

Rayat Shikshan Sanstha's

**Yashwantrao Chavan Institute of Science, Satara
(Autonomous)**

Syllabus under Autonomy

For

B. Sc. II Botany

Academic Year 2020 – 2021

Rayat Shikshan Sanstha's
Yashavantrao Chavan Institute of Science, Satara (Autonomous) Syllabus
introduced from June 2019
Bachelor of Science (B. Sc.) Part - II: Botany

Semester - III
Theory Paper - V (BBT 301) Embryology of Angiosperms

Learning objectives:

1. To impart the basic knowledge of flower structure in angiosperms.
2. To impart basic knowledge about processes of pollination.
3. To impart basic knowledge about the process of fertilization.
4. To impart the basic knowledge of embryo development.

Total Lectures - 45

Unit - I: Structural Organization of Flower **[10]**

Concept of flower as a modified Shoot, structure of typical flower, structure of typical androecium, types of anther, adhesion, cohesion, adalphy, epipetalous, epiphylous, structure of tetrasporangiate anther and pollen grain, structure of gynoecium; parts of carpel, syncarpus, apocarpus, types of style; structure of ovule, types of ovules

Unit - II: Pollination and Fertilization **[12]**

Definition, types and mechanism in Anemophily (*Zea mays*), Entomophily (*Calotropis*) and Hydrophily (*Vallisneria*), structure of tetrasporangiate anther (Microsporogenesis), pollen germination and male gametophyte; megasporogenesis, structure of embryo sac: Monosporic (*Polygonum*) and Bisporic (*Allium*); fertilization: Entry of pollen tube (Chalazogamy, mesogamy, porogamy), double fertilization and triple fusion. Significance of double fertilization

Unit - III: Embryo and Endosperm Development **[12]**

Structure and development of embryo in Monocotyledons and Dicotyledons.
Development of endosperm, Types of endosperm- Nuclear, Helobial and Cellular

Unit - IV: Polyembryony, Apomixis and Parthenocarpy

[11]

Polyembryony: Introduction, Types - True polyembryony (Cleavage and Adventive), false polyembryony. Causes of polyembryony, Significance of polyembryony; Apomixis – Introduction causes of Apomixis, Types – Gametophytic & Sporophytic, Significance of Apomixis with respect to parthenocarpy

Learning Outcomes:

After completion of unit - I students are able to:

1. Describe the structural organization of typical angiosperm flower.
2. Describe the functions of angiosperm flower.

After completion of unit - II students are able to:

1. Define concepts of pollination and different processes of pollination.
2. Describe the concept of microsporogenesis and megasporogenesis and to define concept of fertilization in angiosperms.

After completion of unit - III students are able to:

1. Describe the process of embryo developments and the variations found in the process.
2. Describe the different types of endosperms and its uses.

After completion of unit - IV students are able to:

1. Explain the different concepts in embryology such as polyembryony, apomixis and parthenocarpy and their applications.
2. Write answers and brief notes about embryology of angiosperms.

References:

1. An Embryology of Angiosperms, Bhojwani SS and Bhatnagar SP (6th Edn.), Vikas Publishing House Pvt. Ltd., Noida (2015)
2. An Introduction to Embryology of Angiosperms, Maheshwari P, Tata McGraw Hill Publishing Co. New Delhi (1950)
3. Biology of Plants, Raven, P.H., Evert, R.F. and Eichhorn, S.E. (5th Edn.) W.H., Freeman and Co., Worth Publishers, New York (1999)
4. Developmental Biology of Flowering Plants, Raghvan, V., Springer-Verlag, New York (2000)
5. Essentials of Palynology, Nair PKK, Today & Tomorrow's Printers and Publishers, New Delhi (1985)
6. Patterns in Plant Development, Steeves TA and Sussex IM (2nd Edn.), Cambridge University Press, Cambridge (1989)
7. Systematic Botany, Datta SC, New Age International Publishers, New Delhi (2015)
8. Trees: Their Natural History, Thomas, P. Cambridge University Press, Cambridge (2000)

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Bachelor of Science (B.Sc.) Part - II : Botany**

**Semester - III
Theory Paper VI (BBT 302) Plant Physiology**

Learning Objectives:

1. To impart the basic knowledge of different plant water relationships.
2. To impart the basic knowledge aspects of plant nutrition.
3. To impart the basic knowledge of photosynthesis.
4. To impart the basic knowledge of processes involved in growth and development in plants.

