text book of Plant Ecology. Students Friends Co.Varanasi.

16. Dash M.C. (1993) Fundamentals of Ecology. Tata McGraw Hill Publishing Company Ltd. New Delhi.
17. Kumar H.D. (1977) Modern Concepts of Ecology. Vikas Publications. New Delhi.

**FIFTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME**
**OPEN COURSE - Choice - 2: APPLIED BOTANY**
**Code: BOT5D02**

## COURSE OUTCOMES (COs)

By the end of the course, students are expected to:

1. Develop general awareness on applied aspects of Plant science.
2. Realize the role of plants in everyday life.
3. Apply vegetative propagation methods in everyday life.
4. Realize the economic importance of plants

## DISTRIBUTION OF TEACHING HOURS (18 hrs/Semester = 1hr/week)

| Sl no | Subject | Total |
|---|---|---|
| 1 | Module –I Plant Propagation | 12 |
| 2 | Module – II Steps of growing plants | 12 |
| 3 | Module – III. Botany in Everyday life | 24 |
| 4 | Module – IV. Economic Botany | 6 |
| **Total** | | **54** |

## QUESTION PAPER PATTERN

| Type of questions | No of questions | Total |
|---|---|---|
| 2 marks | 12 | Ceiling 20 |
| 5 marks | 7 | Ceiling 30 |
| 10 marks | 2 | 1x10 = 10 |
| **Total** | | **60** |

### Module –I Plant Propagation

1. Seed propagation – Seed dormancy, seed treatment, conditions for successful propagation, rising of seed beds, care of seedling, transplanting techniques.
2. Vegetative propagation:
   (a) Cutting (stem, roots)
   (b) Grafting (approach, cleft)
   (c) Budding (T-budding, patch)
   (d) Layering (simple, air)
3. Micro propagation - General account

### Module – II Steps of Growing Plants

1. Soil- Composition, Types, Texture, Soil pH, Correcting pH, Humus
2. Pots & Potting – Earthen, Fibre, Polythene bags, Potting mixture, Potting, Depotting, Repotting.
3. Chemical fertilizers: types, application, merits and demerits
4. Organic manure; types, application, merits and demerits

5. Need of water: Irrigation – Surface, spray, drip irrigation, sprinklers.
6. Plant protection: Biological, Physical and mechanical, Chemical, biopestcide

**Module – III.Botany in Everyday life**

1. Vegetable gardening
2. Mushroom cultivation
3. Vermi composting- technique
4. Biofertlizer Technology
5. Orchid and Anthurium cultivation
6. Creating Bonsai

**Module – IV. Economic Botany**

1. General account on various plants of economic importance
2. Study the Binomial, Family, Morphology of the useful part of the following plants.
   Cereals and Millets – Rice, Wheat
   Pulses -Greengram, Bengalgram, Blackgram
   Beverages – Coffee, Tea, Cocoa.
   Fibre – Coir, Cotton
   Timber – Teak, Rose wood, Jack
   Spices – Pepper, Ginger, Cardamom
   Medicinal – Adhatoda, Phyllanthus, Rauvolfia
   Oil- coconut, Gingelly
   Ornamental pants of economic importance – Rose, jasmine
   Fruit – Mango, Banana

***REFERENCES***


1. Nishi Sinha: Gardening in India, Abhinav Publications, New Delhi.
2. Andiance and Brison. 1971. Propagation Horticultural Plants.
3. Rekha Sarin. The Art of Flower Arrangement, UBS Publishers, New Delhi.
4. Katyal, S.C., Vegetable growing in India, Oxford, New York.
5. Naik, K.C., South Indian Fruits and their Culture.
6. Chanda, K.L. and Choudhury, B. Ornamental Horticulture in India.
7. Premchand, Agriculture and Forest Pest and their Management,OxfordPublication.
8. George Acquaah, Horticulture: Principles and Practices. Pearson Education,Delhi.
9. Prasad, S., and U. Kumar. Green house Management for Horticultural Crops,Agrobios, Jodhpur.
10. Kumar, U.: Methods in Plant Tissue Culture. Agrobios (India), Jodhpur.
11. Kolay, A.K. Basic Concepts of Soil Science. New Age International Publishers,Delhi.
12. Bal, J.S., Fruit growing, Kalyani Publishers, Delhi.
13. Rodgran, M.K. Plant Tissue Culture, Oxford & IBH Publishing Ltd., NewDelhi.

