

**SU/BOS/Science/481**

**Date: 01/07/2023**

**To,**

The Principal, All Concerned Affiliated Colleges/Institutions Shivaji University, Kolhapur	The Head/Co-ordinator/Director All Concerned Department (Science) Shivaji University, Kolhapur.
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**Subject:** Regarding syllabi of B.Sc. Part-II (Sem. III & IV) as per NEP-2020 degree programme under the Faculty of Science and Technology.

**Sir/Madam,**

With reference to the subject mentioned above, I am directed to inform you that the university authorities have accepted and granted approval to the revised syllabi, nature of question paper and equivalence of B.Sc. Part-II (Sem. III & IV) as per NEP-2020 degree programme under the Faculty of Science and Technology.

B.Sc. Part-II (Sem III & IV) as per NEP-2020			
1.	Mathematics	8.	Chemistry
2.	Statistics	9.	Sugar Technology (Entire)
3.	Physics	10.	Microbiology
4.	Astrophysics	11.	Industrial Microbiology
5.	Zoology	12.	Electronics
6.	Botany	13.	Geology
7.	Plant Protection		

This syllabus, nature of question and equivalence shall be implemented from the academic year 2023-2024 onwards. A soft copy containing the syllabus is attached herewith and it is also available on university website [www.unishivaji.ac.in](http://www.unishivaji.ac.in)

The question papers on the pre-revised syllabi of above-mentioned course will be set for the examinations to be held in October /November 2023 & March/April 2024. These chances are available for repeater students, if any.

You are, therefore, requested to bring this to the notice of all students and teachers concerned.

Thanking you,

  
**Dy Registrar**  
**Dr. S. M. Kubal**

**Copy to:**

1	The Dean, Faculty of Science & Technology	8	P.G. Admission/Seminar Section
2	Director, Board of Examinations and Evaluation	9	Computer Centre/ Eligibility Section
3	The Chairman, Respective Board of Studies	10	Affiliation Section (U.G.) (P.G.)
4	B.Sc. Exam/ Appointment Section	11	Centre for Distance Education

# **SHIVAJI UNIVERSITY, KOLHAPUR.**



**Accredited By NAAC with 'A<sup>++</sup>' Grade**

**Revised Syllabus For**

**B. Sc. II Botany**

(Faculty of Science & Technology)

**Paper –V, VI - (Semester- III)**

**and**

**Paper -VII, VIII - (Semester- IV)**

**(NEP-2020) CBCS Syllabus to be implemented from June, 2023 onwards**

**A] Ordinance and Regulations: (As applicable to Degree Course)**

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**B] Shivaji University, Kolhapur**

Revised syllabus for Bachelor of Science

**1. TITLE:** Subject-Botany

Optional under the Faculty of Science

**2. YEAR OF IMPLEMENTATION:-** Revised Syllabi (As per NEP 2020) will be implemented from June 2023 onwards.

**3. PREAMBLE:-**

[**Note:** - The Board of Studies should briefly mention foundation, core and applied components of the course/paper. The student should get into the prime objectives and expected level of study with required outcome in terms of basic and advance knowledge at examination level.]

**4. GENERAL OBJECTIVES OF THE COURSE:**

**(as applicable to the Degree concerned) Objectives:-**

- 1) To impart knowledge of Science is the basic objective of education.
- 2) To develop scientific attitude is the major objective to make the students open minded, critical, curious.
- 3) To develop skill in practical work, experiments and laboratory materials and equipments along with the collection and interpretation of scientific data to contribute the science.
- 4) To understand scientific terms, concepts, facts, phenomenon and their relationships.
- 5) To make the students aware of natural resources and environment.
- 6) To provide practical experience to the students as a part of the course to develop scientific ability to work in the field of research and other fields of their own interest and to make them fit for society.
- 7) The students are expected to acquire knowledge of plant and related subjects so as to understand natural phenomenon, manipulation of nature and environment in the benefit of human beings.
- 8) To develop ability for the application of the acquired knowledge to improve agriculture and other related fields to make the country self reliant and sufficient.
- 9) To create the interest of the society in the subject and scientific hobbies, exhibitions and other similar activities.

**5. DURATION**

The course shall be a fulltime course.

**6. PATTERN:-**

Pattern of examination will be semester.

## **7. FEE STRUCTURE:-**

### **As per Government / University rules**

1. Refer brochure and prospectus of concern affiliated college/institute to Shivaji University, Kolhapur.
2. Other fee will be applicable as per rules and norms of Shivaji University, Kolhapur.