Total Lectures 45

Unit - I: Plant water relationship

[11]

Structure and physicochemical properties of water; Role of water in plant life; Forms of water in soil; Root hair as water absorbing part of the plant – movement of water in plant Water transport processes (Mechanism of water absorption: active and passive absorption theories, water transport through xylem and tracheids)

Transpiration: Definition, types, mechanism of stomatal movements, significance of transpiration, Anti-transpirants, Guttation

Ascent of Sap- Introduction, concept, theories (cohesion of water theory; Root pressure theory)

Unit - II: Mineral nutrition

[11]

Introduction; Essential elements (Macro and Micronutrients); criteria of essentiality; Mineral nutrient uptake - Passive (Diffusion), Active (Carrier Concept); Mineral deficiencies and plant disorders; role of deficiency symptoms of N, P, K, Mn, Zn, Cobalt treating nutritional deficiencies; Role of essential elements in agriculture and horticulture

Unit - III: Photosynthesis

[12]

Introduction; ultra-structure of chloroplast; photosynthetic pigments (Chlorophylls, Carotenoids and Phycobilins)

Mechanism of photosynthesis: a) Light reaction - Photolysis of water, Photosystem I and II, Photophosphorylation - Cyclic and Non-cyclic; b) Dark reaction: C₃, C₄ and CAM pathways of carbon fixation. Significance of photosynthesis

Unit - IV: Growth and development

[11]

Growth : Introduction; Definition, Region of growth, Phases of growth, growth curve, Grand period of growth

Plant growth regulators: Introduction and definition; Discovery, site of synthesis, Physiological (Practical applications) roles of growth regulators – Auxins, Cytokinins, Gibberellins, Ethylene and Abscisic acid.

Reproductive growth: Concept of photoperiodism; SDP, LDP, Day neutral plants; concept of vernalization

Learning Outcomes:

After completion of unit - I students are able to:

1. Describe the structure and physicochemical properties of water.
2. Describe the processes involved in water uptake and utilization in plants.

After completion of unit - II students are able to:

1. Explain the major and minor elements.
2. Explain the role of minerals in plants.

After completion of unit - III students are able to:

1. Explain the ultrastructure of chloroplast.
2. Describe the basics of the processes involved in photosynthesis.

After completion of unit - IV students are able to:

1. Describe the mechanisms of growth and development in plants.
2. Explain the physiology of flowering.

References:

1. Fundamentals of Plant Physiology, Jain VK, S. Chand & Company Ltd., New Delhi
2. Introduction to Plant Physiology, Hopkins, WG, John Wiley & Sons, Inc., New York, USA (1995)
3. Plant Physiology, Bidwell RGS, Macmillan Pub. Co., NY (1974)
4. Plant Physiology, Grewal RC, Campus Books International, New Delhi
5. Plant Physiology, Pandey SN, Vikas Publishing House (P) Ltd., New Delhi (1991)
6. Plant Physiology, Salisbury FB and Ross CW (4th Edn.). Wadsworth Publishing Co., California, USA (1992)
7. Plant Physiology, Taiz Land Zeiger E (2nd Edn.) Sinauer Associates, Inc., Publishers, Massachusetts, USA (1998)

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Bachelor of Science (B. Sc.) Part - II: Botany**

**Semester - III
Practical Paper III (BBP 303) Practicals based on Theory Paper V
and VI**

Learning Objectives:

1. To give practical knowledge to students about identification of plants around them.
2. To give the practical knowledge about morphological and anatomical variations in plants.
3. To participate students in different experimental aspects of plant physiology.
4. To participate students in experiential learning with these practicals.

Practicals

Group A based on Paper - V

1. Study of typical flower and its parts (floral whorls with their functions)
2. Study of simple tissues and complex tissues.
3. Study of young / mature anther by permanent slides and slide preparations.
4. Study of germination of pollen grains.
5. Detection of pollen fertility by staining technique.
6. Mechanisms of pollination in angiosperms.
7. Study of types of Gynoecium in angiosperms.
8. Study of types of ovules (by permanent slide or photograph).
9. Study of dicotyledon and monocotyledon embryo (by permanent slide or photograph).
10. Dissection of embryo / endosperm from developing seeds (*Grevillia / Cucumis*).
11. Study of parthenocarpic fruits.

