



**SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY,  
NANDED**

**SEMESTER PATTERN CURRICULUM UNDER**

**CHOICE BASED CREDIT SYSTEM (CBCS)**

**for**

**Faculty of Science and Technology  
Under Graduate Program**

**SUBJECT: BOTANY**

**B. Sc. Second Year**

**With Effect from June 2020**

  
**Principal**

**Late. Babasaheb Deshmukh  
Gorthekar Arts, Commerce  
& Science Mahavidyalaya,  
Umri, Dist. Nanded, [M.S.]**

॥ सा विद्या या विमुक्तये ॥

# स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

“ज्ञानतीर्थ” परिसर, विष्णुपुरी, नांदेड - ४३१६०६ (महाराष्ट्र)

**SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY NANDED**

“Dnyanteerth”, Vishnupuri, Nanded - 431606 Maharashtra State (INDIA)

Established on 17th September 1994 - Recognized by the UGC U/s 2(f) and 12(B), NAAC Re-accredited with 'A' Grade

## ACADEMIC (1-BOARD OF STUDIES) SECTION

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संलग्नित महाविद्यालयांतील विज्ञान व तंत्रज्ञान विद्याशाखेतील पदवी स्तरावरील द्वितीय वर्षाचे CBCS Pattern नुसारचे अभ्यासक्रम शैक्षणिक वर्ष २०२०-२१ पासून लागू करण्याबाबत.

## परिपत्रक

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, दिनांक २० जून २०२० रोजी संपन्न झालेल्या ४७व्या मा. विद्या परिषद बैठकीतील विषय क्र.११/४७-२०२०च्या ठरवानुसार प्रस्तुत विद्यापीठाच्या संलग्नित महाविद्यालयांतील विज्ञान व तंत्रज्ञान विद्याशाखेतील पदवी स्तरावरील द्वितीय वर्षाचे खालील विषयांचे C.B.C.S. (Choice Based Credit System) Pattern नुसारचे अभ्यासक्रम शैक्षणिक वर्ष २०२०-२१ पासून लागू करण्यात येत आहेत.

- |   |   |
|---|---|
| 1. B.Sc.-II Year-Biophysics                             | 2. B.Sc.-II Year-Bioinformatics                       |
| 3. B.Sc.-II Year-Biotechnology                          | 4. B.Sc.-II Year-Biotechnology (Vocational)           |
| 5. B.Sc.-II Year-Food Science                           | 6. B.Sc.-II Year-Botany                               |
| 7. B.Sc.-II Year-Horticulture                           | 8. B.Sc.-II Year-Agro Chemical Fertilizers            |
| 9. B.Sc.-II Year-Analytical Chemistry                   | 10. B.Sc.-II Year-Biochemistry                        |
| 11. B.Sc.-II Year-Chemistry                             | 12. B.Sc.-II Year-Dyes & Drugs Chemistry              |
| 13. B.Sc.-II Year-Industrial Chemistry                  | 14. B.C.A. (Bachelor of Computer Application)-II Year |
| 15. B.I.T. (Bachelor of Information Technology)-II Year | 16. B.Sc.-II Year-Computer Science                    |
| 17. B.Sc.-II Year-Network Technology                    | 18. B.Sc.-II Year-Computer Application (Optional)     |
| 19. B.Sc.-II Year-Computer Science (Optional)           | 20. B.Sc.-II Year-Information Technology (Optional)   |
| 21. B.Sc.-II Year-Software Engineering                  | 22. B.Sc.-II Year-Dairy Science                       |
| 23. B.Sc.-II Year-Electronics                           | 24. B.Sc.-II Year-Environmental Science               |
| 25. B.Sc.-II Year-Fishery Science                       | 26. B.Sc.-II Year-Geology                             |
| 27. B.Sc.-II Year-Mathematics                           | 28. B.Sc.-II Year-Microbiology                        |
| 29. B.Sc.-II year Agricultural Microbiology             | 30. B.Sc.-II Year-Physics                             |
| 31. B.Sc.-II Year Statistics                            | 32. B.Sc.-II Year-Zoology                             |

सदरील परिपत्रक व अभ्यासक्रम प्रस्तुत विद्यापीठाच्या [www.srtmun.ac.in](http://www.srtmun.ac.in) या संकेतस्थळावर उपलब्ध आहेत. तरी सदरील बाब ही सर्व संबंधितांच्या निदर्शनास आणून द्यावी.

‘ज्ञानतीर्थ’ परिसर,

विष्णुपुरी, नांदेड - ४३१ ६०६.

जा.क्र.: शैक्षणिक-१/परिपत्रक/पदवी-सीबीसीएस अभ्यासक्रम/

२०२०-२१/३३३

दिनांक : १५.०७.२०२०.

प्रत माहिती व पुढील कार्यवाहीस्तव :

- १) मा. कुलसचिव यांचे कार्यालय, प्रस्तुत विद्यापीठ.
- २) मा. संचालक, परीक्षा व मूल्यमापन मंडळ यांचे कार्यालय, प्रस्तुत विद्यापीठ.
- ३) प्राचार्य, सर्व संबंधित संलग्नित महाविद्यालये, प्रस्तुत विद्यापीठ.
- ४) साहाय्यक कुलसचिव, पदव्युत्तर विभाग, प्रस्तुत विद्यापीठ.
- ५) उपकुलसचिव, पात्रता विभाग, प्रस्तुत विद्यापीठ.
- ६) सिस्टम एक्सपर्ट, शैक्षणिक विभाग, प्रस्तुत विद्यापीठ.

  
Principal

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स्वाक्षरित/-

उपकुलसचिव

शैक्षणिक (१-अभ्यासमंडळ) विभाग



## Introduction:

The University Grants Commission (UGC) has initiated several measures to bring equity, efficiency and excellence in the Higher Education System of country. The important measures taken to enhance academic standards and quality in higher education include innovation and improvements in the curriculum, teaching-learning process, examination and evaluation systems, besides governance and other matters.

