

**B.Sc. BOTANY: Semester III**  
**Theory: Discipline Specific Core Course (DSCC)**  
**Title of the Course and Code:**

**BOT-A-3.1: PLANT ANATOMY AND DEVELOPMENT BIOLOGY**

Course No.	Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/ Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
<b>BOT-A-3.1</b>	DSCC	Theory	04	04	56 hrs	2hrs	40	60	100

**Course Outcome:**

On completion of this course, the students will develop the following skills:

1. Observation of variations that exist in internal structure of various parts of a plant and among different plant groups in support of the evolutionary concept.
2. Skill development for the proper description of internal structure using botanical terms, their identification and further classification.
3. Induction of the enthusiasm on internal structure of locally available plants.
4. Understanding various levels of organization in a plant body with an outlook in the relationship between the structure and function through comparative studies.
5. Observation and classification of the floral variations from the premises of college and house.
6. Understanding the various reproductive methods sub-stages in the life cycle of plants
7. Observation and classification of the embryological variations in angiosperms.
8. Enthusiasm to understand evolution based on the variations in reproduction among plants

**PLANT ANATOMY**

**Unit 1: Plant Cells, Tissues and Tissue systems**

**14 Hrs**

Introduction, objectives and scope of Plant Anatomy; General structure of plant cells - structure of plant cell wall.

**Tissue and tissue systems** - Definitions, structure and functions of Meristematic tissues and permanent tissues (Simple and Complex). A brief account of plant secretory tissues/cells. Concept of tissue systems - Ground tissues, Dermal tissues and Vascular tissues.

**Classification of meristems:** Based on location (apical, intercalary and lateral), Origin (promeristem, primary and secondary meristem) and function (protoderm, procambium and ground meristem).

**Apical meristems:** Generalised structure of shoot apex, theories on organization of Shoot Apical Meristem (SAM) - Apical cell theory, Tunica-Corpus theory and Histogen theory. Generalised structure of root apex, theories on organisation of Root Apical Meristem (RAM) – Apical Cell Theory, Histogen theory, Quiescent centre theory and Korper – Kappe theory.

**Unit II: Primary and Secondary anatomy of Angiosperms**

**14 Hrs**

**Primary anatomy of root:** Dicot (Tridax/Sunflower), monocot (Maize).

**Primary anatomy of stem:** Dicot (Tridax/Sunflower), Monocot (Maize), Nodal anatomy.

**Anatomy of leaf:** Dicot (Tridax/Sunflower), Monocot (Maize). Types of trichomes and stomata.

**Secondary Growth:** Normal Secondary growth in stem and root (Tridax/Sunflower). Anomalous secondary growth in *Aristolochia* and *Boerhaavia* (dicot stem), *Dracaena* (monocot stem).

Applications of anatomy in Plant systematics, forensics and Pharmacognosy.

## DEVELOPMENT BIOLOGY

### Unit III: Differentiation and Morphogenesis in Plants

14 Hrs.

Introduction to the concepts of differentiation and morphogenesis (definitions and significance in plant growth and development process). Concept of totipotency and de-differentiation.

Differentiation and cell polarity in acellular (*Dictyostelium*), Unicellular (*Acetabularia*) and multicellular plant system (*Arabidopsis*).

**Shoot Apical meristem (SAM):** Origin, structure and function, Cytohistological zonation and Ultrastructure of meristems.

**Organogenesis:** Differentiation of root, stem, leaf and axillary buds; bud dormancy

**Leaf development:** Mechanism of leaf primordium initiation, development and Phyllotaxis, Diversity in size, shape and arrangement of leaves

**Structure and function of root apical meristem (RAM):** Root cap, quiescent centre and origin of lateral roots.

**Flower development:** Overview of flower initiation and development, Genetic control of flower development - ABC model of flower development. Senescence in plants – a general account.

### Unit IV: Reproductive Biology

14 Hrs.

Introduction, Scope and contributions of Indian embryologists: P. Maheshwari, B G L Swamy

**Microsporangium:** Development and structure of mature anther; Anther wall layers; Tapetum -types, structure and functions; sporogenous tissue.

**Microsporogenesis** - Microspore mother cells, microspore tetrads and its types; Pollinia.

**Microgametogenesis** – Formation of vegetative and generative cells, structure of male gametophyte. Pollen embryosac (Nemec phenomenon).

**Megasporangium** – Structure of typical Angiosperm ovule. Types of ovules- Anatropous, Orthotropous, Amphitropous, Campylotropous, Circinotropous. **Megagametogenesis** –Female gametophyte embryosac- monosporic - *Polygonum* type, bisporic – *Allium* type, tetrasporic - *Fritillaria* type. Structure of mature embryosac.

**Pollination and fertilization:** Structural and functional aspects of pollen, stigma and style. Post pollination events; Current aspects of fertilization; Significance of double fertilization, Post fertilization changes.