Group B based on Paper - VI

12. Study of stomatal and cuticular transpiration by cobalt chloride paper method.
13. Study of role and deficiency symptoms of P, K, Ca, Mg.
14. Estimation of Chlorophylls by Colorometric / Spectrophotometric method.
15. Separation of photosynthetic pigments by paper chromatography.
16. Study of Kranz leaf anatomy in C₄ plants.
17. Analysis of vegetative growth (any suitable method).

18. Demonstration of Ascent of sap
19. Study of evolution of oxygen during photosynthesis.
20. Study of effect of light intensity on photosynthesis
21. Study of permeability of plasma membrane by using different concentrations of organic solvent.

Learning Outcome:

1. After completion of practical 1 student are able to describe the typical flower of angiosperms.
2. After completion of practical 2 student are able to distinguish between simple and complex tissues.
3. After completion of practical 3 to 6 students are able to pollen biology.
4. After completion of practical 7 and 8 students are able to describe the types of gynoecium and ovules.
5. After completion of practical 9 and 10 students are able to describe the development of embryo and endosperm.
6. After completion of practical 11 students are able to describe the process and significance of parthenocarpy.
7. After completion of practical 12 students are able to explain the concept of transpiration.
8. After completion of practical 13 students are able to trace effect of plant growth regulators on plants growth.
9. After completion of practical 14 to 21 students are able to learn the different physiological processes and different techniques used in plant physiology.

Books Recommended:

1. Angiosperm systematics : Theory and Practice, Singh G, S. Chand and Company Ltd., New Delhi (2000)
2. Modern Practical Botany, Pandey BP, Vol. I, S. Chand and Company Ltd., New Delhi (2011)
3. Modern Practical Botany, Pandey BP, Vol. II, S. Chand and Company Ltd., New Delhi (2011)
4. Practical Botany for Advanced Level and Intermediate Students, Wallis CJ (5th Ed.), William Heinemann Medical Books Ltd (1966)
5. Practical Botany, Bendre A, Rastogi Publications, Meerut (2010)
6. Taxonomy of Vascular Plants, Lawrence GHM, Oxford and IBH Publ. Co. Pvt. Ltd. New Delhi (1951)

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Bachelor of Science (B. Sc.) Part - II: Botany

Semester - IV

Theory Paper VII (BBT 401) Plant Anatomy

Learning objectives:

1. To make students aware about the basic concepts of anatomy.
2. To understand anatomical framework of angiosperms.
3. To make the students aware about the different types of tissue systems in plants.
4. To understand the concept of primary and secondary growth in plants.

Total Lectures 45

Unit - I: Organization of higher plant body [09]

Development of plant body; the plant organs; internal organization of the plant body

Unit - II: Meristematic and Permanent Tissue [12]

Meristem:

- i. Introduction, Characteristics and Classification of meristems based on position
- ii. Theories of structural development -
i] Apical cell theory; ii] Histogen theory; iii] Tunica Corpus theory

Permanent tissue:

- i. Simple tissue- Parenchyma, Chlorenchyma, Collenchyma and Sclerenchyma
- ii. Complex tissue: Xylem and Phloem; types of Vascular bundles
- iii. Special tissues: Secretory tissues

Unit - III: Tissue systems**[12]**

- A. Epidermal tissue system: Structure and Function; Uniseriate and multiple; epidermal outgrowths-unicellular, multicellular, glandular and non-glandular; stomata- structure, types and function.
- B. Secretory tissue system: Glandular and laticiferous
- C. Mechanical tissue system: Principles involved in distribution of mechanical tissues; distribution of mechanical tissue in leaf, stem and root of dicot and monocot.

Unit - IV: Primary and secondary structure of plant body**[12]**

Primary structure of root, stem and leaf of Monocotyledon and Dicotyledon. Normal secondary growth in Dicotyledon root and stem – introduction and need; structure and function of periderm (bark and lenticels)
Anomalous secondary growth; definition and causes; Anomalous secondary growth in *Bignonia* (Dicot) and *Dracaena* (Monocot) stem.

