

**Rayat Shikshan Sanstha's**  
**Yashwantrao Chavan Institute of Science,**  
**Satara**

**(An Autonomous College)**  
**Syllabus under Autonomy**

**B. Sc. II (Botany)**

**Implemented w. e. f. June 2022**

Rayat Shikshan Sanstha's  
**Yashwantrao Chavan Institute of Science, Satara**  
**(An Autonomous College)**

**Syllabus for (B. Sc.) Part – II**

**1. TITLE: Botany**

**2. YEAR OF IMPLEMENTATION: 2022-23**

**5. DURATION: 01 year**

**6. PATTERN: Semester**

**7. MEDIUM OF INSTRUCTION: English**

**8. STRUCTURE OF COURSE:**

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**Syllabus introduced from June 2022**

**B. Sc. Part – II**

**Course Structure**

**Semester III**

<b>Nature of the Course</b>	<b>Course code</b>	<b>Name of the Course</b>
Theory	BBT 301	Embryology of Angiosperms
	BBT 302	Plant Physiology
Practical	BBP 303	Practicals based on Theory Paper BBT 301 and BBT 302

**Semester IV**

<b>Nature of the Course</b>	<b>Course code</b>	<b>Name of the Course</b>
Theory	BBT 401	Plant Anatomy
	BBT 402	Plant Metabolism
Practical	BBP 403	Practical's based on Theory Paper VII and VIII

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**B. Sc. Part – II**

**Semester III**

**Theory Paper – BBT- 301 Embryology of Angiosperms**

**Learning objectives:** Students will be able to

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

<b>Credits=4</b>	<b>SEMESTER-III BBT 301: Embryology of Angiosperm</b>	<b>No. of hours per unit/ credits</b>
<b>Credit –I</b> Unit-I:	<b>Structural Organization of Flower</b>	
	1.1 Structure of typical flower 1.2 Structure of typical androecium 1.3 Types of anther, adhesion, cohesion, adalphy, epipetalous, epiphyllous 1.4 Structure of Bisporangiate anther, tetrasporangiate anther and pollen grain 1.5 structure of gynoecium; parts of carpel, syncarpus, apocarpus, types of style; 1.6 structure of ovule, types of ovules 1.7 Concept of flower as a modified Shoot,	<b>(11)</b>
<b>Credit –1</b>	<b>Pollination and Fertilization</b>	<b>(12)</b>

<b>UNIT II</b>		
	<p>1.1 Definition, types and mechanism in Anemophily (<i>Zea mays</i>), Entomophily (<i>Calotropis</i>) and Hydrophily (<i>Vallisneria</i>)</p> <p>1.2 Pollen germination and male gametophyte; megasporogenesis</p> <p>1.3 structure of embryo sac: Monosporic (<i>Polygonum</i>) and Bisporic (<i>Allium</i>); fertilization: Entry of pollen tube (Chalazogamy, mesogamy, porogamy)</p> <p>1.4 Double fertilization and triple fusion. Significance of double fertilization</p>	
<b>Credit –1 UNIT III</b>	<b>Embryo and Endosperm Development</b>	<b>(10)</b>
	<p>1.1 Structure and development of embryo in Monocotyledons and Dicotyledons.</p> <p>1.2 Development of endosperm, Types of endosperm- Nuclear, Helobial and Cellular</p>	
<b>Credit –1 UNIT IV</b>	<b>Polyembryony, Apomixis and Parthenocarpy</b>	<b>(12)</b>
	<p>1.1 Polyembryony: Introduction, Types - True polyembryony (Cleavage and Adventive), false polyembryony. Causes of polyembryony, Significance of polyembryony;</p> <p>1.2 Apomixis – Introduction causes of Apomixis, Types – Gametophytic &amp; Sporophytic, Significance of Apomixis with respect to parthenocarpy,</p> <p>1.3 Apomixis and its Application in Crop Improvement.</p> <p>1.4 Industrial applications</p>	

**Course Outcomes:** Students will be able to:

1. Understand the structural organization of typical angiosperm flower, functions pollination and different processes of pollination
2. Imbibe the concept to microsporogenesis and megasporogenesis and fertilization in angiosperms.
4. Study the embryo developments and the variations found in the process. Types of endosperm and its uses
5. Understand different concepts in embryology such as polyembryony, apomixis and parthenocarpy and their applications.