## **8. ELIGIBILITY FOR ADMISSION:**

As per guidelines obtained from Shivaji University, Kolhapur by following rules and regarding reservations by Govt. of Maharashtra

## **9. MEDIUM OF INSTRUCTION:**

The medium of instruction shall be in English.

## **10. STRUCTURE OF THE COURSE - B. Sc. II Botany**

### **SECOND YEAR (SEMESTER III / IV) ( NO. OF PAPERS 4)**

<b>Sr. No.</b>	<b>Subjects/Papers</b>	<b>Theory</b>	<b>Internal</b>	<b>Total Marks</b>
1.	Paper-V	40	10	50
2.	Paper-VI	40	10	50
3.	Paper-VII	40	10	50
4.	Paper-VIII	40	10	50
	Practical-I			50
	Practical-II			50
<b>Total</b>				<b>300</b>

## **11. SCHEME OF TEACHING AND EXAMINATION:-**

[The scheme of teaching and examination should be given as applicable to the course/paper concerned.]

**SECOND YEAR- SEMESTER–III/IV: Botany (Optional)**

## Scheme of Teaching and Examination

Sr. No.	Subject/Paper	Teaching Scheme (Hrs/Week)				Examination Scheme (Marks)		
		L	T	P	Total	Theory	Term Work	Total
	<b>Semester-III</b>							
1	Paper-V	03	-	-	03	40	10	50
2	Paper-VI	03	-	-	03	40	10	50
	<b>Semester-IV</b>							
3	Paper-VII	03	-	-	03	40	10	50
4	Paper-VIII	03	-	-	03	40	10	50
	Practical- I (annual)	-	-	04	04	-	-	50
	Practical- II (annual)	-	-	04	04	-	-	50
	Total	06	-	08	14	-	-	300

**12. SCHEME OF EXAMINATION :-**

- The examination shall be conducted at the end of each term for semester pattern.
- The theory paper shall carry 40 marks.
- The evaluation of the performance of the students in theory papers shall be on the basis of Semester Examination of 40 marks.
- The internal evaluation for each paper shall carry 10 marks. (Semester III: Group activity and Semester IV: Case study/Oral examination)
- Question paper will be set in the view of the /in accordance with the entire syllabus and preferably covering each unit of syllabi.

**13. STANDARD OF PASSING:-**

As prescribed under rules and regulation for each degree.

**14. NATURE OF THEORY QUESTION PAPER AND SCHEME OF MARKING:**

- Q. 1. Multiple choices questions (8-questions) --- 8 Marks
- Q. 2. Attempt **any two** of the following (out of three).  
(Essay type / Broad answer questions)---- 16 Marks
- Q. 3. Write short notes (**any four**) (out of six). 16 Marks

**15. EQUIVALENCE IN ACCORDANCE WITH TITLES AND CONTENTS OF PAPERS- (FOR REVISED SYLLABUS)**

**(Introduced from June 2023 onwards)**

<b>Old Syllabus (Semester pattern)</b>		<b>Revised Syllabus (Semester pattern)</b>		
<b>Paper No.</b>	<b>Title of Old Paper</b>	<b>Semester No.</b>	<b>Paper No.</b>	<b>Title of New Paper</b>
V	Embryology of Angiosperms	Semester- III	V	Plant Systematics and Anatomy
VI	Plant Physiology		VI	Genetics and Molecular Biology
VII	Plant Anatomy	Semester- IV	VII	Plant Ecology and Economic Botany
VIII	Plant Metabolism		VIII	Plant Physiology, Nursery and Gardening Techniques

**16. SPECIAL INSTRUCTIONS, IF ANY**

**SEMESTER-III**  
**Botany Paper V: DSC C13: PLANT SYSTEMATICS AND ANATOMY**  
**CREDITS: 2, LECTURE PERIOD: 3 PER WEEK**  
**LECTURE HOURS: 3 PER WEEK, MARKS: 50**