**Endosperm** – Types and its biological importance. Free nuclear (*Cocos nucifera*), cellular (*Cucumis*), helobial types. Ruminant endosperm.

**Embryogenesis** : Structure Dicot and Monocot seed, Dicot (*Capsella bursa-pastoris*) and Monocot (*Najas*) embryo development.

**B.Sc. BOTANY: Semester III**  
**Practical: Discipline Specific Core Course (DSCC)**  
**Title of the Course and Code:**  
**BOT-A-3.2: PLANT ANATOMY AND DEVELOPMENT BIOLOGY**

Course No.	Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/ Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
<b>BOT-A-3.2</b>	DSCC	Practical	02	04	56 hrs	3hrs	25	25	50

**LIST OF EXPERIMENTS**

**LIST OF EXPERIMENT TO BE CONDUCTED**

**Practical No.1**

- i) Study of meristem (Permanent slides/ Photographs).
- ii) Study of Simple Tissues: Parenchyma, Collenchyma and Sclerenchyma

**Practical No.2**

Complex Tissues - xylem and phloem; Maceration technique to study elements of xylem and phloem

**Practical No.3**

Study of primary structure of dicot and monocot stem

**Practical No.4**

Study of primary structure of dicot and monocot root and leaf

**Practical No. 5**

Study of Normal secondary growth structure in dicot stem and root (Sunflower) and Anomalous secondary growth: *Aristolochia*, *Boerhaavia* (dicot stem) *Dracaena* (monocot stem)

**Practical No. 6**

Study of trichomes (any three types) and stomata (any three types) with the help of locally available plant materials

**Practical No. 7**

Permanent slides of Microsporogenesis and male gametophyte Mounting of Pollen grains of Grass and *Hibiscus* and Pollinia of *Calotropis*

**Practical No. 8**

Pollen germination (hanging drop method) and Effect of Boron and Calcium on pollen germination

### **Practical No. 9**

Permanent slides of types of ovules, Megasporogenesis and embryosac development.

### **Practical No. 10**

Types of placentation: Axile, Marginal and Parietal types. Sectioning of ovary, for the studied types of placentation

### **Practical No. 11**

Mounting of embryo: Any locally available seeds. Tridax and Cyamopsis, Mounting of endosperm: *Cucumis*

### **Practical No. 12**

Histochemical localization of proteins/ carbohydrates

### **Practical No. 13 and 14**

Mini project work in groups of 3-5 students, from the following list. This is to be recorded in the practical record book.

- a) Study of pollen morphology of different flowers with respect to shape, colour, aperture etc.
- b) Pollen germination of different pollen grains and calculating percentage of germination.
- c) Calculating percentage of germination of one particular type of pollen grain collected from different localities/ under different conditions.
- d) Study of placentation of different flowers.
- e) Any other relevant study related to Anatomy / Embryology.

### **Text Books for Reference:**

1. Bhojwani and Bhatnagar, Introduction to Embryology of Angiosperms –Oxford & IBH, Delhi
2. Bhojwani Sant Saran, 2014.Current Trends in the Embryology of Angiosperms, Woong-Young Soh, Springer Netherlands,
3. Coutler E. G. , 1969. Plant Anatomy – Part I Cells and Tissues – Edward Arnold, London.
4. Dickison, W.C. (2000). Integrative Plant Anatomy, Harcourt Academic Press, USA
5. Eames A. J. - Morphology of Angiosperms - Mc Graw Hill, New York.
6. Esau, K. 1990. Plant Anatomy, Wiley Eastern Pvt Ltd New Delhi
7. Evert, R.F. (2006) Esau's Plant Anatomy: Meristem, Cells, and Tissues of the Plant Body: Their Structure, Function and Development. John Wiley and Sons, Inc
8. Fahn, A.1992. Plant Anatomy, Pergamon Press, USA
9. Johri, B.M. I., 1984.Embryology of Angiosperms, Springer-Verlag, Netherlands.
10. Karp G., 1985. Cell Biology; Mc.Graw Hill Company
11. Maheshwari,P 1950. An introduction to the embryology of angiosperms. New York: McGraw-Hill
12. Mauseth, J.D. (1988). Plant Anatomy, the Benjammin/Cummings Publisher, USA.
13. Nair P .K .K - Pollen Morphology of Angiosperms - Scholar Publishing House, Lucknow
14. Pandey S.N. 1997, Plant Anatomy and Embryology .A. Chadha, Vikas Publication House Pvt Ltd;
15. Pandey, B. P., 1997. Plant Anatomy, S.Chand and Co. New Delhi
16. Raghavan, V., 2000. Developmental Biology of Flowering plants, Springer, Netherlands.
17. Saxena M. R. – Palynology – A treatise - Oxford & I. B .H., New Delhi.