**References:**

1. Raven, P. H., Evert, R. F. and Eichhorn, S. E Biology of Plants, (5th Edn.) W. H., Freeman and Co., Worth Publishers, New York (1999). Unit I.
2. Datta S. C., Systematic Botany, New Age International Publishers, New Delhi (2015). Unit-I
3. Raghvan, V., Springer-Verlag. Developmental Biology of Flowering Plants, New York (2000). Unit I.
4. Thomas, P. Trees: Their Natural History, Cambridge University Press, Cambridge (2000). Unit –II.
5. Steeves T. A. and Sussex IM Patterns in Plant Development, (2nd Edn.), Cambridge University Press, Cambridge (1989). Unit –III.
6. Bhojwani S. S. and Bhatnagar S. P. An Embryology of Angiosperms, (6<sup>th</sup>Edn.), Vikas Publishing House Pvt. Ltd., Noida, (2015). Unit –IV
7. Nair PKK, Essentials of Palynology, Today&Tomorrow's Printers and Publishers, New Delhi (1985). Unit –IV.
8. Maheshwariv P. An Introduction to Embryology of Angiosperms, Tata Mc Graw Hill Publishing Co. New Delhi (1950). Unit IV.

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B.Sc. Part - II: Botany

**Semester - III**

**Course BBT 302- Plant Physiology**

**Learning Objectives:** Students will be able to

1. Understand the basic knowledge of different plant water relationships.
2. Imbibe basic knowledge as concepts of plant nutrition.
3. To impart the basic knowledge of photosynthesis.
4. Understand basic knowledge of processes involved in growth and development in plants. **Total**

**Lectures 45**

<b>Credits=4</b>	<b>Semester - III - Course BBT 302 Plant Physiology</b>	<b>No. of hours per unit/ credits</b>
<b>Credit –I</b> <b>Unit-I:</b>	Unit - I: Plant water relationship 1.1 Structure and physicochemical properties of water. 1.2 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 1.3 Water transport processes (Mechanism of water absorption: active and passive absorption theories 1.4 Transpiration: Definition, types, structure of stomata mechanism of stomatal movements, significance of transpiration. 1.5 Anti-transpiration, Theories (cohesion of water theory; Root pressure theory)	<b>(10)</b>
<b>Credit –1</b> <b>UNIT II</b>	<b>Unit - II: Mineral nutrition</b> 2.1 Introduction; Essential elements (Macro and Micronutrients); criteria of essentiality.	<b>(11)</b>

	<p>2.2 Mineral nutrient uptake - Passive (Diffusion), Active (Carrier Concept);</p> <p>2.3 Mineral deficiencies and plant disorders.</p> <p>2.4 Role of essential elements in agriculture and horticulture</p>	
<b>Credit – 1</b>	<p><b>Unit - III: Photosynthesis</b></p> <p>3.1 Introduction; ultra-structure of chloroplast; photosynthetic pigments (Chlorophylls, Carotenoids and Phycobilins)</p> <p>3.2 Mechanism of photosynthesis: a) Light reaction - Photolysis of water, Photosystem I and II,</p> <p>3.3 Photophosphorylation - Cyclic and Non-cyclic; b) Dark reaction: C<sub>3</sub>, C<sub>4</sub> and. Significance of photosynthesis</p>	<b>(12)</b>
<b>Credit –1</b>	<p>Growth and development</p> <p>4.1 Growth: Introduction; Definition, Region of growth.</p> <p>4.2 Phases of growth, growth curve, Grand period of growth.</p> <p>4.3 Plant growth regulators: Introduction and definition; Discovery, site of synthesis, Physiological (Practical applications)</p> <p>4.4 Roles of growth regulators – Auxins, Cytokinins, Gibberellins, Ethylene and Abscisic acid.</p> <p>4.5 Reproductive growth: Concept of photoperiodism; SDP, LDP, Day neutral plants; concept of vernalization</p>	<b>(12)</b>

### Course Outcomes

#### Students will be able to:

- 1 Understand classification of enzymes
2. Understand the role of enzymes in plant physiology
4. understand of nitrogen metabolism in plants



5. Imbibe the fixation and assimilation, concepts of respiration in plants, different respiratory cycles in plants.

**References:**

1. Jain VK, S. Chand .Fundamentals of Plant Physiology, Company Ltd., New Delhi 2. Unit-I
2. W 2. G, John Wiley. Introduction to Plant Physiology, Hopkins, & Sons, Inc., New York, USA (1995) Unit –I
3. Bidwell RGS, Macmillan. Plant Physiology, Pub. Co., NY (1974). Unit I to Unit IV
4. Grewal R. Plant Physiology, C, Campus Books International, New Delhi. Plant Physiology, Unit-III.
5. Pandey S. N, Vikas Publishing House (P) Ltd., New Delhi(1991) Plant Physiology, Salisbury FB and Ross C. W (4thEdn.). Unit IV
6. Wadsworth Publishing Co., California, USA (1992) 7. Plant Physiology, Unit III, IV
7. Taiz L and Zeiger E (2<sup>nd</sup>Edn.) Plant Physiology Sinauer Associates, Inc., Publishers, Massachusetts, USA (1998) . Unit –II, Unit I