Swami Ramanand Teerth Marathwada University has several initiatives towards academic excellence, quality improvement and administrative reforms. In view of this priority and in-keeping with Vision and Mission, process was already initiated towards introduction of semester system, grading system and credit system. University had implemented Choice Based Credit System (CBCS) pattern at UG level from the academic year 2016-2017 progressively.

Revision and updating of the curriculum is the continuous process to provide an updated education to the students at large. In view of this priority and in-keeping with Vision and Mission, process of revision and updating the curriculum is initiated and implemented at UG level from the academic year 2019-2020 progressively. Presently there is wide diversity in the curriculum of different Indian Universities which inhibited mobility of students in other universities or states. To ensure uniform curriculum at UG level, curriculum of different Indian Universities, syllabus of NET, SET, MPSC, UPSC, Forest Services and the UGC model curriculum are referred to serve as a base in updating the same.

The CBCS provides choice for students to select from the prescribed courses. The choice based credit system provides a 'cafeteria' type approach in which the students can take courses of their choice, learn at their own pace, undergo additional courses and acquire more than the required credits, and adopt an interdisciplinary approach to learning. Our university has already introduced the choice based credit system. The semester system accelerates the teaching-learning process and enables vertical and horizontal mobility in learning.

Keeping in mind BoS in Botany prepared the curriculum to ensure up-to-date level of understanding of plant sciences. Studying plant sciences prepares the students for a career working either in an educational institution or an industry in which they can be directly involved in the research and development and Knowledge of modern and applied plant science and excellent career prospects.

The study of Botany aims to expand and increase current knowledge about plants in order to solve problems in many fields including agriculture, ecology, medicine, biotechnology and

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horticulture are some of the objectives kept in mind during executing the syllabus. How plants function at the cellular, tissue, organ, and organismal levels? How evolution of plants and how they contribute to biodiversity. How interactions with each other impacts their physical environment are the core objectives.

The addition of Skill enhancement courses aims to develop skills in plant sciences and practical experience in the students.

At the end of the curriculum, the student should have increased: an aptitude towards science and nature and also undertakes the fundamental and applied research in plant science in the benefit of the human and nature.

At last comments, suggestions are welcome from all the teachers, stakeholders and students for the upbringing the curriculum.

**Salient Features:**

The syllabus of B.Sc. S.Y. Botany has been framed to meet the requirement of Choice Based Credit System. The courses offered here Plant anatomy, Embryology, Plant physiology and Plant metabolism and Biochemistry will train and orient the students in the specific fields of Botany. This would help students to lay a strong foundation in the field of Botany.

The courses which deal with the environment, sustainability and ethics are Viruses, Bacteria Algae , Fungi , Lichens and Mycorrhiza, Plant Ecology , Phytogeography and Environmental Biology, Bryophytes, Pteridophytes Gymnosperms and Palaeobotany and Taxonomy of Angiosperms. These courses create awareness about conservation of biodiversity and its relevance with the socio-economical and environmental aspects. It also aims to make the students aware of bioethics, legislations and acts prevalent to control the degradation of our environment.

Overall after completion of this course, students will also acquire fundamental knowledge in Plant Science and also understand that Botany is an integral part of the human life and developments.

Skill Enhancement Courses offered during third year of this program are being designed with the aim of imparting specific skills to the students which will lead to the self-employability through development of their own enterprises.

**Program Educational Objectives:**

The Objectives of this program are:

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**PEO1:** To provide an updated education to the students at large in order to know the importance and scope of the discipline and to provide mobility to students from one university or state to other.

**PEO2:** To update curriculum by introducing recent advances in the subject and enable the students to face NET, SET, UPSC and other competitive examinations successfully.

**PEO3:** To impart knowledge of plant science as the basic objective of Education.

**PEO4:** To develop a scientific attitude to make students open minded, critical and curious.

**PEO5:** To develop an ability to work on their own and to make them fit for the society.

**PEO6:** To expose themselves to the diversity amongst life forms.

**PEO7:** To develop skill in practical work, experiments, equipments and laboratory use along with collection and interpretation of plant materials and data.

**PEO8:** To make aware of natural resources and environment and the importance of conserving the same.

**PEO9:** To develop ability for the application of the acquired knowledge in the fields of life so as to make our country self-reliant and self-sufficient.

**PEO10:** To appreciate and apply ethical principles to plant science research and studies.

### **Program Outcomes:**

#### **The Outcomes of this program are:**

**PO1:** This program will train and orient the students in the field of diversity of different life forms, Plant Anatomy, Plant Embryology, Plant Physiology, Plant Metabolism and Biochemistry.

**PO2:** This program will help the students for their career development.

**PO3:** This program will provide updated curriculum with recent advances in the subject and enable the students to face NET, SET, UPSC and other competitive examinations successfully.

**PO4:** This program shall train and orient the students for laboratory skills and serve as human resource for the educational institutes, industries and other organizations.

**PO5:** The programme also has a strong interdisciplinary component. Emphasis is given on the experimental learning through hands-on laboratory exercises, field trips and assignments.

**PO6:** Students will be able to understand and explain different specializations of Botany such as anatomy, Embryology, developmental biology, physiology, biochemistry etc. Students will be

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able to demonstrate the experimental techniques and methods in plant sciences and have innovative research ideas.

**PO7:** The programme will enlighten the current thrust areas of the subject and provide substantial exposure and skills in plant biology.

**PO8:** Skill Enhancement Courses being offered during this program will provide job opportunities and additional specific skills to the students for self-employability through the development of their own enterprises.

### **Prerequisite:**

The optional courses are offered to the students registered for undergraduate programs. Such students should have the basic knowledge of Plant Science and willing to gain additional knowledge in the field of Botany.

Admissions to B. Sc. Program are given as per the University rules.

