Program Outcomes (Pos) for B. Sc. Program

PO1	**Disciplinary Knowledge:** Demonstrate comprehensive knowledge of the disciplines that form a part of a graduate programme. Execute strong theoretical and practical understanding generated from the specific graduate programme in the area of work.
PO2	**Critical Thinking and Problem solving:** Exhibit the skills of analysis, inference, interpretation and problem-solving by observing the situation closely and design the solutions.
PO3	**Social competence:** Display the understanding, behavioural skills needed for successful social adaptation , work in groups, exhibit thoughts and ideas effectively in writing and orally
PO4	**Research-related skills and Scientific temper :** Develop the working knowledge and applications of instrumentation and laboratory techniques. Able to apply skills to design and conduct independent experiments, interpret, establish hypothesis and inquisitiveness towards research.
PO5	**Trans-disciplinary knowledge:** Integrate different disciplines to uplift the domains of cognitive abilities and transcend beyond discipline-specific approaches to address a common problem
PO6	**Personal and professional competence:** Performing dependently and also collaboratively as a part of a team to meet defined objectives and carry out work across interdisciplinary fields. Execute interpersonal relationships, self-motivation and adaptability skills and commit to professional ethics.
PO7	**Effective Citizenship and Ethics:** Demonstrate empathetic social concern and equity centred national development, and ability to act with an informed awareness of moral and ethical issues and commit to professional ethics and responsibility.
PO8	**Environment and Sustainability:** Understand the impact of the scientific solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.
PO9	**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.

Class	**:**	**S. Y. B. Sc. (Semester - IV)**		
Course Code	**:**	**USBT 241**		
Paper	**:**	**I**	**Course Title**	**: Plant Anatomy and Embryology**
Credit	**:**	**3**	**No. of lectures**	**: 48**

A) Learning Objectives:

1. To introduce students with internal structure of plant and its organs.
2. To study developmental aspects of male gamete, female gamete, fertilization and embryodevelopment.
3. To study different tissues present in plant.

B) Course Outcome:

By the end of the course, students will be able to:

CO1. Students get knowledge of internal structure o f tissue system in plant.
CO2. Students are aware about microsporogenesis, megasporogenesis and embryogenesis.
CO3. Students get knowledge of tissue and tissue systems present in plant.
CO4. Students get knowledge of secondary growth in plants.
CO5. Students are able to know reasons for anomalous secondary growth in plants.
CO6. Students get knowledge of wood anatomy.
CO7. Students get knowledge of endosperm and seed.

Credit – I **(14L)**

1. Plant anatomy introduction **(2L)**

Definition, scope of plant anatomy and types of tissues

2. Epidermal tissue system **(4L)**

Structure and function of epidermal tissue system, uniseriate and multiseriate epidermis, stomata: structure, types and functions, epidermal outgrowth: glandular and non-glandular trichomes.

3. Mechanical tissue system **(4L)**

Principles involved in distribution of mechanical tissues – inflexibility, incompressibility, inextensibility and shearing stress, tissues providing mechanical support, their distribution inleaf, stem and root of dicots and monocots.

4. Vascular tissue system **(4L)**

Structure and function of xylem, phloem and cambium

Credit - II **(16L)**

1. Normal secondary growth **(5L)**

Introduction, cambium and its role in secondary growth, process of secondary growth in stems of *Helianthus annus*, extrastelar and intrastelar secondary growth**,** annual rings, periderm, bark, tylosis and lenticels.

2. Anomalous secondary growth **(5L)**

Introduction causes or reasons of anomalous secondary growth, anomalous secondary growth in dicot stem (*Bignonia*), dicot root (*Raphanus*) and monocot stem (*Dracaena*).

3. Plant embryology introduction **(1L)**

4. Definition and scope of plant embryology.

5. Microsporangium and male gametophyte **(5L)**

a. Microsporangium**:** structure of tetrasporangiate anther, types of tapetum, sporogenoustissue.

b. Microsporogenesis: process and its types, types of microspore tetrad.

c. Male gametophyte: structure and development of male gametophyte.

Credit – III **(18L)**

1 Megasporangium and female gametophyte: **(7L)**

a) Megasporangium: structure, types of ovules - anatropous, orthotropous, amphitropous, campylotropous, circinotropous.

b) Megasporogenesis: process and its types, types of megaspore tetrads.

c) Female gametophyte: structure of typical embryo sac, types of embryo sacs withexamples - monosporic, bisporic and tetrasporic.

2. Fertilization: **(5L)**

Mechanism of pollination - entomophily, anemophily, hydrophily, zoophily, germination of pollen grain, double fertilization (syngamy and triple fusion) and its significance.