UNIT	SUBUNIT	TOPIC	LECTURE PERIOD
<b>1.</b>	<b>PLANT SYSTEMATICS</b>		<b>15</b>
	1a. Plant systematics	1.1 Introduction to systematics, Functions of Taxonomy: Plant Identification, Classification, Nomenclature. 1.2 Principle and Rules of ICN 1.3 Morphology of flowering plants: a. Root: Definition, Types and Modifications (Conical, Fusiform, Napiform, Prop, Pneumatophore) b. Stem: Definition and Modifications (Phylloclade, Rhizome, Corm, Tuber) c. Leaf: Definition and (Simple and Compound, Phyllotaxy) d. Flower: Definition, Typical flower and Types (Actinomorphic, Zygomorphic) e. Inflorescence: Definition and Types f. Fruits: Definition and types 1.4 Bentham and Hooker's Classification (outline up to subclasses mentioning the numbers of series, orders), Merits and demerits.	<b>13</b>
	1b. Herbaria and Botanic gardens	1.5 Herbaria: Introduction and functions, examples with salient features: a. 'CAL' b. 'K' (Virtual herbarium) 1.6 Botanic gardens: Introduction and functions, example with salient features: Lead Botanic Garden (SUK)	<b>2</b>
<b>2.</b>	<b>PLANT ANATOMY</b>		<b>15</b>
	2a. Structure and development of plant body	2.1 Anatomy: Introduction to internal organization of plant body 2.2 Organization of shoot apex: Apical cell theory 2.3 Organization of root apex: Quiescent centre concept 2.4 Types of tissues: a. Meristematic tissue types based on position (Apical, intercalary and lateral) b. Permanent tissue types [Simple tissue: Parenchyma, Collenchyma, Sclerenchyma and Complex tissue: Xylem, Phloem]	<b>9</b>
	2b. Primary and secondary structure	2.6 Primary structure of root, stem and leaf (Dicot and Monocot)	<b>6</b>

		2.7 Secondary structure (Normal) of root and stem (Dicot and Monocot)	
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### SEMESTER-III

#### Botany Paper VI: DSC C14: GENETICS AND MOLECULAR BIOLOGY

**CREDITS: 2, LECTURE PERIOD: 3 PER WEEK**

**LECTURE HOURS: 3 PER WEEK, MARKS: 50**

UNIT	SUBUNIT	TOPIC	LECTURE PERIOD
<b>1.</b>	<b>GENETICS</b>		<b>15</b>
	1a. Mendelian inheritance	1.1 Introduction and terminologies 1.2 Principles of inheritance-Mendel's Laws 1.3 Chromosome theory of inheritance 1.4 Linkage: Introduction, types and significance 1.5 Crossing over : Introduction and significance	<b>8</b>
	1b. Variation in Chromosome Number and Structure	1.6 Structure of chromosome and types of chromosome based on position of centromere 1.7 Structural variations: Deletion, Duplication, Inversion and Translocation 1.8 Numerical variations: Euploidy and Aneuploidy	<b>7</b>
<b>2.</b>	<b>MOLECULAR BIOLOGY</b>		<b>15</b>
	2a. Nucleic Acids: Carriers of Genetic Information	2.1 Nucleic acids – DNA and RNA a. DNA structure: Watson and Crick's Model, Forms of DNA – A, B, Z. b. RNA structure, Types- mRNA, tRNA and rRNA c. Significance of nucleic acids 2.2 DNA as a genetic material: Griffith's experiment.	<b>9</b>
	2b. DNA Replication	2.3 Concept of Central Dogma of molecular biology 2.4 DNA replication and Enzymes involved 2.5 Concept of genetic code	<b>6</b>



**SEMESTER-IV****Botany Paper VII: DSC D13: PLANT ECOLOGY AND ECONOMIC BOTANY**  
**CREDITS: 2, LECTURE PERIOD: 3 PER WEEK**  
**LECTURE HOURS: 3 PER WEEK, MARKS: 50**

Module	Sub-Module	Topics	Lecture Period
<b>1</b>	<b>PLANT ECOLOGY</b>		<b>15</b>
	1a. Introduction to Plant Ecology	1.1 Basic Concept, Levels of organization 1.2 Concept and Types of ecosystems: a. Terrestrial-Grassland b. Aquatic-Lake 1.3 Trophic organization, Food Chains and Webs and Ecological pyramids 1.4 Phytogeography: Principles, Phytogeographical regions of India (Chattarjee, 1962)	<b>9</b>
	1b. Abiotic factors: Soil and Water	1.5 Soil: Importance, Origin, Formation, Composition and Soil profile. 1.6 Water: Introduction and importance, States of water in the soil and environment, Water Table; plant indicators of water table.	<b>6</b>
<b>2</b>	<b>ECONOMIC BOTANY</b>		<b>15</b>
	2a. Origin of Cultivated Plants	2.1 Concept of Centers of Origin, their importance with reference to Vavilov's work, 2.2 Importance of Germplasm diversity- Seed bank; Contribution of Padmashree Rahibai Soma Popere (Bijmata)	<b>4</b>
<b>F</b>	2b. Utilization of plants	2.3 Botanical name, Origin (Native place), Morphology, Plant parts used and Economic importance of a. Millets: Finger millet b. Spices: Clove c. Condiment: Bay leaf (Tamalpatra) d. Beverages: Coffee e. Oil yielding: Soybean f. Medicinal: Neem g. Dyes: Heena h. Cosmetics: <i>Aloe</i> i. Timber: Teak j. Fibers: Cotton k. Rubber: Rubber fig	<b>11</b>