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**Syllabus introduced from June 2022**

**B. Sc. Part – II**

**Semester III**

**BBP 303**

**PRACTICAL COURSE –Depend on BBT 301and 302**

**Course Objectives:**

**Learning objectives: Student will be able to:-**

- 1) Understand the practical knowledge to students about identification of plants around them.
- 2) Understand the practical knowledge about morphological and anatomical variations in plants.
- 3) Employ various techniques in different experimental aspects of plant physiology.
- 4) Understand the in experiential learning with these practical's

Credits=2	SEMESTER-III BBP 303:	No. of hours per unit/ credits
<b>Credit –I UNIT I</b>	<p style="text-align: center;"><b>Practical's Group A based on BBT 301</b></p> <ol style="list-style-type: none"> <li>1. Study of typical flower and its parts (floral whorls with their functions)</li> <li>2. Study of simple tissues and complex tissues.</li> <li>3. Study of young / mature anther by permanent slides and slide preparations.</li> <li>4. Study of germination of pollen grains.</li> <li>5. Detection of pollen fertility by staining technique.</li> <li>6. Mechanisms of pollination in angiosperms.</li> <li>7. Study of types of Gynoecium in angiosperms.</li> <li>8. Study of types of ovules (by permanent slide or photograph).</li> <li>9. Study of dicotyledon and monocotyledon embryo (by permanent slide or photograph).</li> <li>10. Dissection of embryo / endosperm from developing seeds (Grevellia</li> </ol>	<b>(15)</b>

	/Cucumis). 11. Study of parthenocarpic fruits).	
<b>Credit –1 UNIT II</b>	<b>Group B based on BBT- 302</b> 12. Study of stomatal and cuticular transpiration by cobalt chloride paper method. 13. Study of role and deficiency symptoms of N, P, K. 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)	<b>(15)</b>

**Course Outcome:** Student should be able to:-

1. Understand the typical flower of angiosperms.
2. Understand the distinguish between simple and complex tissues.
3. Understand pollen biology .types of gynoecium and ovules, development of embryo and endosperm.
4. Imbibe the process and significance of parthenocarpy. concept of transpiration, The effect of plant growth regulators on plants growth,

### **References**

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

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**Syllabus implemented W. e. f. June 2022**  
**B. Sc. Part – II**  
**Semester –IV**

<b>Nature of the Course</b>	<b>Course code</b>	<b>Name of the Course</b>
Theory	BBT 401	Plant Anatomy
	BBT 402	Plant Metabolism
Practical	BBP 403	Practical's based on Theory Paper VII and VIII

**Learning objectives:** Student will be able to

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

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**B. Sc. Part – II**

<b>Credits=4</b>	<b>SEMESTER-IV</b> <b>BBT 401: Plant Anatomy</b>	<b>No. of hours per unit/ credits</b>
<b>Credit –I</b> Unit-I:	<b>Organization of higher plant body</b>	<b>(09)</b>
	Development of plant body; 1.1 The plant organs; internal organization of the plant body ( stem and leaf)	
<b>Credit –1</b> <b>UNIT II</b>	<b>Meristematic and Permanent Tissue</b>	<b>(11)</b>
	<b>Meristem:</b> 1.1 Introduction, Characteristics and Classification of meristems based on position 1.2 Theories of structural development a) Apical cell theory b) Histogen theory; c) Tunica Corpus theory <b>1.3 Permanent tissue:</b> i. Simple tissue- Parenchyma, Chlorenchyma, Collenchyma and Sclerenchyma ii. Complex tissue: Xylem and Phloem; types of Vascular bundles iii. Special tissues: Secretory tissues	