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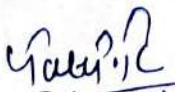
**SEMESTER PATTERN CURRICULUM UNDER  
CHOICE BASED CREDIT SYSTEM (CBCS) FOR  
Under Graduate Course  
Faculty of Science and Technology**

**SUBJECT: BOTANY**

**CLASS: B.Sc. SECOND YEAR**  
An Outline:

Semester/ Annual	Course No.	Course Name	Instructional Hrs/week	Total Periods	Marks for		Credits (Marks)
					Internal (CA)	External (ESE)	
Semester-III	CCB-III (Section-A)	<b>Theory Paper-VI:</b> Plant Anatomy	03	45	10	40	Credits: 02 (Marks:50)
	CCB-III (Section-B)	<b>Theory Paper-VII:</b> Plant Physiology and Biochemistry	03	45	10	40	Credits: 02 (Marks:50)
Semester-IV	CCB-IV (Section-A)	<b>Theory Paper-VIII:</b> Plant Embryology	03	45	10	40	Credits: 02 (Marks:50)
	CCB-IV (Section-B)	<b>Theory Paper-IX:</b> Plant Metabolism and Biotechnology	03	45	10	40	Credits: 02 (Marks:50)
Annual Pattern	CCBP-II	<b>Practical Paper-X:</b> Practicals based on CCB-III (Section-A) CCB-IV (Section-A)	03	16 Practicals	10	40	Credits: 02 (Marks:50)
	SECB-I	SEC- I A Fruit &Vegetable processing OR SEC-1 B Bioinstrumentation		45	25	25	Credits: 02 (Marks:50)
Annual Pattern	CCBP-III	<b>Practical Paper-XI:</b> Practicals based on CCB-III (Section-B) CCB-IV (Section-B)	03	16 Practicals	10	40	Credits: 02 (Marks:50)
	SECB-II	SEC- II A Nursery & Gardening OR SEC-II B Biofertilizers	03	45	25	25	Credits: 02 (Marks:50)
Total Credits Semester-III and IV					Marks: 60+50= 110	Marks: 240+50= 290	Credits: 12+04=16 (Marks: 300+100 =400)

**ESE** : End Semester Examination, **CA** : Continues Assessment, **SECB**: Skill Enhancement Course Botany, **CCB**: Core Course Botany, **CCBP**: Core Course Botany Practical.

  
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**Distribution of Credits:** 80 % of the total credits for the ESE and 20% for CA

**CA of 10 Marks (Theory):** 05 Marks for test & 05 Marks for Assignment

**CA of 10 Marks (Practicals):** 05 Marks for test & 05 Marks for Record Book, Submission of collection and field note and Excursion Report.

**CA of 25 Marks:** 15 Marks for Seminar & 10 Marks for Test

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BOTANY

B.Sc. Second Year

Semester III

CCB-III (A)

Theory Paper- VI

Plant Anatomy

Periods 45

Credits: 02

Maximum Marks: 50

**Learning Objectives:**

1. To know about the internal structure of the most evolved group of plants, the Angiosperm.
2. To study cells, tissues, meristem, epidermal and vascular tissue system in plants.
3. To acquire knowledge of tissue systems, histology and growth pattern in plants.

**Learning Outcomes:**

1. The students will be able to understand the meristem (RAM & SAM) different simple and complex tissues and secondary growth in root and stem.
2. Students will acquire knowledge of anatomy of root, stem and leaf in dicot and monocot plants.

**UNIT I: MERISTEMATIC TISSUE (10 Period)**

Introduction and Scope of Plant Anatomy

**Meristematic Tissues:** Definition, classification based on origin, function, position and development, organization of root apical meristem (RAM) and shoot apical meristem (SAM), apical cell theory, Histogen theory and Tunica corpus theory.

**Unit II : TISSUE SYSTEMS IN PLANTS (12 Period)**

**Simple Tissues:** Parenchyma, Collenchyma, Sclerenchyma.

**Complex tissues:** Xylem and Phloem.

**Secretory Structures in Plants:** Laticiferous tissues (Latex cells and vessels), glandular tissues (External glands-digestive glands, nectary glands & internal glands-Oil glands, hydathodes)

**Adaptive & Protective systems in plants:** stomata, Epidermis, cutin, cuticle & other types of coverings, epidermal appendages.

**UNIT III: ANATOMY -I (11 Period)**

**Vascular Bundles:** Definition and types.

**Primary structures:**

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Root anatomy of Monocotyledons (Maize) and Dicotyledons (Sunflower),

Stem anatomy of Monocotyledons (Maize) and Dicotyledons (Sunflower),

Leaf anatomy of Monocotyledons (Maize) and Dicotyledons (Sunflower),

Primary growth in roots and stems of plants.

#### UNIT IV: ANATOMY -II (12 Period)

**Secondary Growth-** Normal Secondary growth in root and stem of Dicotyledons (Sunflower),

**Anomalous Secondary growth:** *Achyranthes* stem, *Mirabilis*, *Bignonia* and *Dracaena* stem.

**Wood Anatomy-** Annual rings , Wood Elements, heartwood and sapwood, Springwood, Summer wood, Tension Wood, Economic importance of wood and wood elements, Dendrochronology.

**Periderm:** Development and composition of periderm, rhytidome and lenticels.

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BOTANY

B.Sc. Second Year

Semester III

CCB-III (B)

Theory Paper- VII

Plant Physiology and Biochemistry

Periods 45

Credits: 02

Maximum Marks: 50

Learning Objectives:

1. To make students realize how plants function, namely the importance of water, minerals, hormones, and light in plant growth and development; understand transport mechanisms and translocation in the phloem, applications of plant physiology.
2. To acquaint the students with the types and their functions of different biomolecules and secondary metabolites
3. To know the role of different plant growth regulators in plant physiology.

Learning Outcomes:

1. Students will gain the knowledge of water and nutrient uptake, movement in plants, role of mineral elements, translocation of sugars, Role of various plant growth regulators, phytochrome in plants.
2. Students shall learn different types of biomolecules and secondary metabolites
3. Students will learn the flowering physiology, vernalization and seed dormancy in plants.