18. Shivanna, K.R., 2003. Pollen Biology and Biotechnology. Oxford and IBH Publishing Co. Pvt.Ltd. Delhi.
19. Vashishta .P.C .,1984. Plant Anatomy – Pradeep Publications – Jalandhar
20. Vashishta, P.C. 1997. Plant Anatomy, Pradeep Publications
21. T Pullaiah, K C Naidu and K Lakhminarayana, 2017. Plant Development. Daya Publishing House, New Delhi.

Online Resources : [https://onlinecourses.nptel.ac.in/noc19\\_bt17/preview](https://onlinecourses.nptel.ac.in/noc19_bt17/preview)

B.Sc. BOTANY –Semester III  
**Open Elective Course (OEC - 3)**  
**(OEC for other students)**  
**Paper: Community Forestry**  
**Code: OEC-3.1**

Course No.	Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures / Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
OEC-3.1	OEC	Theory	03	03	42 hrs	2 hrs	40	60	100

Learning outcomes:

After completion of the course, the students will be able to;

- Understand community forestry and its conservation
- Examine the use of trees and community forestry
- Interpret the role of indigenous / tribal people in conservation of forest
- Examine the role of various community forestry conservation programs
- Measure the different properties of trees such as wood volume, age, height etc.

**Unit I**

**14 lectures**

Community forestry - Definition, Indigenous community based forestry systems, Case studies of indigenous forest management systems in India, History of commercial forestry in India, Diseases of commercial forestry, maintenance of forests, Protection from fire, illicit felling, Measurement of Trees- Height, girth, wood density, wood quality, clear and selective felling.

**Unit II**

**14 lectures**

Role of community forestry in Environmental conservation, Water shed management, soil management and poverty reduction, Trees as a forest management tool, managing vegetation to modify climate, soil conditions & ecological processes. Social considerations on land-uses.

**Unit III**

**14 lectures**

State-sponsored community forestry and conservation programs, Changing paradigms in forestry and environmental conservation, Community-managed commercial timber harvesting. Community based forestry and collaborative conservation in India. Factors contributing to the rise of community forestry, Role of tribes in forest management.

**Suggested Reading**

1. Agrawal, A and C.C. Gibson. (2001). Introduction: The Role of Community in Natural Resource Conservation. In: Agrawal, A and C. C. Gibson (eds).Communities and the Environment. NJ: Rutgers University Press

2. Mosse, D.(2001).‘People's knowledge’, participation and patronage: operations and representations in rural development. In: Cook, B & Kothari, U (eds), Participation the newtyranny? Zed Press
3. Ong, C.K. & Huxley, P.K. (1996). Tree Crop Interactions–A Physiological Approach. ICRAF.
4. Robinson, D. (2018). The Economic Theory of Community Forestry (Routledge Explorations in Environmental Economics) Routledge.
5. Sagreiya, K.P. (1979). Forests and Forestry. National Book Trust, India, New Delhi, P1-307.

**B.Sc. BOTANY –Semester III**  
**Open Elective Course (OEC - 3)**  
**(OEC for other students)**  
**Paper: Algal Cultivation and Applications**  
**Code: OEC-3.2**

Course No.	Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures / Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
OEC-3.2	OEC	Theory	03	03	42 hrs	2 hrs	40	60	100

**Learning outcomes:**

On completion of this course, the students will be able to;

- Understand core concepts and fundamentals of various levels of algal growth
- Translate various algal technologies for benefit of ecosystem
- Demonstrate algal growth in different types of natural water.
- Analyze emerging areas of Algal Biotechnology for identifying commercial potentials of algal products & their uses.

**Unit I**

**14 lectures**

A brief account of culture techniques and media for algal research. Measurement of algal growth: lag phase, log phase, stationary phase and death phase using biomass, chlorophyll content. Limits to algal growth in natural waters. Dynamics and consequences of marine & freshwater algal blooms; Causative factors for eutrophication and its impact on algal blooms.

**Unit II**

**14 lectures**

Algal immobilization: methods and applications, Algal technologies for the restoration/maintenance of soil fertility; reclamation of usar soils. Restoration of degraded aquatic systems through algae; High rate algal ponds for the treatment of wastewaters for the production of useful biomass & fuels.

**Unit III**

**14 lectures**

Emerging areas of Algal Biotechnology: Single cell proteins, bio-fertilizers, Algae as food, medicine, feed, Biofuel, industrial products such as phyco-colloid Agar-agar, Algin, Carrageenan, Diatomite); A brief account of commercial potentials of algal products & their uses. Algae as indicators of pollution. Biofouling, Sewage disposal. Waste-land reclamation. Use of Algae in experimental studies. Algae in space. Algal toxins.