3. Endosperm and embryo **(6L)**

a) Endosperm: Types-– nuclear, helobial and cellular.

b) Embryogeny**:** structure of dicot and monocot embryo and seed formation

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3. Eams and Mc Daniel, An Introduction to Plant Anatomy, 1990, McGraw –Hill Book Co. Ltd andKogakusha Co, Tokyo, Japan
4. Adriance S Foster Practical Plant Anatomy, 2000, D Van Nostrand Co. INC, Newyork
5. Esau, Plant Anatomy, 2000, Wiley Toppan Co. California, USA
6. Pijush Roy, Plant Anatomy, 2004, New Central Book Agency Ltd, Kolkata
7. Pandey S N and Ajanta Chadha, Plant Anatomy and Embryology, 2005, Vikas Publishing House, Pvt, Ltd, New Delhi/
8. Bhojwani S S and Bhatnagar S P, An Embryology of Angiosperms.
9. Maheshwari P, An introduction to Embryology of Angiosperm.

Choice Based Credit System Syllabus (2022 Pattern)

Mapping of Program Outcomes with Course Outcomes

Class: S.Y. B. Sc. (Sem. IV) **Subject**: Botany

Course: Plant Anatomy and Embryology **Course Code**: USBT 241

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)								
Course Outcomes	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9
CO 1	3								
CO 2	3								
CO 3	3								
CO 4	3							2	
CO 5	3	2		3					
CO 6	3	2				3			
CO 7	3								

Justification for the mapping

PO1: Disciplinary Knowledge

CO1. Students get knowledge of internal structure o f tissue system in plant.

CO2. Students are aware about microsporogenesis, megasporogenesis and embryogenesis.

CO3.Students get knowledge of tissue and tissue systems present in plant.
CO4. Students get knowledge of secondary growth in plants.
CO5. Students are able to know reasons for anomalous secondary growth in plants.
CO6. Students get knowledge of wood anatomy.
CO7. Students get knowledge of endosperm and seed.

PO2: Critical Thinking and Problem Solving

CO5. Students are able to know reasons for anomalous secondary growth in plants.
CO6. Students get knowledge of wood anatomy.
CO7. Students get knowledge of endosperm and seed.

PO 4: Research-related skills and Scientific temper

CO6.Describe and identify flowering plants.

PO6: Personal and Professional Competence

CO6. Students get knowledge of wood anatomy.

PO 8: Environment and Sustainability

CO4. Know different methods of conservation of Phanerogams.

Class	**:**	**S. Y. B. Sc. (Semester - IV)**			
Paper Code	**:**	**USBT 242**			
Paper	**:**	**II**	**Title of Paper**	**:**	**Plant Ecology**
Credit	**:**	**3**	**No. of lectures**	**:**	**48**

A) Learning Objectives:

1. To understand the concepts of plant ecology.
2. To impart ecosystem dynamics.
3. To knowledge about ecological adaptations and ecological successions.

B) Course Outcomes:

By the end of the course, students will be able to:

CO1. The student can analyse and interpret the plant relation with the environment and impactof human interventions on ecosystem.

CO2. Appreciate the ethical, cross-cultural and historical context of environmental issues and the links between human and natural systems.

CO3. Provide plant description; describe the morphology and reproductive structure of cryptogams.

CO4. Gain the proficiency in the identification of cryptogams.

CO5. Knowledge of comparison between cryptogams and other plant groups.

CO6. Knowledge of scope of the cryptogams diversity.

CO7. Knowledge about habitat conservation of cryptogams diversity.

Credit - I **(16L)**

1. Introduction of plant ecology **(02L)**

Introduction, concept, definition, autecology and synecology, applications.

2. Ecosystem ecology **(08L)**

Introduction, ecological organization, concept of population, community, ecosystem and biosphere.

Kinds of ecosystem – natural and artificial, terrestrial and aquatic-fresh (lotic/lentic), marine and brackish.

Components of ecosystem – biotic and abiotic components.

Ecosystem dynamics – food chain, food web and ecological pyramids.

Biogeochemical cycles – carbon, nitrogen and phosphorous.

3. Population and community ecology **(04 L)**

Population – concept, definition, characteristics- size, density, distribution, age structure,reproductive base and ecotypes.

Community – concept, definition, characteristics-structure, dominance, diversity, periodicity, stratification, ecotone and edge structure

Credit - II **(16L)**

1. Ecological adaptations **(04 L)**

Adaptive features of plants - external and internal features.

Classification of plants and characteristics – hydrophytes, mesophytes, xerophytes.

2. Ecological succession **(06 L)**

Introduction, concept, definition, Principles and types – primary and secondary.

Hydrosere, xerosere and climax community.

3. Man and Environment **(06L)**

Introduction, Interrelationship between the living world and the environment, components and dynamism of Ecosystem, homeostasis.

Impact of human activities on environment – Causes, Prevention and control of – Air,water and Soil Pollution

Environmental toxicology – Eutrophication, bioaccumulation and biomagnifications

Environmental Crisis-Desertification, Ozone depletion and Global warming

Credit - III **(16 L)**

1. Environmental Impact Assessment and Environmental audit (**06L)**

EIA- concept, definition, objectives, methodology, EIS, applications

Environmental Audit- concept, definition, need, methodology, certification

difference between EIA and Environmental audit

2. Remote Sensing **(4L)**

Definition, basic principles, Process of data acquisition and interpretation,

Global positioning System

Application of Remote Sensing in ecology.