UNIT-I: PLANT WATER RELATIONS (11 periods)

**Physical aspects of water absorption** – Diffusion, DP, DPD Imbibition Osmosis – OP, Exosmosis, Endosmosis, Plasmolysis, Water potential, Mechanism of water absorption by root – active and passive absorption

**Ascent of sap:** Introduction and mechanism (transpiration pull theory)

**Transpiration:** Definition, types, structure of stomata, mechanism of opening and closing of Stomata (starch-sugar theory and K<sup>+</sup> pump theory), guttation, antitranspirants.

**Plant movements:** Introduction, classification, paratonic and nastic movements.

UNIT-II: MINERAL NUTRITION (11 periods)

**Major and Minor elements:** Introduction, source, deficiency symptoms and their role. Foliar nutrition, hydroponic technique.

**Mineral salt absorption:** Introduction, mechanism of passive absorption (ion exchange theory) and active absorption (carrier concept theory)

**Translocation of organic solutes:** Introduction, mechanism of translocation (Munch-Mass Flow hypothesis)

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### UNIT-III: GROWTH AND DEVELOPMENT (12 periods)

**Growth and Plant growth regulators:** Introduction, phases of growth, measurement of growth (Arc indicator and Pfeiffer's auxanometer), factors affecting growth.

Chemical nature and practical applications of Auxins, Gibberellins, Cytokinins, Abscisic Acid and Ethylene. Circadian Rhythms in plants.

**Seed dormancy:** Introduction, causes of seed dormancy and methods of breaking seed dormancy

**Seed germination:** Introduction, types and mechanism of seed germination,

**Physiology of flowering:** Introduction, Photoperiodism (LDP, SDP and DNP), Phytochrome, red and far red light responses on photomorphogenesis. Photo-morphogenesis: Photo receptors, phyto-chrome, crypto-chrome

**Vernalization and devernalization:** Introduction, mechanism and significance

### UNIT-IV: BIOMOLECULES AND SECONDARY METABOLITES (10 periods)

**Carbohydrates:** Introduction, structure and classification, Monosaccharides, disaccharides and polysaccharides (starch and cellulose) biological functions of carbohydrates.

**Protein-** Introduction, classification and biological functions of Primary, secondary ( $\alpha$  helix and  $\beta$  sheets), tertiary and quaternary structure of proteins

**Lipids:** Introduction, structure classification and biological functions of lipids.

**Secondary metabolites:** Biological functions of tannins, terpenoids, flavonoids, alkaloids, essential oils and organic acids

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BOTANY

B.Sc. Second Year

Semester IV

CCB-IV (A)

Theory Paper- VIII

Plant Embryology

Periods 45

Credits: 02

Maximum Marks: 50

**Learning Objective:**

1. To study the flowering and fruiting, reproduction process, role of pollinators, ovule fertilization, Endosperm and seed development in angiosperms.

**Learning Outcomes:**

1. This course will be able to demonstrate foundational knowledge in embryology of plants.
2. Students will be able to understand the development of pollen, Ovule, and fertilization and palynological information.

**UNIT I: EMBRYOLOGY (13 Periods)**

Introduction- Definition and Scope,

Contribution of embryologists: W. Hofmeister, E. Strasburger, S.G. Nawaschin, P. Maheshwari, B.G.L. Swamy and B.M. Johri

Microsporangium- Structure of typical anther, T.S. of Anther, Microsporogenesis, Structure of Pollen grain, Development of male gametophyte, male sterility, Pollen germination, Pollen tube growth and guidance, Pollen storage, Pollen allergy, Pollen embryo. Brief account of Palynology

**UNIT II: POLLINATION BIOLOGY (10 Periods)**

Pollination, introduction, definition, Agents of pollination, mechanism of pollination in *Salvia* plant, types of pollination, self-pollination, cross pollination, adaptations (contrivances) in pollination

**UNIT III: MEGASPORANGIUM AND FERTILIZATION –II (11 Period)**

Megasporangium- Structure of typical ovule, L.S. Ovule, types of ovule (Orthotropous, Anatropous, Hemianatropous, Amphitropous, Camphyotropous and Circinotropous)

Megasporogenesis, structure of the embryo sac, Development of Monosporic (*Polygonum* type), Bisporic (*Allium* type) and Tetrasporic (*Adoxa* type) female gametophytes,

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Fertilization- Double fertilization and triple fusion, Significance of fertilization

#### UNIT IV: EMBRYO AND ENDOSPERM (11 Period)

Endosperm- Definition and types of endosperms (Nuclear, Cellular and Helobial endosperm),

Embryo- Definition, Development of Dicot (Crucifer type) embryo and Monocot (Sagittaria type), Development of seed and Fruit (Post fertilization changes), Seed dispersal and Seed germination, Seed appendages, Endospermic and non-endospermic seeds.

A brief account of Polyembryony, Apomixis and Parthenocarpy

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BOTANY

B.Sc. Second Year

Semester IV

CCB-IV (B)

Theory Paper- IX

Plant Metabolism and Biotechnology

Periods 45

Credits: 02

Maximum Marks: 50

Learning Objectives:

1. To study of different pathways in Photosynthesis , respiration , nitrogen metabolism
2. To gain the knowledge of basic aspects and applications of plant tissue culture
3. To study the different aspects of genetic engineering and bioinformatics

Learning Outcomes:

1. Students will be able to understand the various metabolic processes such as photosynthesis, respiration, Nitrogen metabolism etc. which are important for life.
2. Students shall be become familiar with the gene cloning and its transfer in plants
3. Students shall learn different databases and their applications

UNIT-I: PHOTOSYNTHESIS & RESPIRATION (11 periods)

**Photosynthesis:** Introduction, ultra structure of chloroplast, photosynthetic pigments, concepts of two Photosystems, Mechanism of photosynthesis, Light reaction, Hill's reaction, Cyclic and Non-cyclic photophosphorylation, , Calvin cycle (C<sub>3</sub>) and Hatch and Slack (C<sub>4</sub>) pathway, CAM pathway, Significance of photosynthesis, photorespiration.