## Suggested Readings

1. Hoek, C. and Van D. (2009) *Algae: An Introduction to Phycology*. Cambridge University Press
2. Bast, F. (2014). An Illustrated Review on Cultivation and Life History of Agronomically Important Seaplants. In *Seaweed: Mineral Composition, Nutritional and Antioxidant Benefits and Agricultural Uses*, Eds. Vitor Hugo Pomin, 39-70. Nova Publishers, New York ISBN:978-1-63117-571-8
3. Kumar, H.D.(1999). *Introductory Phycology*. Affiliated East-West Press, Delhi
4. Sahoo, D. (2000). *Farming the ocean: seaweeds cultivation and utilization*. Aravali International, New Delhi.
5. Bast, F. (2014). Seaweeds: Ancestors of land plants with rich diversity. *Resonance*,19 (2)1032-1043/ISSN:0971-8044

B.Sc. BOTANY – Semester III  
**Open Elective Course (OEC - 3)**  
**(OEC for other students)**  
**Paper: Landscaping and Gardening**  
**Code: OEC-3.3**

Course No.	Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures / Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
OEC -3.3	OEC	Theory	03	03	42 hrs	2 hrs	40	60	100

**Learning outcomes:**

After the completion of this course the learner will be able to:

- Apply the basic principles and components of gardening
- Conceptualize flower arrangement and bio-aesthetic planning
- Design various types of gardens according to the culture and art of bonsai
- Distinguish between formal, informal and free style gardens
- Establish and maintain special types of gardens for outdoor and indoor landscaping

**Unit I**

**14 lectures**

Principles of gardening, garden components, adornments, lawn making, methods of designing rockery, water garden. Special types of gardens, their walk-paths, bridges, constructed features; their design, values in land scaping. planting trees, shrubs and herbaceous perennials. climbers and creepers, palms, ferns, grasses and succulents. Green house.

**Unit II**

**14 lectures**

Flower gardens: importance, production details and cultural operations, constraints, post-harvest practices. Bio-aesthetic planning, definition, need, round country planning, urban planning and planting avenues in schools, villages, railway stations, dam sites, hydroelectric stations, colonies, river banks, play grounds.

**Unit III**

**14 lectures**

Land scape designs, Urban land scaping, Land scaping for specific situations - institutions, industries, residents, hospitals, road sides, traffic islands, dam sites, IT parks, corporate; establishment and maintenance. Styles of garden - formal, informal and freestyle gardens. Types of gardens - vertical gardens, roof gardens, parks and public gardens, indoor gardening, therapeutic gardening. Culture of bonsai, art of making bonsai, non-plant components, water-scaping, xeri-scaping, hardscaping; Computer Aided Designing (CAD) for outdoor and indoor scaping, exposure to CAD (Computer Aided Designing). Eco-tourism.

## **Suggested Readings**

1. Berry, F. and Kress, J. (1991). *Heliconia: An Identification Guide*. Smithsonian Books
2. Butts, E. and Stensson, K. (2012). *Sheridan Nurseries: One hundred years of People, Plans, and Plants*. Dundurn Group Ltd.
3. Russell, T.(2012). *Nature Guide: Trees: The world in your hands* (Nature Guides).

**B.Sc. BOTANY: Semester IV**  
**Theory: Discipline Specific Core Course (DSCC)**  
**Title of the Course and Code:**  
**BOT-A-4.1: Ecology and Conservation Biology**

Course No.	Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/ Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
<b>BOT-A-4.1</b>	DSCC	Theory	04	04	56 hrs	2hrs	40	60	100

**Course outcome:**

1. A basic course to understand ecosystem functioning
2. Chapters on autecology, community ecology and population ecology can be of use in higher studies
3. Chapters on global warming and pollution of various kinds are very relevant and helps to appreciate these problems
4. It gives an exhaustive idea about biodiversity at different levels and groups of plants
5. A detailed account on endemism and the various uses of biodiversity further emphasises the importance of biodiversity
6. Also, there is a detailed study on the use of remote sensing in monitoring various aspects of diversity
7. With the tremendous human impact on biodiversity the course becomes very relevant

<b>Contents of Theory Course</b>		
<b>Unit 1</b>	<b>Topics</b>	<b>Teaching Hours</b>
I	<p><b>Introduction to Ecology and Conservation Biology:</b> Definitions, Principles of Ecology, Brief History, Major Indian Contributions, Scope and importance. Ecological levels of organisation.</p> <p><b>Ecological factors:</b> Climatic factors: light, temperature, precipitation and humidity.</p> <p><b>Edaphic factors:</b> Soil and its types, soil texture, soil profile, soil formation; physico-chemical properties of soil - mineral particle, soil pH, soil aeration, organic matter, soil humus and soil microorganisms. Topographic Factors: Altitude</p> <p><b>Ecological groups of plants and their adaptations:</b> Morphological and anatomical adaptations of hydrophytes, xerophytes, epiphytes and halophytes mesophytes</p>	14 hrs
II	<p><b>Ecosystem Ecology:</b> Introduction, types of ecosystems with examples -terrestrial and aquatic, natural and artificial.</p> <p>Structure of ecosystem: Biotic and Abiotic components, detailed structure of a pond ecosystem.</p> <p>Ecosystem functions and processes: Food chain-grazing and detritus; Food web. Ecological pyramids -Pyramids of energy, biomass and number. Principles of Energy flow in ecosystem.</p>	14 hrs

