Tribhuvan University

Institute of Science and Technology

4 Years B. Sc. Botany Course of Study

Course Title : **Diversity, Structure, Function and Development of Angiosperms (Angiosperms, Physiology, Cytology and genetics, Embryology and Anatomy)**

Course No: BOT 201 Full Marks: 100
Nature of the Course: Theory Pass Marks: 35
Year: II year Lecture: 150

Course Objectives (BOT 201 & BOT 202)

- To introduce the concept of internal and external organization in higher plants
- To highlight the impact of environment on structure and functions\
- To study physiological processes in plants.

Unit I. Angiosperms 35

Principles and Practices

1. **Introduction**: General features of angiosperms; Definition of taxonomy and systematics; Basic components of taxonomy (Identification, Description, Nomenclature and Classification); Aims and scope of taxonomy……..……..……...…….……1

2. **Plant morphology in relation to taxonomy**
   Morphological structural terminology of angiosperms applied as taxonomy evidence focusing representative species- Teaching materials- Charts.

   General terminology of vegetative parts: Roots (types); Stems (durations, habits and types of both general and modified stems); Leaves (parts, venation, phyllotaxy, types, shapes, margins, apex, base, surface, etc.); Stipules (types)……..……..……3

   General terminology of reproductive parts: Inflorescences (types); Bracts (types); Flowers (parts, nature, position of ovary, placentation); Fruits (parts, types) …….…....4

3. **Plant collection and Herbarium techniques**

   Introduction and importance of herbarium (K, K-W, E, BM, Cal, TI, KATH, TUCH); Materials needed for collecting specimens; Methods of collecting specimens; Recording field data ……1

   Preparing herbarium specimens: Procedures for pressing; Drying; Mounting; Labeling; Storage; Preserving specimens…….……..…… 1

   Ethics for collecting specimens at field; Handling herbarium specimens; …….…….. 1

4. **Nomenclature and Classification**

Define rank and taxa; Ranking of taxa in taxonomic hierarchy (recognized by International Code of Nomenclature such as kingdom, division, class, order, family, genus and species as principal ranks and subphylum, subclass, suborder, subfamily, etc., as secondary ranks)…….....…… 1

Binomial nomenclature; International Code of Nomenclature (ICN); Principles and application of the Code of Nomenclature (scientific name, author citation, nomenclature type/ type method, priority of publication, conservation of names, name changes, basionym, synonym, valid publication, rejection of names)……..……..…….. 1

5. **Principles of classification**

   History and development of classification systems of angiosperms giving examples of systems in Pre-Darwinian Classification (Theophrastus, Carlous Linnaeus, A.P. de Candolle, G. Bentham and J.D. Hooker) and Post Darwinian system (Adolf Engler and Karl Prantl, John Hutchinson, Arthur Cronquist, etc.) System based on Darwin concept……...….. 1

6. **Major classification systems of angiosperms with merits and demerits:**
   Artificial system-Carlous Linnaeus 1753, introduction, contributions, concept and outline classification……..….. 1

   Natural system-George Bentham and Joseph Dalton Hooker 1862-1883, introduction, concept, outline classification up to Cohorts (recent Orders) giving one family as an example in each order, merits and demerits ……..…….……... 1

7. **Phylogenetic system: Earlier system** (Engler and Diels 1936 – refinement of Engler and Prantl's system by Engler and Diels): Introduction, concept, outline classification up to major orders showing evolutionary trends, merits and demerits …….……..... 1
8. **Contemporary system: Recent phylogenetic system** (Cronquist system1988): Introduction, concept and characteristic features of classification of up to subclass showing evolutionary trends……..…….…….. 1
9. **Basic concept of Angiosperm Phylogeny Group** (APG): Background and concepts of APG 1998; APG II 2003; APG III 2009; Showing clades and eudicots of APG II 2003……..……. 1

10. **Systematic Study:** Describing distinguishing features (each subclass, order and family); Classification (Arthur Cronquist's system, 1988); Range of vegetative structure (habit, stem, leaf); Reproductive (inflorescence, flower, fruit) structures; Economic importance (consider local species too) and Phylogeny (affinity) of following representative families of Magnoliophyta (angiosperms): **Magnoliaceae, Ranunculaceae, Moraceae, Caryophyllaceae, Malvaceae, Rosaceae, Lamiaceae, Araceae, Cyperaceae, Orchidaceae** ……...…….. 16

Unit II. Plant Physiology 50

1. Water Relations of Plants: Water availability in soil; water potential; movement of water: diffusion, osmosis; transport of water in plants: absorption by roots, root to shoot transport, transpiration (mechanism and factors affecting transpiration), cohesion-tension theory of ascent of sap; water stress: effects and plants' response. 8

2. Plant Nutrients: Nutrient availability in soil; nutrient absorption by root; macro and micronutrients: roles in plant and symptoms of deficiencies; hydroponics. 5