<b>Credit –1 UNIT III</b>	<b>Tissue systems</b>	<b>(13)</b>
	<p><b>1.1</b> Epidermal tissue system: Structure and Function; Uniseriate and multiple; epidermal outgrowths-unicellular, multicellular, glandular and non-glandular; stomata- structure, types and function.</p> <p><b>1.2</b> Secretory tissue system: Glandular and laticiferous</p> <p>1.3 Mechanical tissue system: distribution of mechanical tissue in leaf, stem and root of dicot and monocot</p>	
<b>Credit –1 UNIT IV</b>	<b>Primary and secondary structure of plant body</b>	<b>(12)</b>
	<p>4.1 Primary structure of root, stem and leaf of Monocotyledon and Dicotyledon.</p> <p>4.2 Normal secondary growth in Dicotyledon root and stem</p> <p>4.3 Structure and function of periderm (bark and lenticels)</p> <p>4.4 Anomalous secondary growth; definition and causes , Anomalous secondary growth in <i>Bignonia</i> (Dicot) and <i>Dracaena</i> (Monocot) stem</p>	

**Learning outcomes:** Students are able to:

1 Understand morphological features of angiosperm

1. Imbibe the meristematic tissue of plants.

2. Understand the different types of tissue systems in plants.

3. Understand the different stages of growth in plants.

4. Imbibe the primary and secondary structure of the plant body.

**References:**

1. Eames and Mc Daniel, McGraw–Hill. An Introduction to Plant Anatomy, Inc. s. US; New editing (1984) . Unit-I
2. Peterson C. A. Book review: *An introduction to plant structure and development. Annals of Botany.* 2006; 97:1158. Unit-III,IV

3. Evert RF. Esau's Plant anatomy, Meristems, cells, and tissues of the plant body: their structure, function, and development. 3rd edn. Hoboken, NJ: John Wiley & Sons, Inc; 2006. Unit I, II, III.
4. Dickison W. C Integrative plant anatomy. New York: Harcourt Academic Press; 2000. Unit II.
5. Beck CB. *An introduction to plant structure and development*. 1st edn. Cambridge: Cambridge University Press; 2005. Unit-III.
6. Bowes B. G, Mauseth, J. D. *Plant structure: a colour guide*. . 2 edn. London: Manson Publishing; 2008. Unit III.
7. Crang R, Vassilyev A Electronic plant anatomy. . 2003 CD-ROM. McGraw-Hill. Unit III.
8. Cutler D. F, Botha T. Plant anatomy. Stevenson DW. : *An applied approach*. Oxford: Blackwell Publishing; 2008. Unit I-IV .
9. Esau K, Anatomy of Seed Plants, (2nd Edn.), John Wiley and Sons, New York, (1977) Unit I-IV .
10. Datta, A. C Botany for Degree Students, Press-Delhi, Bombay, Madras . Unit I-IV .
11. Verlag, Berlin. Comparative Wood Anatomy: Systematic, Ecological and Evolutionary Aspects of dicotyledonous Wood, Carlquist S, Springer- (1998). Unit I-IV
12. Pandey, S. N, Chadha A. Plant Anatomy and Embryology, , Vikas Publishing House, Pvt. Ltd, New Delhi Unit I-IV .
13. Chandurkar P. J. Plant Anatomy, , Oxford and IBH publication Co. New Delhi (1971)
14. Fahn A. Plant Anatomy, (2nd Edn.), Pergamon Press, Oxford (1974) . Unit I-IV .
15. Mauseth J. D. Plant Anatomy, , The Benjamin/Cummings Publishing Company Inc., Metro Park, California, USA (1988) . Unit I-IV .
16. Pandey B. P, S. Chand. Plant Anatomy, & Company, Ltd., New Delhi
17. Pijush Roy. Plant Anatomy,. New Central Book Agency Ltd, Kolkata . Unit I-IV .
18. Vashista P. C., Plant Anatomy, Pradip Publications, Opposite Sitlamandir, Jalandhar

19. Culter E. G. (Plant Anatomy: Experiment and Interpretation, Part II Organs), Edward Arnold, London, (1971) Unit I-IV .
20. UnwinHyman.Plant Development: The Cellular Basis, Lyndon RF, , London (1990)
21. Adriance S. Foster, D., Van Practical Plant Anatomy, Nostrand Co. Inc, New York. Unit I-IV .
22. Nair MNB. Wood Anatomy and Major Uses of Wood, , Faculty of Forestry, Universiti Putra Malaysia, Selangor DE, Malaysia (1998) . Unit I-IV .



