

**B.Sc. BOTANY: Semester - 3**  
**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
BOT-A-3.1	DSCC	Theory	04	04	56 hrs	3hrs	40	60	100

**Course Outcomes:**

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

1. Observation of variations that exist in internal structure of various parts of a plant and as well as among different plant groups in support for 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: ANGIOSPERM ANATOMY, PLANT CELL STRUCTURE AND TISSUES**

**14 Hrs**

Introduction, objective and scope of Plant Anatomy, Plant cell structure – nature of plant cell wall.

**Tissue and tissue systems** - meristematic tissue, permanent tissue and secretory cells.

Classification of meristem: (apical, intercalary and lateral), primary and secondary meristem.

**Apical meristem:** Theories on organization of meristem (apical cell theory, Tunica-Corpus theory, histogen theory and Korper-Kappe theory), quiescent centre, Root cap.

Evolution and concept of organization of shoot apex (Apical cell theory, Histogen theory, Tunica Corpus theory continuing meristematic residue, cytohistological zonation).

**Unit II: MORPHOGENESIS AND DIFFERENTIATION**

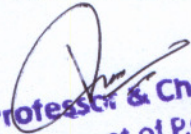
**14 Hrs.**

Morphogenesis in plants - Differentiation of root, stems and leaf.

Types of vascular bundles and Vascular cambium, Origin, development, arrangement and diversity in size and shape of leaves.

Structure of Dicot root: primary and secondary structures (Tridax/Sunflower), Structure of monocot root (Maize).

Structure of Dicot stem: Primary and secondary structures (Tridax/Sunflower), Structure of Monocot stem (Maize), Nodal anatomy.

  
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 2019-2020



Structure of Dicot leaf: primary structure (Tridax/Sunflower), primary structure of Monocot leaf (Maize), Stomatal types. Anomalous secondary growth: Aristolochia, Boerhaavia (dicot stem) Dracaena (monocot stem)

Applications in systematics; forensics and Pharmacognosy.

## DEVELOPMENT BIOLOGY

### Unit III: Morphogenesis and Differentiation

14 Hrs.

Differentiation and cell polarity in acellular (*Dictyostelium*), Unicellular (*Acetabularia*) and multicellular system (root hair and stomata formation) 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

Mechanism of leaf primordium initiation, development and Phyllotaxis (Diversity in size and shape of leaves)

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

Transition from vegetative apex into reproductive apex

Developmental patterns at flowering apex: ABC model specification of floral organs. Modification of gene action by growth hormones and cellular differences between floral organs. Senescence – a general account.

### Unit IV: Reproductive Biology

14 Hrs.

Introduction, Scope and contributions of Indian embryologists: P. Maheswari, B G L Swamy, M.S. Swaminathan.

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

**Microsporogenesis** - Microspore mother cells, microspore tetrads, Pollinia.

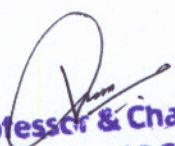
**Microgametogenesis** – Formation of vegetative and generative cells, structure of male gametophyte. Pollen embryosac (Nemec phenomenon).

**Megasporangium** – Structure of typical Angiosperm ovule. Types of ovule- Anatropous, Orthotropous, Amphitropous, Circinotropous. **Megagametogenesis** – Types of development of 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 and 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 and composition of zygote, Dicot (*Capsella bursa-pastoris*) and Monocot (*Najas*) embryo development. A general account of seed development.

  
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**B.Sc. BOTANY: Semester - 3**  
**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
BOT-A-3.2	DSCC	Practical	02	04	52 hrs	3hrs	25	25	50

**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) and Complex Tissues (xylem and phloem).

**Practical No.2**

Maceration technique to study elements of xylem and phloem, Study of primary structure of dicot root, stem and leaf (Sunflower) and monocot root, stem and leaf (Maize)

**Practical No.3**

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. 4**

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

**Practical No. 5**

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

**Practical No. 6**


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

**Practical No. 7**

Permanent slides of types of ovules, Megasporogenesis & embryo sac development and types of placentation: Axile, Marginal and Parietal types. Sectioning of ovary, for the studied types of placentation

**Practical No. 8**

Mounting of embryo: Tridax and Cyamopsis, Mounting of endosperm: Cucumis

  
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## Practical No. 09

Histochemical localization of proteins/ carbohydrates

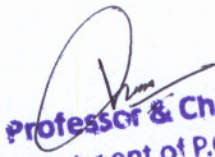
## Practical No. 10 and 11

Mini project work in groups of 3-5 students, from the following list

- a) Study of pollen morphology of different flowers with respect to shape, colour, aperture etc.
- b) Pollen germination of different pollen grains and calculates 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

  
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**B.Sc. BOTANY – III Semester**  
**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, volume etc.

**Keywords:**

Community forestry, Commercial forestry, Conservation Land uses, Timber harvesting

**Unit I**

**14 lectures**

Defining community forestry and conservation, Indigenous community-based forestry systems and their changes, Case studies of indigenous forest management systems: 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**

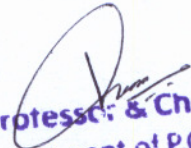
State-sponsored community forestry and conservation programs, Changing paradigms

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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 and 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.

  
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**B.Sc. BOTANY – III Semester**  
**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
OE C-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.

**Keywords:**

Culture techniques, Algal growth, Algal blooms, Eutrophication, Algal immobilization, Biofertilizers, Pollution indicators

**Unit I**

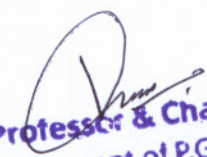
**14 lectures**

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;

**Unit II**

**14 lectures**

Causative factors for eutrophication and its impact on algal blooms. 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.

  
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### 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

  
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**B.Sc. BOTANY – III Semester**  
**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
OE C-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 land scaping

**Keywords:**

Gardening, Landscaping, Flower arrangement, Vertical gardens, Roof gardens, Computer aided designing

**Unit I**


**14 lectures**

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

**Unit II**

**14 lectures**

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

  
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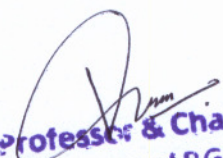
### Unit III

14 lectures

Vertical gardens, roof gardens. Culture of bonsai, art of making bonsai. Parks and public gardens. Land scape designs, Styles of garden, formal, informal and freestyle gardens, types of gardens, Urban land scaping, Land scaping for specific situations, institutions, industries, residents, hospitals, road sides, traffic islands, dam sites, IT parks, corporate. Establishment and maintenance, special types of gardens, Bio-aesthetic planning, eco-tourism, indoor gardening, therapeutic gardening, non-plant components, water-scaping, xeri-scaping, hardscaping; Computer Aided Designing (CAD) for outdoor and indoor scaping Exposure to CAD (Computer Aided Designing)

### 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).

  
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