Learning outcomes:**After completion of unit I students able to:**

- 1. Explain morphological features of angiosperm.
- 2. Explain anatomical features of angiosperm.

After completion of unit II students able to:

- 1. Describe the meristematic tissue of plants.
- 2. Describe the permanent tissue of plants.

After completion of unit III students able to:

- 1. Identify the different types of tissue systems in plants.
- 2. Explain the importance of different types of tissue systems in plant organization.

After completion of unit IV students able to:

- 1. Identify the different stages of growth in plants.

2. Explain the primary and secondary structure of the plant body.

References:

1. An Introduction to Plant Anatomy, Eames and Mc Daniel, McGraw–Hill Inc. s. US; New editing(1984)
2. Anatomy of Seed Plants, Esau K, (2nd Edn.), John Wiley and Sons, New York, (1977)
3. Botany for Degree Students, Datta AC, Press-Delhi, Bombay, Madras
4. Comparative Wood Anatomy: Systematic, Ecological and Evolutionary Aspects of dicotyledonous Wood, Carlquist S, Springer-Verlag, Berlin (1998)
5. Plant Anatomy and Embryology, Pandey SN, Chadha A, Vikas Publishing House, Pvt. Ltd, New Delhi
6. Plant Anatomy, Chandurkar PJ, Oxford and IBH publication Co. New Delhi (1971)
7. Plant Anatomy, Fahn A (2nd Edn.), Pergamon Press, Oxford (1974)
8. Plant Anatomy, Mauseth JD, The Benjamin/Cummings Publishing Company Inc., Metro Park, California, USA (1988)
9. Plant Anatomy, Pandey BP, S. Chand & Company, Ltd., New Delhi
10. Plant Anatomy, Pijush Roy. New Central Book Agency Ltd, Kolkata
11. Plant Anatomy, Vashista PC, Pradip Publications, Opposite Sitla mandir, Jalandhar
12. Plant Anatomy: Experiment and Interpretation, Culter EG (Part II Organs), Edward Arnold, London, (1971)
13. Plant Development: The Cellular Basis, Lyndon RF, Unwin Hyman, London (1990)
14. Practical Plant Anatomy, Adriance S Foster, D Van Nostrand Co. Inc, New York
15. Wood Anatomy and Major Uses of Wood, Nair MNB, Faculty of Forestry, Universiti Putra Malaysia, Selangor DE, Malaysia (1998)

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Bachelor of Science (B. Sc.) Part - II : Botany

Semester - IV
Theory Paper VIII (BBT 402) Plant Metabolism

Learning Objectives:

1. To impart the basic knowledge of different aspects of enzymology.
2. To impart basic knowledge of mechanisms on nitrogen metabolism in plants.
3. To impart the knowledge of concepts in respiration in plants.
4. To impart the basic knowledge of seed dormancy and germination in plants.

Total Lectures 45

Unit - I: Enzymes **[11]**

Introduction, definition Structure and properties of Enzyme; Classification and nomenclature of enzymes

Mechanism of enzymes catalysis and inhibition a) Lock and key hypothesis, b) Induced fit Hypothesis

Factor affecting enzyme activity: a) Temperature; b) pH; c) Substrate Concentration

Unit - II: Nitrogen Metabolism **[11]**

Introduction of Nitrogen Metabolism; Biological nitrogen fixation, non-symbiotic and symbiotic nitrogen fixation; Nitrogen assimilation; Enzymes involved in Nitrogen fixation

Unit - III: Respiration **[11]**

Respiration: Introduction, structure of mitochondrion, types of respiration, Glycolysis, Formation of Acetyl Co A, TCA cycle, ETS in mitochondria, ATP synthesis and inhibitors of respiration

Unit - IV: Seed Dormancy and Germination **[12]**

Concept of dormancy, causes of dormancy, Methods of breaking of seed Dormancy, Seed germination: Introduction and types (Epigeal, Hypogeal and Viviparous); Factors affecting seed germination, Biochemical changes during seed germination

Learning Outcomes:

After completion of unit I students are able to:

1. Explain the concept, structure and classification of enzymes.
2. Write answers and brief notes about the role of enzymes in plant physiology.