**SEMESTER-IV**  
**Botany Paper VIII: DSC D14: PLANT PHYSIOLOGY, NURSERY AND**  
**GARDENING TECHNIQUES**  
**CREDITS: 2, LECTURE PERIOD: 3 PER WEEK**  
**LECTURE HOURS: 3 PER WEEK, MARKS: 50**

Module	Sub-Module	Topics	Lecture Period
<b>1</b>	<b>PLANT PHYSIOLOGY</b>		<b>15</b>
	1a. Fundamentals of Plant Physiology and Photosynthesis	1.1 Introduction to Plant Physiology. 1.2 Photosynthesis-Introduction and significance 1.3 Photosynthetic pigments(Chlorophyll a, b, xanthophylls, carotene) and Photosystems 1.4 Mechanism of Photosynthesis- a) Light reaction: Photolysis of water, Photophosphorylation (cyclic and non-cyclic) b) Dark Reaction: C <sub>3</sub> , C <sub>4</sub> and CAM pathways	<b>8</b>
	1b. Respiration	1.5 Respiration: Introduction and significance 1.6 Types of Respiration: Aerobic and Anaerobic 1.7 Mechanism of Aerobic respiration a) Glycolysis b) Formation of Acetyl- CoA c) TCA / Krebs cycle d) Electron transport system in mitochondria	<b>7</b>
<b>2</b>	<b>NURSERY AND GARDENING TECHNIQUES</b>		<b>15</b>
	2a. Nursery techniques	2.1 Nursery: Definition, objectives, types and scope 2.2 Infrastructure and planning for nursery, poly house. 2.3 Propagation practices a. Seed propagation - Planting-direct seedling and transplants. b. Vegetative propagation – cutting (Soft wood and hard wood), layering (air), grafting (Whip and Tongue) and budding ('T' and Patch).	<b>07</b>
	2b. Gardening Techniques	2.4 Introduction, objectives, scope and advanced gardening 2.5 Types of gardening-landscape and home gardening, Terrarium, Floating garden, Bottle garden, Hanging garden, Vertical garden. 2.6 Bonsai technique 2.7: Important gardens in India: Lalbagh (Bangalore) and Mughal Garden (New Delhi)	<b>08</b>

## **Practical - I**

### **(Based on paper V and VI)**

1. Study of types and modifications of root and stem.
2. Study of typical flower and types of inflorescence.
3. Study of types of fruits.
- 4 and 5. Study of vegetative and floral characters of the following families:
  - i. Polypetalae : Leguminosae (Papilionaceae)
  - ii. Gamopetalae : Bignoniaceae
  - iii. Apetalae : Euphorbiaceae
  - iv. Monocot : Amaryllidaceae
6. Preparation of herbarium specimens (technique) and searching of digital or e-herbarium specimen at virtual herbarium (K) (e.g. *Ficus religiosa*).
7. Study of meristem (RAM and SAM).
8. Study of simple and complex tissues. (by permanent slides)
9. Study of primary structure of dicot and monocot root.
10. Study of primary structure of dicot and monocot stem.
11. Preparation of double stained permanent slide of any suitable material.
12. Maceration technique
13. Study of Mendel's Law through suitable phenotypic trait in plant material.
14. Genetic examples of Linkage.
15. Genetic examples of Crossing over.
- 16 and 17. Karyotypic study in plants using photomicrograph (any two plant materials e.g. *Allium cepa* and *Aloe vera*).
18. Study of structural variations in chromosome with the help of photomicrograph.
19. Study of 'nucleic acid as genetic material by using photographs (Griffith's experiment).
20. Determination of amino acid sequences in polypeptide from the given data (nucleotide sequence of mRNA).
21. Preparation of nuclear stains: Acetocarmine or Aceto orcein
22. Isolation of plant genomic DNA.
23. Estimation of DNA from plant material by using Diphenylamine.
24. Estimation of RNA from plant material by using Orcinol.
25. Submission of herbarium specimen of weeds (Minimum 10).