	<p>Bio-geo chemical cycles: Gaseous cycles -carbon and nitrogen, Sedimentary cycle-Phosphorus.</p> <p>Ecological succession: Definition, types- primary and secondary. General stages of succession. Hydrosere and xerosere.</p> <p><b>Community Ecology:</b> Community and its characteristics – frequency, density, Abundance, cover and basal area, phenology, stratifications, life-forms. Concept of Ecotone and Ecotypes.</p> <p>Intra-specific and Inter-specific interactions with examples.</p> <p><b>Ecological methods and techniques:</b> Methods of sampling plant communities – transects and quadrates. Remote sensing as a tool for vegetation analysis, land use – land cover mapping.</p> <p><b>Population Ecology:</b> Population and its characteristics – Population density, natality, mortality, age distribution, population growth curves and dispersal.</p>	
III	<p><b>Phytogeography and Environmental issues:</b></p> <p>Theory of land bridge, theory of continental drift, polar oscillations and glaciations. Centre of origin of plant-Vavilov’s concept, types. Phytogeographical regions - concept, phytogeographical regions of India.</p> <p>Vegetation types of Karnataka – Composition and distribution of evergreen, semi-evergreen, deciduous, scrub, mangroves, shola forests and grasslands. An account of the vegetation of the Western Ghats.</p> <p>Pollution: Water pollution: Causes, effect, types; water quality indicators, water quality standards in India, control of water pollution; Waste water treatment.</p> <p>Water pollution disasters – National mission on clean Ganga, Minamata, Pacific gyre garbage patch, Exxon valdez oil spill.</p> <p>Air pollution: Causes, effect, air quality standards, control; acid rain, global warming, ozone depletion</p> <p>Soil pollution: Causes, effect, solid waste management, control measures of soil pollution.</p>	14hrs
IV	<p><b>Biodiversity and its conservation:</b></p> <p>Biodiversity: Definition, types of biodiversity - habitat diversity, species diversity and genetic diversity, Global and Indian species diversity. Sustainable development goals in biodiversity conservation.</p> <p>Values of Biodiversity – Economic and aesthetic value, Medicinal and timber yielding plants. NTFP.</p> <p>Concept of Biodiversity Hotspots, Biodiversity hot spots of India.</p> <p>Concept of endemism and endemic species.</p> <p>IUCN plant categories with special reference to Karnataka/ Western Ghats, Red data Book</p> <p>Biodiversity Conservation- Indian forest conservation act, Biodiversity bill (2002).</p> <p>Threats to biodiversity. Conservation methods</p> <p><i>In-situ</i> methods –Biosphere reserves, National parks, Sanctuaries, Sacred grooves.</p> <p><i>Ex-situ</i> methods-Botanical gardens, Seed bank, Gene banks, Pollen banks, Culture collections, Cryopreservation.</p>	14 hrs
<b>Total</b>		<b>56 Hours</b>

### **SUGGESTED REFERENCE BOOKS:**

1. Sharma, P.D. 2018. Fundamentals of Ecology. Rastogi Publications.
2. Odum E.P. (1975): Ecology By Holt, Rinert& Winston.
3. Oosting, H.G. (1978): Plants and Ecosystem Wadworth Belmont.
4. Kochhar, P.L. (1975): Plant Ecology. (9th Edn.,) New Delhi, Bombay, Calcutta-226pp.,
5. Kumar, H.D. (1992): Modern Concepts of Ecology (7th Edn.,) Vikas Publishing Co., New Delhi.
6. Kumar H.D. (2000): Biodiversity & Sustainable Conservation. Oxford & IBH Publishing Co Ltd. New Delhi.
7. Newman, E.I. (2000): Applied Ecology, Blackwell Scientific Publisher, U.K.
8. Chapman, J.L&M.J. Reiss (1992): Ecology (Principles & Applications). Cambridge University Press, U.K.
9. Malcolm L. Hunter Jr., James P. Gibbs, Viorel D. Popescu, 2020. Fundamentals of Conservation Biology, 4th Edition. Wiley-Blackwel.
10. Saha T. K., 2017. Ecology and Environmental Biology. Books and Allied Publishers.