3. Biodiversity and conservation **(06 L)**

Concept, definition and types of biodiversity. Methods of biodiversity conservation *Ex-situ and In-situ* social approaches in biodiversity conservation-sacred groves, Chipko movement

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Choice Based Credit System Syllabus (202 Pattern)

Mapping of Program Outcomes with Course Outcomes

Class: S.Y. B. Sc. (Sem. IV) **Subject**: Botany

Course: Plant Ecology **Course Code**: USBT 242

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)								
Course Outcomes	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9
CO 1		3							
CO 2							2		
CO 3	3								
CO 4				2					
CO 5	3								
CO 6	3								
CO 7	3							3	

Justification for the mapping

PO1: Disciplinary Knowledge

CO3. Provide plant description, describe the morphology and reproductive structure of cryptogams.

CO5. Knowledge of comparison between cryptogams and other plant groups.

CO6. Knowledge of scope of the cryptogams diversity.

CO7. Knowledge about habitat conservation of cryptogams diversity.

PO2: Critical Thinking and Problem Solving

CO1. The student can analyse and interpret the plant relation with the environment and impactof human interventions on ecosystem.

PO 4: Research-related skills and Scientific temper

CO4.Gain the proficiency in the identification of cryptogams.

PO 7: Effective Citizenship and Ethics

CO2. Appreciate the ethical, cross-cultural and historical context of environmental issues and the links between human and natural systems.

PO 8: Environment and Sustainability

CO 7. Knowledge about habitat conservation of cryptogams diversity.

Class	**:**	**S. Y. B. Sc. (Semester - IV)**			
Course Code	**:**	**USBOT 243**			
Paper	**:**	**III**			
Course Title	**:**	**Practical based on USBT 241 and USBT 242**			
Credit	**:**	**2**	**No. of Practicals**	**:**	**12**

A) Learning Objectives:

1. To study internal morphology of plant.
2. To study in detail developmental changes during microsporogenesis, megasporogenesis and embryogenesis.
3. To study ecological adaptations in plants.
4. To make students expertise in sectioning and staining technique.

B) Course Outcome:

By the end of the course, students will be able to:

CO1. Students learned internal morphology of plant.
CO2. Students get knowledge of developmental changes during microsporogenesis, megasporogenesis and embryogenesis.
CO3. Students learned ecological adaptations in plant.
CO4. Students are expertise in sectioning and staining technique.
CO5. Students should know the practical applications of anatomy, embryology and ecology inrecent advances in plant sciences.
CO6. Get knowledge of preparation of bio-fertilizers.
CO7. Students should know the practical applications of anatomy, embryology and ecology in recent advances in plant sciences.

Practicals:

1) Study of epidermal tissue system – non-glandular and glandular trichomes, multilayeredepidermis, typical stomata (dicot and monocot). (01 P)
2) Study of mechanical tissues and their distribution in root, stem and leaves. (01 P)
3) Study of normal secondary growth in dicot stem – *Annona* /*Moringa*. (Double stainedtemporary preparation). (01 P)
4) Study of anomalous secondary growth in *Bignonia* and *Dracaena* stem. (Double stained temporary preparation). (01 P)
5) Study of tetrasporangiate anther and types of ovules. (01 P)
6) Study of dicot and monocot embryo. (01 P)
7) Vegetation study by list count quadrat method. (01 P)
8) Study of Hydrophytes. (01 P)
9) Study of Xerophytes. (01 P)
10) Study of Ecological instruments. (01 P)
11) Determination of organic carbon in soil by titration method. (01 P)
12) Interpretation of data using satellite imageries. (01 P)

N.B. Visit to any aquatic / terrestrials ecosystem and submission of visit report iscompulsory.

Choice Based Credit System Syllabus (2022 Pattern)

Mapping of Program Outcomes with Course Outcomes

Class: S.Y. B. Sc. (Sem. IV) **Subject**: Botany

Course: Practical II **Course Code**: USBT 243

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)								
Course Outcomes	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9
CO 1	3								
CO 2	3								
CO 3	2								
CO 4				2					
CO 5		3							
CO 6	3					3			
CO 7	2					2			

Justification for the mapping

PO1: Disciplinary Knowledge

CO1. Students learned internal morphology of plant.

CO2. Students get knowledge of developmental changes during microsporogenesis, megasporogenesis and embryogenesis.

CO3. Students learned ecological adaptations in plant.

CO6. Get knowledge of preparation of bio-fertilizers.

CO7. Students should know the practical applications of anatomy, embryology and ecology in recent advances in plant sciences.

PO2: Critical Thinking and Problem Solving

CO5. Students should know the practical applications of anatomy, embryology and ecology inrecent advances in plant sciences.

PO 4: Research-related skills and Scientific temper

CO4. Students are expertise in sectioning and staining technique.

PO6: Personal and Professional Competence

CO6. Get knowledge of preparation of bio-fertilizers.

CO7. Students should know the practical applications of anatomy, embryology and ecology in recent advances in plant sciences.