**Respiration:** Introduction, ultra structure of mitochondria, structure and functions of ATP, significance of respiration. Respiratory quotient (RQ)

**Types of respiration:**

Aerobic respiration- Glycolysis, Kreb's cycle, Electron Transport System. Anaerobic respiration- Fermentation (Alcoholic and Lactic acid)

UNIT-II: ENZYMES AND NITROGEN METABOLISM (11 periods)

**Enzymes:** Introduction, nomenclature and classification (IUB), mechanism of enzyme action (Lock and key model, induced fit model), Concept of holoenzyme, mechanism of regulation of Enzyme activity-Feedback and allosteric regulation.

**Nitrogen metabolism:** Introduction, types of nitrogen fixation- Physical and biological (Symbiotic and Asymbiotic), Ammonification, Nitrification and Denitrification, Nitrate reductase, Nitrogen cycle.

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### UNIT-III: BIOTECHNOLOGY-PLANT TISSUE CULTURE (12periods)

Introduction to Biotechnology, current uses of biotechnology,

Plant Tissue Culture: Introduction to plant tissue culture, totipotency of plant cells, basic aspects of tissue culture laboratory, nutrient media, composition and its preparation , Technique of plant tissue culture: selection and surface sterilization of explants, inoculation, incubation (temperature and light regime) ,Initiation of callus cultures and cell suspension cultures, Regeneration of plants (Organogenesis and embryogenesis).

**Applications of tissue culture:** Micropropagation, Production of disease free plants, production of secondary metabolites, Anther culture and production of haploids, protoplast culture and somatic hybridization, synthetic seeds

### UNIT-IV: BIOTECHNOLOGY-GENETIC ENGINEERING (11 periods)

Introduction to genetic engineering ,tools and techniques and applications of recombinant DNA technology, Cloning vectors (Plasmid-PBR 322, Bacteriophage, Cosmid, Phagemid ), Gene cloning, Genomic library and cDNA library, *Agrobacterium* mediated gene transfer, transgenic plants, Polymerase Chain Reaction and its applications.

**Bioinformatics:** Introduction, Biological database, NCBI, BLAST.

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BOTANY – CURRICULUM

B.Sc. General (Semester Pattern)

Choice Based Credit System (CBCS) Pattern

B. Sc. Second Year

Annual Pattern

CCBP-II

PRACTICAL PAPER-X: BASED ON THEORY PAPERS-VI & VIII

Maximum Marks: 50

**Practical Exercises:**

1. Study of Meristematic tissues (Study of root apex and shoot apex) with the help of Slides/ Models/Charts/ Photocopies (2 practicals)
2. Study of tissues, Parenchyma, Collenchyma, Sclerenchyma, Xylem And Phloem (Permanent slides only) (2 practicals)
3. Maceration of tissues and the observation of sclereids- types, vessels- thickening
4. Study secretory tissues with the help of Slides/Models/Charts/ Photocopies
5. Study of Epidermal tissue system: stomata types; trichomes: non-glandular and glandular
6. Microtomy: dehydration, clearing and embedding of material, section cutting, dewaxing
7. Preparation of a double stained permanent slide of stem of *Maize*, *Sunflower*, *Achyranthus*, *Mirabilis*, *Bignonia* and *Dracaena*, for the study of internal structures (6 practicals )
8. Study of wood specimens for Heart wood ,sap wood etc.
9. Study of Leaf anatomy : Dicot and Monocot leaf (only Permanent slides)
10. Study of root anatomy: Monocot: *Zea mays*; Dicot: *Helianthus*; Secondary growth: *Helianthus* (only Permanent slides).
11. Study of T.S of anther with help of *Datura* flower
12. Mounting of pollen grains (available flowers only) *Ipomea*, *Vinca*, *Malvaceae* and Legume.

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13. Study of Ovule/Types of ovules–Megasporogenesis and Female gametophyte (permanent slides/ Models )
14. Study of embryo and types of Endosperms (permanent slides/ Models/ Charts)
15. Study of Seed dispersal mechanisms (adaptations through photographs / specimens)
16. Field study of several types of flower with different pollination mechanisms (Wind pollination, thrips pollination, bee/butterfly pollination, bird pollination)
17. One short and one long Botanical excursion are compulsory

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BOTANY – CURRICULUM

B.Sc. General (CBCS Pattern)

Skeleton Question Paper

B. Sc. SECOND YEAR BOTANY

Annual Pattern

CCBP-II

PRACTICAL PAPER-X: BASED ON THEORY PAPER-VI & VIII

Time: Four hours

Maximum Marks: 40

Note: - (i) Attempt all questions

(ii) Show your preparation to the examiner

(iii) Draw neat and well labeled diagrams wherever necessary

Q1. Make a double stained permanent preparation of the given specimen-A. Identify and describe its internal structure. (*Maize stem / Sunflower stem / Mirabilis / Bignonia / Achyranthus* stem for specimen-A may be given alternately to the students) (10 marks)

Q2. Make a temporary preparation of (Maceration of tissues) given material and describe xylem elements (10 marks)

Q3. Describe T.S. Anther / L.S. Of Ovule with the help of given material (Flower) (08 marks)

Q4. Identify and describe the given spots (Histology & Anatomy - 2, Embryology -2) giving reasons (08 marks)

Q5. Viva-voce (04 Marks)