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**Syllabus introduced from June 2022**

**Bachelor of Science (B. Sc.) Part – II**

**Semester IV**

BBT 402 Plant Metabolisms

**Course objectives:** Students will be able to

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

**Total Lectures 45**

<b>Credits=4</b>	BBT 402 Plant Metabolisms	<b>No. of hours per unit/ credits</b>
<b>Credit –I</b> Unit-I:	Enzymes : 1.1 Introduction, definition Structure and properties of Enzyme 1.2 Classification and nomenclature of enzymes 1.3 Mechanism of enzymes catalysis and inhibition a)Lock and key hypothesis, b)Induced fit Hypothesis 1.4 Factor affecting enzyme activity: a) Temperature; b) pH; c) Substrate Concentration	<b>(11)</b>
<b>Credit –1</b> <b>UNIT II</b>	Nitrogen Metabolism 2.1 Introduction of Nitrogen Metabolism; Biological nitrogen fixation, non-symbiotic and symbiotic nitrogen fixation. 2.2 Nitrogen assimilation 2.3 Enzymes involved in Nitrogen fixation	<b>(11)</b>

	Respiration	
<b>Credit –1</b> <b>UNIT III</b>	1.1 Respiration: Introduction, structure of mitochondrion. 1.2 Types of respiration, Glycolysis, Formation of Acetyl Co A, TCA cycle, 1.3 ETS in mitochondria 1.4 ATP synthesis and inhibitors of respiration	<b>(11)</b>
<b>Credit –1</b> <b>UNIT IV</b>	Seed Dormancy and Germination 4.1 Concept of dormancy, causes of dormancy 4.2 Methods of breaking of seed Dormancy, Seed germination: 4.3 Introduction and types (Epigeal, Hypogeal and Viviparous) 4.4 Factors affecting seed germination 4.5 Biochemical changes during seed germination	<b>(12)</b>

**Learning outcomes:** Students are able to

1. Understand concept, structure and classification of enzymes.

1. Imbibe the role of enzymes in plant physiology

2. Understand the nitrogen metabolism in plants

3. Understand the nitrogen fixation and assimilation

4. Imbibe the seed dormancy, seed germination and seed physiology

**References:**

1. Jain VK, Fundamentals of Plant Physiology, S. Chand & Company Ltd., New Delhi

2. Hopkins, WG, John Wiley & Sons, Introduction to Plant Physiology, , Inc., New York, USA (1995)

3. Bidwell RGS Plant Physiology, Macmillan Pub.Co., NY (1974)

4. Grewal R C. Plant Physiology, Campus Books International, New Delhi

5. Pandey S. N. Plant Physiology, Vikas Publishing House (P) Ltd., New Delhi(1991)

6. Salisbury F and Ross C. W (4th Edn Plant Physiology.). Wadsworth Publishing Co., California, USA (1992)

7. Taiz L, and Zeiger E (2nd Edn.). Plant Physiology, Sinauer Associates, Inc., Publishers, Massachusetts, USA (1998)
8. Verma V, Emkay, Text Book of Plant Physiology, Publications, Delhi

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**Bachelor of Science (B. Sc.) Part – II**

**Semester IV**

**Practical Course BBP - 403.**

**Course Objectives:** Student will able to-

1. Understand about anatomical features of plants.
2. Understand the practical knowledge about various physiological processes.
3. Participate students in experiential learning with these practical's

<b>Credits=2</b>	<b>SEMESTER-IV</b> Practicals Group A based on Paper - 401	<b>No. of hours per unit/ credits</b>
<b>Credit –I</b> <b>Group A based on</b> <b>BBT 401</b>	<b>Practicals</b> 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 ( <i>Annona</i> / <i>Moringa</i> / <i>Sunflower</i> ) by temporary double stained preparation. 9. Study of anomalous/abnormal secondary growth in <i>Bignonia</i> (Dicot stem). 10. Study of anomalous/abnormal secondary growth in <i>Dracaena</i> (Monocot stem).	<b>(15)</b>

	11. Study of Periderm and Lenticel	
<b>Credit –I Group – Bbased on BBT 402</b>	1 Study of effect of pH on dehydrogenase enzyme activity. 2. Study of effect of temperature on catalase enzyme activity. 1. Study on nitrogen fixing microorganisms (demonstration). 4. Study of nitrate reductase enzyme activity. 5. Effect of Red and far red light on growth of plants.	15

**Course Outcomes:** Student should be able to:

1. Imbibe to identify and describe the anatomical features of plants and their functions
2. Understand the double stain preparation for the study of anatomical features of plants.
3. Understand primary structure of stem and secondary growth of the wood in monocot and dicot plants.
4. Understand enzyme activity, nitrogen metabolism in plants, physiology of seeds and physiological processes and techniques

**References:**

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



**In charge**

**B. Sc. II Seed Technology**



**Chairman<sub>2</sub>  
Board of Studies**



**Head**

**Department of Botany**