After completion of unit II students are able to:

1. Explain the concept of nitrogen metabolism in plants.
2. Explain the nitrogen fixation and assimilation.

After completion of unit III students are able to:

1. Explain the concepts of respiration in plants.
2. Explain different respiratory cycles in plants.

After completion of unit IV students are able to:

1. Explain the concept of seed dormancy.
2. Explain the concepts seed germination and seed physiology.

References:

1. Fundamentals of Plant Physiology, Jain VK, S. Chand & Company Ltd., New Delhi
2. Introduction to Plant Physiology, Hopkins, WG, John Wiley & Sons, Inc., New York, USA (1995)
3. Plant Physiology, Bidwell RGS, Macmillan Pub. Co., NY (1974)
4. Plant Physiology, Grewal RC, Campus Books International, New Delhi
5. Plant Physiology, Pandey SN, Vikas Publishing House (P) Ltd., New Delhi (1991)
6. Plant Physiology, Salisbury FB and Ross CW (4th Edn.). Wadsworth Publishing Co., California, USA (1992)
7. Plant Physiology, Taiz L, and Zeiger E (2nd Edn.) Sinauer Associates, Inc., Publishers, Massachusetts, USA (1998)
8. Text Book of Plant Physiology, Verma V, Emkay Publications, Delhi

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**Semester - IV
Practical Paper IV (BBP 403) Practicals based on Theory Paper
VII and VIII**

Learning Objectives:

1. To give practical knowledge to students about anatomical features of plants.
2. To give the practical knowledge about various physiological processes.
3. To participate students in experiential learning with these practicals.

Practicals

Group A based on Paper VII

1. Study of shoot and root apex by permanent slides.
2. Study of simple tissues and complex tissues.
3. Study of epidermal tissue system.
4. Study of mechanical tissue system.
5. Study of secretory tissue system.
6. Double stained permanent micro preparation of any suitable material.
7. Study of primary structure of dicot and monocot stem.
8. Studies of normal secondary growth in dicot stem (*Annona* / *Moringa* / *Sunflower*) by temporary double stained preparation.
9. Study of anomalous/abnormal secondary growth in *Bignonia* (Dicot stem).
10. Study of anomalous/abnormal secondary growth in *Dracaena* (Monocot stem).

Group B based on Paper VIII

11. Study of effect of pH on dehydrogenase enzyme activity.
12. Study of effect of temperature on catalase enzyme activity.
13. Study on nitrogen fixing microorganisms (demonstration).
14. Study of nitrate reductase enzyme activity.
15. Effect of Red and far red light on growth of plants.

16. Study of breaking seed dormancy by mechanical and chemical scarification.
17. Determination of rate of respiration during seed germination by Ganong's respirometer.
18. Janus green B staining technique for mitochondria.
19. Separation of amino acids by TLC

Learning outcomes:

1. After completion of practical 1 to 5 students are able to identify and describe the anatomical features of plants and their functions.
2. After completion of practical 6 students are able to perform the double stain preparation for the study of anatomical features of plants.
3. After completion of practical 7 to 10 students are able to know the primary structure of stem and secondary growth of the wood in monocot and dicot plants.
4. After completion of practical 11 and 12 students are able to estimate an enzyme activity and its regulation.
5. After completion of practical 13 and 14 students are able to explain nitrogen metabolism in plants.
6. After completion of practical 15 students are able to photophysiology of plants.
7. After completion of practical 16 and 17 students are able to describe the physiology of seeds.
8. After completion of practical 18 and 19 students are able to describe different physiological processes and techniques.

References:

1. Biochemical Methods, Sadasivam and Manickam, New Age International Publishers, New Delhi
2. Modern Practical Botany, Pandey BP, Vol. I, S. Chand and Company Ltd., New Delhi (2011)
3. Modern Practical Botany, Pandey BP, Vol. II, S. Chand and Company Ltd., New Delhi (2011)
4. Practical Botany for Advanced Level and Intermediate Students, Wallis CJ (5th Edn.), William Heinemann Medical Books Ltd. (1966)
5. Practical Botany, Bendre A, Rastogi Publications, Meerut (2010)