**B.Sc. BOTANY: Semester IV**  
**Practical: Discipline Specific Core Course (DSCC)**  
**Title of the Course and Code:**  
**BOT-A-4.2: Ecology and Conservation Biology**

Course No.	Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/ Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
<b>BOT-A-4.2</b>	DSCC	Practical	02	04	56 hrs	3hrs	25	25	50

**List of Practicals**

Practical No.	Experiments
1	Determination of pH of different types of Soils, Estimation of salinity of soil/water samples.
2	Study of Ecological instruments – Wet and Dry thermometer, Altimeter, Hygrometer, Soil thermometer, Rain Gauge, Barometer, etc
3	Determination of water holding capacity of soil samples
4	Determination of Biological oxygen demand (BOD)
5	Determination of Chemical oxygen demand (COD)
6	Determination of soil texture of different soil samples.
7	Hydrophytes: Morphological adaptations in <i>Pistia</i> , <i>Eichhornia</i> , <i>Hydrilla</i> , <i>Nymphaea</i> . Anatomical adaptations in <i>Hydrilla</i> (stem) and <i>Nymphaea</i> (petiole).
8	Xerophytes: Morphological adaptations in <i>Asparagus</i> , <i>Casuarina</i> , <i>Acacia</i> , <i>Aloe vera</i> , <i>Euphorbia tirucalli</i> . Anatomical adaptations in phylloclade of <i>Casuarina</i> .
9	Epiphytes: Morphological adaptations in <i>Acampe</i> , <i>Bulbophyllum</i> , <i>Drynaria</i> . Anatomical adaptations in epiphytic root of <i>Acampe/Vanda</i> . Halophytes: study of Vivipary in mangroves; Morphology and anatomy of Pneumatophores.
10	Study of a pond/forest ecosystem and recording the different biotic and abiotic components
11	Demonstration of different types of vegetation sampling methods – transects and quadrats. Determination of Density and frequency.
12	Application of remote sensing to vegetation analysis using satellite imageries
13 and 14	Field visits to study different types of local vegetations/ecosystems and the report to be written in practical record book.

**B.Sc. BOTANY –Semester IV**  
**Open Elective Course (OEC - 4)**  
**(OEC for other students)**  
**Paper: Plant Diversity and Human Welfare**  
**Code: OEC-4.1**

Course No.	Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures / Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
OEC - 4.1	OEC	Theory	03	03	42 hrs	2 hrs	40	60	100

**Learning outcomes:**

After the completion of this course, the learner will be able to:

- Develop understanding of the concept and scope of plant biodiversity
- Identify the causes and implications of loss of biodiversity
- Apply skills to manage plant biodiversity
- Utilize various strategies for the conservation of biodiversity
- Conceptualize the role of plants in human welfare with special reference to India

**Unit I: Plant Diversity and its Scope**

**14 lectures**

Levels of biodiversity: Genetic, Species and Ecosystem; Agro-biodiversity and cultivated plant taxa and related wild taxa. Values and uses of Biodiversity, Methodologies for valuation, Ethical and aesthetic values, Uses of plants; Ecosystem services.

**Unit II: Loss of Biodiversity and Management of Plant Biodiversity**

**14 lectures**

Loss of biodiversity-causes and implications, Hotspots of biodiversity, extinction of species, projected scenario for biodiversity loss. Organizations associated with biodiversity management, IUCN, UNEP, WWF, UNESCO, NBPGR; Biodiversity legislation; Information management and communication.

**Unit III: Conservation of Biodiversity, Role of Plants in Relation to Human Welfare**

**14 lectures**

Conservation of genetic, species and ecosystem diversity, *In situ* and *ex situ* conservation strategies, India's biodiversity and its conservation Social approaches to conservation, Biodiversity awareness programmes, Sustainable development. Importance of forestry their utilization and commercial aspects; Avenue trees; Ornamental plants of India; Alcoholic beverages; Fruits and nuts; Wood and its uses; their commercial importance, NTFP,

**Suggested Readings**

1. Krishnamurthy, K.V. (2004). An Advanced Text Book of Biodiversity-Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi.
2. Singh, J. S., Singh, S.P. and Gupta, S. (2006). Ecology Environment and Resource



Conservation. Anamaya Publications, New Delhi, India.

3. Reddy, K.V. and Veeraiah, S. (2010). Biodiversity and Plant Resources. Aavishkar publication, New Delhi.
4. Heywood, V.H. and Watson, R.T.(1995). Global biodiversity and Assessment. Cambridge University Press.