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**BOTANY – CURRICULUM**

**B.Sc. General (Semester Pattern)**

**Choice Based Credit System (CBCS) Pattern**

**B. Sc. Second Year**

**Annual Pattern**

**CCBP-III**

**PRACTICAL PAPER-XI: BASED ON THEORY PAPERS-VII & IX**

**Maximum Marks: 50**

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**Practical Exercises:**

1. To determine the water potential of potato tuber
2. To determine the osmotic potential of vacuolar sap by plasmolysis
3. To study the effect of temperature/ organic solvent/ concentration of different organic solvents on permeability of plasma membrane (Beet root) by using colorimeter / spectrophotometer.
4. Separation of photosynthetic pigments by paper chromatography.
5. To study the effect of light intensity on rate of photosynthesis.
6. Determination of RF value and identification of amino acids in a mixture.
7. Preparation of standard graph of starch/Glucose using Colorimeter/ Spectrophotometer and determination of starch / Glucose content of the given plant material.
8. Preparation of standard graph of protein using Colorimeter/ Spectrophotometer and determination of protein content from given plant material.
9. To estimate the percentage of oil content in given oil seeds using Soxhlet extractor.
10. Study of catalase activity under different pH and temperature.
11. To study the phenomenon of seed germination (effect of light and darkness).
12. Demonstration of osmosis by potato osmoscope.
13. Demonstration of Ascent of Sap by Balsam plant .
14. To study the mineral deficiency symptoms in at least four locally available plants.

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15. Demonstrations of the Arc indicator (lever auxanometer), Clinostat (Geotropism), Kuhn's fermentation tube experiment (Requirements, procedure and workings of the same are expected).
16. Qualitative analysis of proteins (Biuret/ Xanthoproteic/ Millon tests), Carbohydrates (Molisch /Fehlings /Benedict's) Glucose, sucrose, starch, Cellulose and Pectin.
17. Qualitative test of tannin, terpenoids, saponins, flavonoids and alkaloids.
18. Micro chemical test for organic acids – Tartaric acid, Citric acid, Oxalic and Malic acid.
19. Study of tools used in Tissue culture laboratory for sterilization and inoculation. Principle and working of Autoclave, oven, incubator, Laminar Air flow,
20. Preparation of media for tissue culture.
21. Establishment of callus cultures –from carrot.
22. Different steps involved in genetic engineering for production of Bt. cotton, Golden rice, Flavr Savr tomato through photographs.
23. Study of methods of gene transfer through photographs: *Agrobacterium*-mediated gene transfer .
24. Study major biological databases.
25. Botanical Excursions (Two short excursions and one long excursion and visits to Research laboratories)

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BOTANY – CURRICULUM

B.Sc. General (CBCS Pattern)

Skeleton Question Paper

B. Sc. Second Year

Annual Pattern

CCBP-III

PRACTICAL PAPER-XI: BASED ON THEORY PAPER-VII & IX

Time: Four hours

Maximum Marks: 40

Note: - (i) Attempt all questions

(ii) Show your preparation to the examiner

(iii) Draw neat and well labeled diagrams wherever necessary

- 
- Q1. Perform any one experiment (From practical exercise 1 to 6) (12 Marks)
- Q2. Perform any one experiment (From practical exercise 7 to 11) (10 Marks)
- Q3. Describe procedure and working of any one experiment (From practical exercise 12 to 15) (06 Marks)
- Q4. Perform any four micro-chemical tests (Protein-1, carbohydrates-1, Secondary metabolites 1, Organic acids-1) (08 Marks)
- Q5. Viva –Voce (04 Marks)

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**B.Sc. General (Semester Pattern)**

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**Skeleton Question Paper**

**B. Sc. Second Year**

**Theory Paper**

**Time: 1 hour 30 min.**

**Maximum Marks: 40**

**Note: - (I) Attempt all questions**

**(ii) Illustrate your answer with suitable labelled diagrams, wherever necessary**

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Q1. Single long answer Type question	15 marks
OR	
Two sub questions (a and b of 8 & 7 Marks)	15 marks
(This question will be based on any two units with equal weightage to each unit)	
Q2. Single long answer Type question	15 marks
OR	
Two sub questions (a and b of 8 & 7 Marks)	15 marks
(This question will be based on remaining two units with equal weightage to each unit excluding units used in question no 1)	
Q3. Attempt any two of the four (Each of 05 Marks)	10 marks
a)	
b)	
c)	

(Note: This question shall be on entire syllabus and must have one sub-question from each of the units)

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CHOICE BASED CREDIT SYSTEM (CBCS) FOR**

**SUBJECT: BOTANY**

**B.Sc. Second Year**

**Annual Pattern**

**SECB-I (A) FRUIT AND VEGETABLE PROCESSING**

**Periods: 45**

**Credits: 02 (Marks-50)**

### **UNIT I**

Production and processing scenario of fruits and vegetables in India and World, Scope of fruit and vegetable preservation industry in India. Present status, constraints and prospects, Overview of principles and preservation methods of fruits and vegetables ( Physical and Chemical), Commercial processing technology of fruits and vegetables, Primary processing and pack house handling of fruits and vegetables; Peeling, slicing, cubing, cutting and other size reduction operations for fruits and vegetables, Minimal processing of fruits and vegetables Blanching operations and equipment.

### **UNIT II**

Preparation and preservation of juices, squashes, syrups, sherbets, nectars, cordials, etc; Problems on squash and RTS; Processing and equipment for above products and FSSAI specification Preparation, preservation and machines for manufacture of crystallized fruits and preserves, jam, jelly and candies, Preparation, preservation and machines for manufacture of preserve, concentrate, fruit wine, pickles, sauce, paste, ketchup; toffee, cheese, lather, soup powders; FSSAI specification, Commercial processing technology of selected fruits and vegetables for production of various value added processed products.