3. Plant Development: Growth and differentiation; Tissue culture and organogenesis; Polarity; Photomorphogenesis; Photoperiodism; Seed physiology: Seed germination and mobilization of reserved food, seed dormancy, vernalization; senescence. 12

4. Plant Hormones: Concept of hormone; physiological roles of auxins, gibberellins, cytokinnins, ethylene, abscissic acid, and brassinosteroids; commercial uses of plant hormones. 8

5. Metabolism: Anabolism and Catabolism; Photosynthesis: Radiant energy, ultrastructure of chloroplast, photosynthetic pigments, mechanisms (light reaction, and dark reaction/CO2 assimilation – C3, C4 and CAM), factors affecting photosynthesis; photorespiration; respiration: ultrastructure of mitochondria, anaerobic and aerobic respiration, glycolysis, Kreb's cycle, respiratory chain; chemiosmotic mechanism of ATP synthesis. 17

Unit III. Cytology and Genetics 30

1. Cytology: structural organization of prokaryotic and eukaryotic cells; Ultrastructure and function of cell organelles; cell inclusions; physical and chemical nature of chromosomes; cell division: cell cycle, karyokinesis (amitosis, mitosis and meiosis) and cytokinesis. 12

2. Genetics: Physical structure, type and functions of nucleic acids (DNA and RNA); DNA replication; gene structure, gene expression and regulation in prokaryotes and eukaryotes. Mendelian genetics: Mendel's laws of inheritance, gene interactions (incomplete dominance, co-dominance, epistasis), linkage and crossing over, sex linked inheritance. Sources of genetic variation: gene and chromosomal mutation (chromosomal aberrations, euploidy, aneuploidy and polyploidy). Concept of plant breeding (hybridization). 18

Unit IV. Embryology 15

1. Structure and development of microsporangium, microsporogenesis and the male gametophyte; structure and development of megasporangium, megasporogenesis and the female gametophyte; pollination and fertilization; development and types of endosperm; embryogenesis in typical dicot and monocot plants; polyembryony; apomixes; experimental embryology; palynology: introduction and its scope

Unit V. Plant anatomy 20

1. Tissues and tissue system: structure and functions of meristematic and permanent tissues (simple, complex and special tissues); shoot apical meristem (histological organizations in monocot and dicot stem); root apical meristem (histological organization in monocot and dicot root); theories of apical meristem differentiation. 7

2. Primary structures and functions: epidermis: uniseriate and multiseriate, epidermal appendages and their morphological types; primary structure of typical dicot stem, root and leaf; primary structure of typical monocot stem, root and leaf; cambium: origin, structure and functions. 6
3. Secondary structures and functions: Origin and structure of secondary xylem and phloem; secondary growth in dicot stem and root; anomalous secondary growth (dicot- Boerhaavia, Nyctanthes and Achyranthes; monocot- Dracaena); annual and growth rings; dendrochronology (concept and application); heart wood and sapwood; periderm; wound healing; leaf abscission; nodal anatomy; floral anatomy. 7

Text Books

Pandey BP 2011. College Botany (Vol. 3). S. Chand & Co. Ltd, New Delhi, India.

Suggested Readingss

1. Harris, J. G. & Woolf Harris, M. 2001. *Plant Identification Terminology — an Illustrated Glossary*, 2nd edn. Spring Lake Publishing, Spring Lake, Utah.
2. Lawrence, G.H.M. 1951. *Taxonomy of Vascular Plants*. Macmillian, New York.
3. Naik, V.N. 1991. *Taxonomy of Angiosperms*. Tata McGraw Hill Publishing Company Limited, New Delhi.
4. Simpson, Michael G. 2006. *Plant Systematics*. Elsevier Academic Press, New York (online pdf version available).
5. Woodland Dennis W. 1997. *Contemporary Plant Systematics*. Barrien Springs, Michgian, United States of America.

Plant physiology

Devlin RM. Plant Physiology. Affiliated East West Pvt., New Delhi, India.,

Jain V. K. 2012. Fundamentals of plant Physiology. S. Chand & Co. Ltd, New Delhi, India.

Noggle GR and GJ Fritz. Introductory Plant Physiology. Prentice-Hall of India Pvt. Ltd, New Delhi, India.

Salisbury TB and C Ross. Plant Physiology. Wordsworth Publishing Co., London, UK

Cytology and Genetics

Bhamrah HS and K Juneja. Cytology and Genetics. Amol Publication, New Delhi, India.

Gardner EJ, MJ Simmons and DP Snustad. Principles of Genetics. John Wiley and Sons Inc., New York Singleton, USA

Mohanan, K. V. 2010. Essential of Plant Breeding. PHI learning Pvt. Ltd. New Delhi, India.

Rastogi SC. Cell Biology. Tata McGraw-Hill Publishing Company Ltd. New Delhi.

Sinha U and S Sinha. Cytogenetics, Plant breeding and Evolution. VIkas Publishing House Pvt. Ltd. New Delhi, India.