**B.Sc. BOTANY –Semester IV**  
**Open Elective Course (OEC - 4)**  
**(OEC for other students)**  
**Paper: Medicinal Plants in Health Care**  
**Code: OEC-4.2**

Course No.	Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures / Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
OEC - 4.2	OEC	Theory	03	03	42 hrs	2 hrs	40	60	100

**Learning outcomes:**

On completion of this course, the students will be able to:

- Recognize the basic medicinal plants
- Apply techniques of conservation and propagation of medicinal plants.
- Setup process of harvesting, drying and storage of medicinal herbs
- Propose new strategies to enhance growth of medicinal herbs considering the practical issues pertinent to India

**Unit I: History and Traditional System of Medicine**

**14 lectures**

History, Scope and Importance of Medicinal Plants; Traditional systems of medicine; Definition and Scope.

**Ayurveda:** History, origin, panchamahabhutas, saptadhatu and tridosha concepts, Rasayana, plants used in ayurvedic treatments,

**Siddha:** Origin of Siddha medicinal systems, Basis of Siddha system, plants used in Siddha medicine.

**Unani:** History, concept: Umoor-e-tabiya, tumors treatments / therapy, polyherbal formulations.

**Unit II: Conservation, Augmentation and Ethnobotany and Folk Medicine**

**14 lectures**

Conservation of Endemic and endangered medicinal plants, Red list criteria; *In situ* conservation: Biosphere reserves, sacred groves, National Parks; *Ex situ* conservation: Botanic Gardens, Seed bank pollenbank cryopreservation.

**Propagation of Medicinal Plants:** Objectives of the nursery, its classification, important components of a nursery, sowing, pricking, use of greenhouse for nursery production, propagation through cuttings, layering, grafting and budding.

Ethnobotany and Folk medicines. Definition; Ethnobotany in India: Methods to study ethnobotany; Applications of Ethnobotany: Folk medicines of ethnobotany, ethnomedicine, ethnoecology, ethnic communities of India.

### Unit III Medicinal Plants

14 lectures

Brief description of selected plants and derived drugs, namely Guggul (*Commiphora*) for hypercholesterolemia, *Boswellia* for inflammatory disorders, Arjuna (*Terminalia arjuna*) for cardioprotection, turmeric (*Curcuma longa*) for wound healing, antioxidant and anticancer properties, Kutaki (*Picrorhiza kurroa*) for hepatoprotection, Opium Poppy for analgesic and antitussive, Cinchona and Artemisia for Malaria, Rauwolfia as tranquilizer, Podophyllum as antitumor. *Vinca rosea* as anticancerous, *Morinda citrifolia*, *Acorus calamus*, *Ocinus sanctus*. *Tinospora cordifolia*, *Coleus amboinicus*, *Piper nigrum*

#### Suggested Readings:

1. Akerele, O., Heywood, V. and Synge, H. (1991). The Conservation of Medicinal Plants. Cambridge University Press.
2. AYUSH ([www.indianmedicine.nic.in](http://www.indianmedicine.nic.in)). About the systems—An overview of Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homeopathy. New Delhi: Department of Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homoeopathy (AYUSH), Ministry and Family Welfare, Government of India.
3. CSIR- Central Institute of Medicinal and Aromatic Plants, Lucknow (2016). *Aush Gyanya*: Handbook of Medicinal and Aromatic Plant Cultivation.
4. Dev, S. (1997). Ethno-therapeutics and modern drug development: The potential of Ayurveda. *Current Science* 73:909–928.
5. Evans, W.C. (2009). Trease and Evans Pharmacognosy, 16<sup>th</sup> edn. Philadelphia, PA: Elsevier Saunders Ltd.
6. Jain, S.K. and Jain, Vartika. (eds.) (2017). Methods and Approaches in Ethnobotany: Concepts, Practices and Prospects. Deep Publications, Delhi
7. Kapoor, L.D. (2001). Handbook of Ayurvedic medicinal plants. Boca Raton, FL: CRC Press.
8. Saroya, A.S. (2017). Ethnobotany. ICAR publication.
9. Sharma, R. (2003). Medicinal Plants of India-An Encyclopaedia. Delhi: Daya Publishing House.
10. Sharma, R. (2013) Agro Techniques of Medicinal Plants. Daya Publishing House, Delhi.
11. Thakur, R.S., H.S. Puri, and Husain, A. (1989). Major medicinal plants of India. Central Institute of Medicinal and Aromatic Plants, Lucknow, India.

**B.Sc. BOTANY –Semester IV**  
**Open Elective Course (OEC - 4)**  
**(OEC for other students)**  
**Paper: Floriculture**  
**Code: OEC-4.3**

Course No.	Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures / Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
OEC - 4.3	OEC	Theory	03	03	42 hrs	2 hrs	40	60	100

**Learning outcomes:**

After completing this course the learner will be able to;

- Develop conceptual understanding of gardening from historical perspective
- Analyze various nursery management practices with routine garden operations.
- Distinguish among the various Ornamental Plants and their cultivation
- Evaluate garden designs of different countries
- Appraise the landscaping of public and commercial places for floriculture.
- Diagnose the various diseases and pests of ornamental plants.