#### **Practicals :**

1. Preparation of jam/ jelly from selected fruit
2. Preparation of RTS beverage e.g. Amala, Mango and Pineapple etc
3. Preparation of squash
4. Preparation of fruit candy
5. Preparation of fruit leather
6. Preparation of fruit toffee
7. Preparation of pickle

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8. Preparation of banana and potato wafers
9. Visit to fruits and vegetable processing unit

**Note:** Minimum of 5 practicals need to be conducted.

**Reference Books**

1. Fruit and Vegetable Preservation Principles and Practices: Srivastava R.P. and Sanjeev Kumar International Book Distributing Company, New Delhi 2005
2. Post-Harvest Technology of Fruits and Vegetables: Handling, Processing, Fermentation and Waste Management vol. I & II Varma L. R. and Joshi V.K. Indus Publishing, 2000
3. Preservation of Fruits and Vegetables: Khader ICAR, New Delhi 2010
4. Preservation of Fruits and Vegetable: G. Lal, G.S. Siddappa, G.L. Tandan ICAR Publication,, New Delhi 1996
5. Fruit and Vegetable Processing M.G. Danthy FAO, Rome
6. Post-harvest Handling and Processing of Fruit and Vegetable I.S. Singh Text book Fruit Processing David Arthey,
7. Handbook of Fruit and and Vegetable Processing Sinha and Hui John Wiley Sons, 2010
8. Fruit and Vegetable Preservation -Principles and Practices Srivastava RP & Kumar S International Book Distributors, 2003
9. Handbook of Fruit Science &Technology: Production, Composition and Processing. Salunkhe DK & Kadam SS. Marcel Dekker 1995

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**B.Sc. Second Year**

**Annual Pattern**

**SECB-I (B) BIOINSTRUMENTATION**

**Periods: 45**

**Credits: 02 (Marks-50)**

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**UNIT I**

Chromatography and Centrifugation: General principles of separation, paper chromatography, thin layer, affinity, gel permeation, ion exchange, GLC, HPTLC, preparative and analytical centrifugations and their application

**UNIT II**

Electrophoresis and Spectroscopy: Basic principles of electrophoresis, Factor affecting, Electrophoretic mobility, native and denaturing PAGE, isoelectric focusing, 2DE, Pulse field gel, Electrophoresis. Spectroscopy: Theory and applications of Ultra violet and visible spectroscopy, IR, Nuclear magnetic resonance, Mass and applications.

**Practicals**

**1. Centrifugation**

- a. Isolation of cell organelles like cell membrane, mitochondria, ribosomes etc.
- b. Determination of molecular weight of protein by centrifugation

**2. Chromatography**

- a. Separation of amino acids by paper chromatography
- b. Separation of sugars by TLC
- c. Separation of plant pigments by paper/ TLC
- d. Purification of proteins by Column / ion exchange / Molecular sieve chromatography

**3. Electrophoresis**

- a. Separation of soy bean proteins by PAGE

**4. Spectroscopy**

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- a. Validation of Lambert-Beer's law (Photometer)
- b. Estimation of DNA by DPA method (UV spectrophotometer)
- c. Estimation of reducing sugars by DNSA method (VIS-Spectrophotometer.)

**Note:** Minimum of 5 practicals need to be conducted.

**Reference Books:**

1. Practical Biochemistry Paperback – 2016 - Damodaran Geetha K
2. An Introduction to Practical Biochemistry Paperback –2017 - David Plummer
3. Practical Biochemistry Paperback –2013 - R. C. Gupta
4. Practical Biochemistry: A Student Companion Paperback –2015 - Tiwari Anand
5. Laboratory Manual for Practical Biochemistry Paperback – 2013 - Shivaraja Shankara Ym
6. A Text Book of Practical Biochemistry: 2006 - Rashmi A. Joshi, Manju Saraswat

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**SECB-II (A) NURSERY AND GARDENING**

**Periods: 45**

**Credits: 02 (Marks-50)**

**UNIT I**

**Nursery:** definition, objectives and scope and building up of infrastructure for nursery, planning and seasonal activities - Planting - direct seeding and transplants.

**Vegetative propagation:** air-layering, cutting, selection of cutting, collecting season, treatment of cutting, rooting medium and planting of cuttings, Hardening of plants, green house, mist chamber, shed roof, shade house and glass house.

**Gardening:** definition, objectives and scope, different types of gardening, landscape and home gardening, parks and its components, plant materials and design, computer applications in landscaping, Landscaping highways and Educational institutions.

Gardening operations: soil laying, manuring, watering, management of pests and diseases and harvesting.


**UNIT II**

**Ornamental Plants:** Flowering annuals; Herbaceous perennials; Divine vines; Shade and ornamental trees; Ornamental bulbous and foliage plants; Cacti and succulents; Palms and Cycads; Ferns and Selaginellas; Cultivation of plants in pots; Indoor gardening; Bonsai, diseases and Pests of Ornamental Plants.

**Principles of Garden Designs:** English, Italian, French, Persian, Mughal and Japanese gardens; Features of a garden (Garden wall, Fencing, Steps, Hedge, Edging, Lawn, Flower beds, Shrubbery, Borders, Water garden). Some Famous gardens of India.

**Practicals:**

1. Preparation of nursery beds and sowing of seeds.
2. Study of Soil sterilization process
3. Seed sowing and transplantation methods

  
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4. Study Garden tools and implements, Study of containers - earthen containers, pots, polybags, cement pots and ceramic pots.
5. Garden designing and hedge preparation methods
6. Identification of landscape trees, shrubs / climbers and ground covers.
7. Layout of land for lawn and Preparation of land for lawn.
8. Designing of home gardens
9. Identification and growing of indoor plants of their basic requirements
10. Patterns of flower arrangement in vase
11. Study of disease and pests of ornamental plants
12. Visit to commercial nursery.

**Note:** Minimum of five practicals need to be conducted

**References:**

1. Agrawal, P.K. (1993). Hand Book of Seed Technology. New Delhi, Delhi: Dept. of Agriculture and Cooperation, National Seed Corporation Ltd.
2. Bose T.K., Mukherjee, D. (1972). Gardening in India. New Delhi, Delhi: Oxford & IBH Publishing Co.
3. Jules, J. (1979). Horticultural Science, 3rd edition. San Francisco, California: W.H. Freeman and Co.
4. Kumar, N. (1997). Introduction to Horticulture. Nagercoil, Tamil Nadu: Rajalakshmi Publications.
5. Musser E., Andres. (2005). Fundamentals of Horticulture. New Delhi, Delhi: McGraw Hill Book Co.
6. Sandhu, M.K. (1989). Plant Propagation. Madras, Bangalore: Wile Eastern Ltd.