Srivastava, S and Tyagi, Recent Advances in Genetics. Amol Publication, New Delhi, 1994

Embryology

Bhojwani SS and SP Bhatnagar. The Embryology of Angiosperms. Vikas Publishing House, New Delhi, India.

Pandey AK. Introduction to Embryology of Angiosperms. CBS Publishers and Distributors, New Delhi, India.

Anatomy

Eames AJ and LH MacDaniels. An Introduction to Plant Anatomy. Tata McGraw-Hill Publishing Company Lt., New Delhi, India.

Botany
Second Year

Course Title : **Diversity, Structure, Function and Development of Angiosperms (Angiosperms, Physiology, Cytology and genetics, Embryology and Anatomy)**
Course No: BOT 202 Full Marks: 50
Nature of the Course: Practical Pass Marks: 20
Year: II year Work load : 180 Hrs

Angiosperm

6. Description of flowering plants by using semi-technical terms in the following families focusing locally available materials: (10 families - Magnoliaceae, Ranunculaceae, Moraceae, Rosaceae, Lamiaceae, Malvaceae, Caryophyllaceae, Araceae, Cyperaceae and Orchidaceae) Two plants in each practical class. (eg. Magnoliaceae) Most diagnostic features of each family after describing the specimens and following Cronquist system 1988 for classification purpose.

7. Description of flowering plants by using semi-technical terms in the following families focusing locally available materials: Ranunculaceae (Most diagnostic features of each family after describing the specimens and following Cronquist system 1988 for classification purpose).

8. Description of flowering plants by using semi-technical terms in the following families focusing locally available materials: Moraceae (Most diagnostic features of each family after describing the specimens and following Cronquist system 1988 for classification purpose).

9. Description of flowering plants by using semi-technical terms in the following families focusing locally available materials: Rosaceae (Most diagnostic features of each family after describing the specimens and following Cronquist system 1988 for classification purpose).

10. Description of flowering plants by using semi-technical terms in the following families focusing locally available materials: Lamiaceae (Most diagnostic features of each family after describing the specimens and following Cronquist system 1988 for classification purpose).

11. Description of flowering plants by using semi-technical terms in the following families focusing locally available materials: Malvaceae (Most diagnostic features of each family after describing the specimens and following Cronquist system 1988 for classification purpose).

12. Description of flowering plants by using semi-technical terms in the following families focusing locally available materials: Caryophyllaceae (Most diagnostic features of each family after describing the specimens and following Cronquist system 1988 for classification purpose).

13. Description of flowering plants by using semi-technical terms in the following families focusing locally available materials: Araceae (Most diagnostic features of each family after describing the specimens and following Cronquist system 1988 for classification purpose).

14. Description of flowering plants by using semi-technical terms in the following families focusing locally available materials: Cyperaceae (Most diagnostic features of each family after describing the specimens and following Cronquist system 1988 for classification purpose).

15. Description of flowering plants by using semi-technical terms in the following families focusing locally available materials: Orchidaceae (Most diagnostic features of each family after describing the specimens and following Cronquist system 1988 for classification purpose).

16. Preparation of herbarium specimens of local plants using standard size of herbarium paper sheets (29X41.5cm or 11.5" X 16.5"), at least 20 herbarium specimens representing related families.

17. Field visit to observe vegetation and flora of a specified area. Days and location as mentioned in the curriculum

(*Students are suggested to submit three-five material for all the lower groups in the practical exams*)

Physiology

1. To study the movement of the chloroplast under the microscope.
2. To determine water potential of algal cells by plasmolysis method.
3. To study of effects of various environmental factors upon the rate of transpiration using a potometer.
4. To demonstrate that xylem is a conducting tissue.
5. To study the distribution of stomata and the shape of the guard cells.
6. To demonstrate root pressure.
7. To study the effect of different light colours on the rate of photosynthesis.
8. To perform the aerobic respiration by Ganong's respiroscope.
9. To perform anaerobic respiration in germinating seeds.
10. To distinguish C_3 and C_4 plants on anatomical basis.
11. To study the effect of light on the dark grown seedling of *Vicia faba* (photomorphogenesis).
12. To demonstrate the effect of auxins on elongation of maize coleoptile.
13. To demonstrate polarity in germinating seed.
14. To demonstrate polarity in rooting from stem.
15. To study dormancy in seeds of various weed species.

Cytology and Genetics

1. To study the different stages of mitosis in onion root tip.
2. To study behavior of chromosomes during meiosis in pollen mother cells.

Embryology

1. To study the TS of anther (permanent slide).
2. To study dicot embryo (Permanent slide).
3. To study of monocot embryo (Permanent slide).
4. To study embryo sac (Permanent slide).
5. To study various types of ornamentation in the pollen wall.
6. To estimate pollen viability of various cultivated species.

Anatomy

1. To study anatomical structure of typical dicot and monocot stem.
2. To prepare permanent slides of stem showing anomalous structure (*Boerhaavia, Nyctanthese, Achyranthus, Dracaena*).
3. To study the annual rings of tree species (*Abies, Pinus*).