**Unit I**

**14 lectures**

Introduction: Importance and scope of floriculture and landscape gardening. Nursery Management and Routine Garden Operations: Sexual and vegetative methods of propagation; Soil sterilization; Seed sowing; Pricking; Planting and transplanting; Shading; Stopping or pinching; Defoliation; Wintering; Mulching; Topiary; Role of plant growth regulators.

**Unit II**

**14 lectures**

Ornamental Plants: Flowering annuals; perennials; Divine vines; Shade and ornamental trees; Ornamental bulbous and foliage plants; Cacti and succulents; Palms and Cycads; Ferns and fern allies; Cultivation of plants in pots; Indoor gardening; Bonsai. Principles of Garden Designs: English, Italian, French, Persian, Mughal and Japanese gardens; Features of a garden (Garden wall, Fencing, Steps, Hedge, Edging, Lawn, Flowerbeds, Shrubbery, Borders, Water-garden. Some Famous gardens of India.

Floriculture and green house technology. Commercial aspects and exporting of flowers and ornamental plants. Quarantine and testing requirements.

**Unit III**

**14 lectures**

Landscaping Places of Public Importance: Landscaping highways And Educational institutions. Commercial Floriculture: Factors affecting flower production; Production and packaging of cut flowers; Flower arrangements; Methods to prolong vase life; Cultivation of Important cut flowers (Carnation, Aster, Chrysanthemum, Dahlia, Gerbera, Gladiolus, Marigold, Rose, Liliun, Orchids). Diseases and Pests of Ornamental Plants.

**Suggested Readings**

1. Randhawa, G.S. and Mukhopadhyay, A. (1986).Floriculture in India. Allied Publishers.
2. Adams, C., M. Early and J. Brrok (2011). Principles of Horticulture. Routledge, U.K

**B.Sc. BOTANY: Semester III**  
**Practical: Discipline Specific Core Course (DSCC)**  
**PLANT ANATOMY AND DEVELOPMENT BIOLOGY**

**Question Paper Pattern and Scheme of evaluation**

Time: 2 hrs.

Max. Marks: 25

1. Prepare a temporary stained section of the material **A**. Sketch, label and identify. Leave the preparation for inspection. 05
2. Calculate the percentage of pollen germination/mounting of embryo or pollinia **B**. 04
3. Sketch, label and identify with reasons **C, D and E**. 09
4. Practical Record 07

Sl. No.	Question	Experiment	Marks allotment	
1	A		Prepn 02 Labelled Sk 02 Id <u>01</u> 05	Reg. No. of Candidates Assigned
2	B		Prepn 01 Procedure 01 Calculation/diagram <u>02</u> 04	Reg. No. of absentees:
3	<b>C</b> <b>D</b> <b>E</b>		Labelled Sk 01 Identification 01 Reasons <u>01</u> 03each	Total examined:  Examiners: 1.External
4		Practical Record	07	2.Internal

**Note:**

**A:** Dicot/Monocot stem or root

**B:** Pollen of Vinca/ Impatiens/ Calotropis/ embryo of mustard or any locally available seed

**C, D and E:** Permanent slide on tissue types/ placentation/ovule types/anther/ leaf anatomy

**B.Sc. BOTANY SEMESTER IV**  
**Ecology and Conservation Biology**

**Question Paper Pattern and Scheme of evaluation**

Time: 2 hrs.

Max. Marks: 25

1. Prepare a stained temporary mount of the T.S. of material **A**. Draw a neat labelled diagram. Leave the slide for inspection. 05
2. Determine the water holding capacity/ BOD/ COD/ pH/ texture/ salinity of soil/ water sample 05
3. Identify the ecological instrument **C**, Describe its working mechanism. Mention any one uses 04
4. Identify the ecological group of **D** and **E**. Comment on their ecological features/ adaptation 06
5. Practical Record with field visit report 05

Sl. No.	Question	Experiment	Marks allotment	
1	A		Prepn                    02 Labelled diagram    02 Id                         01 <hr style="width: 50px; margin-left: 100px;"/> 05	Reg. No. of Candidates Assigned  <u>Reg. No. of absentees:</u>  <u>Total examined:</u>  <u>Examiners:</u> 1.External  2.Internal
2	B		Requirements        01 Procedure            02 Setting                01 Result                 01 <hr style="width: 50px; margin-left: 100px;"/> 05	
3	C		Identification        01 Working principle    02 Use                     01 <hr style="width: 50px; margin-left: 100px;"/> 04	
	<b>D</b> <b>E</b>		Ecological group    01 Features              02 <hr style="width: 50px; margin-left: 100px;"/> 03each	
4		Practical Record } Filed visit report }	05	

**Note:**

**A:** Plant material from ecological group must be selected