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B.Sc. Second Year

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SECB-II (B) BIO-FERTILIZERS

Periods: 45

Credits: 02 (Marks – 50)

UNIT 1

General account about the microbes used as biofertilizer – Rhizobium – isolation, identification, mass multiplication, carrier based inoculants, Actinorrhizal symbiosis.

*Azospirillum*: isolation and mass multiplication – carrier based inoculant, associative effect of different microorganisms. *Azotobacter*: classification, characteristics – crop response to *Azotobacter* inoculum, maintenance and mass multiplication. Cyanobacteria (blue green algae), *Azolla* and *Anabaena azollae* association, nitrogen fixation, factors affecting growth, blue green algae and *Azolla* in rice cultivation.

UNIT II

Mycorrhizal association, types of mycorrhizal association, taxonomy, occurrence and distribution, phosphorus nutrition, growth and yield – colonization of VAM – isolation and inoculum production of VAM, and its influence on growth and yield of crop plants.

Organic farming – Green manuring and organic fertilizers, recycling of biodegradable municipal, agricultural and Industrial wastes – biocompost making methods, types and method of vermicomposting – field Application. Biofertilizers - Storage, shelf life, quality control and marketing.

Practicals:

1. Isolation of Phosphate solubilizing micro-organisms from rhizosphere
2. Isolation of Rhizobium from root nodules of leguminous crop
3. Isolation and purification of *Azotobacter* from soil
4. Isolation and purification of *Beijerinckia* form soil
5. Isolation of *Azospirillum*
6. Isolation Blue Green Algae from soil

  
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7. Isolation of organic matter decomposing microorganisms
8. Mass multiplication of *Rhizobium*, *Azotobacter*, and *Azospirillum* inoculants
9. Production and application of blue green algae
10. Production of *Azolla* biofertilizers
11. Isolation of arbuscular mycorrhizal spores from rhizospheric soil
12. Methods of application of biofertilizers
13. Standards for commercial production of biofertilizers- Quality control of biofertilizers.

**Note:** Minimum of five practicals need to be conducted

**References:**

1. Bagyaraj, D.J. and A. Manjunath. 1990. Mycorrhizal symbiosis and plant growth, Univ. of Agricultural Sciences, Bangalore, India.
2. Krieg N.R. and J.G. Holt, 1984 Bergy's manual of systematic bacteriology, Williams and Wilkins, Baltimore, U.S.A.
3. Purohit, S.S., P.R. Kothari and S.K. Mathur, 1993. Basic and Agricultural Biotechnology, Agro Botanical Pub. India.
4. Rangaswamy G. and D.J. Bhagyaraj 1988 Agricultural Microbiology, Oxford and IBH Publication Co. New Delhi.
5. Somani, L.L., S.C. Bhandari, K.K. Vyas and S.N. Saxena. 1990. Biofertilizers, Scientific Publishers - Jodhpur.
6. Subba Rao, Soil microorganisms - Oxford and IBH Publication Co. New Delhi.
7. Subba Rao, Advances in Agril. Microbiology, Oxford and IBH Publication Co, New Delhi.
8. Subba Rao, N. S. 1988. Biological nitrogen fixation: recent developments, Mohan Pramlani for Oxford and IBH Pub. Co. (P) Ltd., India.
9. Subba Rao, N.S., G.S. Venkataraman and S. Kannaiyan 1993. Biological nitrogen Fixation, ICAR Pub., New Delhi.

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CHOICE BASED CREDIT SYSTEM (CBCS) FOR**

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**B.Sc. Second Year**

**Annual Pattern**

**SECB-I &II**

**END OF SEMESTER EXAMINATION (ESE)**

**SEAT NO:**

**MARK SHEET**

<b>Sr. No.</b>	<b>END OF SEMESTER EXAMINATION (ESE)</b>	<b>Maximum Marks</b>	<b>Obtained Marks</b>
<b>1</b>	<b>Skill Work report submission</b>	<b>10</b>	
<b>2</b>	<b>Over all skill judgment</b>	<b>10</b>	
<b>3</b>	<b>Skill Work presentation</b>	<b>05</b>	
<b>Total</b>		<b>25</b>	

**Name & Signature of:**

**Examiner- 1:**

**Examiner- 2:**

  
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- Bajracharya, D. 1999. *Experiments in Plant Physiology: A Laboratory Manual*. Narosa
- Becker, W.M., Kleinsmith, L.J., Hardin, J., Bertoni, G. P. (2009). *The World of the Cell*, 7th edition. San Francisco, Cambridge: Pearson Benjamin Cummings Publishing.
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- Bewley, J.D. and Black, M. *Seeds: Physiology of Development and Germination*, Plenum
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- Bhattacharya, K., Majumdar, M.R. and Bhattacharya, S.G. 2006. *A Textbook of Palynology*. New Central Book Agency (P) Ltd. New Delhi.
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- Bhojwani, S.S. Bhatnagar, S.P. and Dantu, P.K. *The Embryology of Angiosperms (6th revised and enlarged edition)*. Vikas Publishing House, New Delhi, 2015.
- *biology of plants*. Published by Krishan Makhijanifo I.K. International Pvt. Ltd, Upkhaar CinemaMarket, New Delhi, 2007.
- Biondi, F. *Tree-ring Analysis of Environmental Change: Principles and Applications of Biotechnology*. Published by S.Chand and Company Pvt. Ltd., 7361 Ram Nagar,
- Bob B. Buchanan, Wilhelm Grisse and Russel, L. Jones. *Biochemistry and Molecular*
- Bray, C. M. *Nitrogen metabolism in Plants*. Longman, 1983.

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Academic Press Orlando

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