14. Nesamony, Oushadha Sasyangal (Medicinal plants), State Institute ofLanguage, Kerala, Trivandrum.
15. PrakashR., Raj MohanK, Jaivakrishi (Organic farming), State Institute ofLanguages, Trivandrum.
16. Hudson, T. Hartmann, Dale K. Kester, Fred T. Davies, Robert L. Geneve, PlantPropagation, Principles and Practices.

**FIFTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME**
**OPEN COURSE- Choice -3:**
**BASIC TISSUE CULTURE**
**Code: BOT 5 D 03**

## COURSE OUTCOMES (COs)

By the end of the course, students are expected to:

1. Understand plant tissue culture as a rapid propagation method.
2. Explain the steps involved in tissue culture.
3. Realize the applications of plant tissue culture

## DISTRIBUTION OF TEACHING HOURS (18 hrs/Semester = 1hr/week)

| Sl no | Subject | Total |
|---|---|---|
| 1 | Module 1 | 7 |
| 2 | Module 2 | 12 |
| 3 | Module 3 | 9 |
| 4 | Module 4 | 18 |
| 5 | Module 5 | 8 |
| **Total** | | **54** |

## QUESTION PAPER PATTERN

| Type of questions | No of questions | Total |
|---|---|---|
| 2 marks | 12 | Ceiling 20 |
| 5 marks | 7 | Ceiling 30 |
| 10 marks | 2 | 1x10 = 10 |
| **Total** | | **60** |

**Module - I .**

1. Introduction; Aims and objectives of Plant Tissue Culture.
2. Organization and facilities of a Tissue culture Laboratory.
3. Equipment and apparatus in a tissue culture lab.
4. Sterilization techniques – Autoclaving Flame sterilization, UV irradiation, Chemical sterilization. Sterilization of instruments and glass wares, medium, explants

**Module-II**

1. Plant tissue culture – Principles and techniques: Cellular totipotency, *in vitro* differentiation – de differentiation and re-differentiation.
2. Tissue culture medium – Basic components in tissue culture medium – Solid and liquid medium– suspension culture. Murashige and Skoog medium– composition and preparation.
3. Aseptic techniques in tissue culture - preparation of explants – surface sterilization.

Inoculation, incubation and subculturing.

**Module-III**

1. Micropropagation - Different methods – axillary bud proliferation, direct and indirect organogenesis and somatic embryogenesis.
2. Different phases of micropropagation – hardening, transplantation and field Evaluation: Advantages and disadvantages of micro propagation.
3. Somaclonal variation.

**Module – IV**

1. Applications of plant tissue culture: Micropropagation; Somaticembryogenesis; Artificial seeds, Germplasm conservation, Embryo rescue culture, Protoplast isolation, culture and fusion, Anther, pollen and Ovary culture for production of haploids, Cryopreservation. Shoot apical meristem culture and production of pathogen free stocks and somaclonal variation.

**Module –V**

1. Transformation technology – Transgenic plant production, Gene transfermethods in plants, Multiple gene transfers, Vector less or direct genetransfer techniques.

***REFERENCES***


1. Dixon, R.A. & R.A. Gonzales. 1994. Plant Cell Culture – A Practical Approach ($2^{ndEd}$) Oxford University Press.
2. Mantel & Smith (1983) Plant Biotechnology. Cambridge University Press
3. Mantel, S. H, Mathew, J.A. et al. 1985. An introduction to Genetic Engineering in plants. Blackwell Scientific Publishers, London.
4. Gupta, P.K. 1996. Elementary Biotechnology. Rastogi & Company, Meerut.
5. Hammond, J., Megary, P et al. 2000. Plant Biotechnology. Springerverlag.
6. Gamborg, O.L. & G.C. Philips (Eds.) 1995. Plant Cell, Tissue and Organ Culture Fundamental Methods. Narosa Pulishing House, New Delhi.
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