**Practical - II**  
**(Based on Paper VII and VIII)**

1. Study of Phytogeographical regions of India (Chattarjee, 1962).
2. Determination of soil texture. (any two samples)
3. Determination of water holding capacity of soil. (any two samples)
4. Determination of pH of water. (any two samples)
5. Determination of Soil Water Content (SWC) of any two samples.
6. Study of ecological pyramids from given data.
7. Preparation of Nachani Satwa.
8. Study of origin (Native place), Botanical name, Morphology, Plant parts used and Economic importance of Spices and Medicinal plant: Bay leaf and Neem.
9. Study of origin (Native place), Botanical name, Morphology, Plant parts used and Economic importance of Beverages: Coffee and Oil yielding plant: Soybean.
10. Preparation of Heena dye and Aloe gel.
11. Study of origin (Native place), Botanical name, Morphology, Plant parts used and Economic importance of Timber: Teak and Rubber: Rubber fig
12. Study of origin (Native place), Botanical name, Morphology, Plant parts used and Economic importance of Fiber yielding plant: Cotton
13. Separation of Photosynthetic pigments by paper chromatography/TLC.
14. Study of Kranz leaf anatomy in C<sub>4</sub> plants.
15. Estimation of TAN value in CAM plants.
16. Study of effect of light intensity on photosynthesis.
17. Study of respiration in germinating seeds by using Ganong's respirometer.
18. Demonstration of fermentation.
19. Study of budding technique-Patch.
20. Study of grafting technique- Whip.
21. Preparation of potting mixture and technique of potting and repotting.
22. Demonstration of Bonsai technique.
23. Garden layout designing and drawing (any type).
24. Garden implements (any four) - Garden shear, sickle, cutter, shovel, budding knife, secateurs, water can, pruning scissors, sprayer, spade.
25. Visit to nursery/Aesthetic garden/ Places of botanical interest (Separate report to be submitted by students).

## PRACTICALS IN BOTANY

### Study Tour/Botanical excursion:

One teacher along with a batch not more than 20 students is taken for Botanical excursions to places of botanical interest, one in each term. If there are female students in a batch of sixteen, one additional lady teacher is permissible for excursion. Each excursion will not be more than 4 days during college working days. T.A. and D.A. for teachers and non teaching staff participating in the excursions should be paid as per the rules. The tour report duly certified by the concerned teacher and the head of the department should be submitted at the time of practical examination.

### Details of Practical Examination

B. Sc. II Botany Practical – I and II are to be covered in 25 practicals each. These practicals are to be performed by the students. Each practical is to be supplemented by permanent slides, preserved / fresh specimens / materials, charts, photomicrograph, ideogram herbarium sheets, wherever necessary.

Every candidate must produce a certificate from Head of the Department in his / her college stating that he / she has completed practical course in a satisfactory manner as per the lines laid down by academic council on the recommendations of Board of Studies in Botany. The student should record his / her observations and report of each experiment should be written in the Journal.

The Journal is to be signed periodically by teacher in charge and certified by Head of the Department at the end of the year. Candidates have to produce their certified journal and tour reports at the time of practical examination. **A candidate will not be allowed to appear for the practical examination without a certified journal, otherwise a candidate must produce a separate certificate of his / her regular attendance for practical course and completion of the same signed by the concerned teacher and Head of the Department.**

### Total Marks for practical 100 Marks

- a) Practical – I : 50 Marks
- b) Practical – II : 50 Marks

The practical course is to be covered in 50 practicals. The practical course should be divided into Practical - I which will comprise 25 practicals based on Paper V and Paper VI where as the Practical - II will comprise 25 practicals based on Paper VII and VIII. The Practical - I will carry 50 marks and practical II will also carry 50 marks. The practical examination will be conducted at the end of semester IV on two successive days.

Each practical examination (Practical I and II) should be of 5 hours duration and shall test a candidate in respect of following –

- i. Identification and preparation of temporary and permanent slides.
- ii. Practical study of external and internal structures of different plants as per the syllabus.
- iii. Understanding of principles of the experiments.
- iv. Identification and setting of physiological experiments.
- v. Recording of observations and conclusions.
- vi. Identification and understanding of the practicals conducted with respect to development of plants.
- vii. Spotting of the specimens as per the syllabus.
- viii. Submission of the tour report.

## **Course Outcomes:**

### **Paper V:**

After successful completion of the course, the students will be able

1. To know the scope and importance of the plant systematics.
2. To understand plant morphology, nomenclature and classification
3. To prepare and demonstrate herbarium and to understand importance of Botanical gardens.
4. To examine internal organization of plant organs.
5. To differentiate and understand plant tissue systems.
6. To analyze the composition of different parts of plant.

### **Paper VI:**

After successful completion of the course, the students will be able

1. To understand the principles of Mendelian inheritance and gene interaction.
2. To differentiate between structural and numerical variations in chromosomes.
3. To analyze and solve genetic problems on linkage and crossing over.
4. To know the composition and significance of nucleic acids.
5. To summarize concept of central dogma and genetic code.

### **Paper VII:**

After successful completion of the course, the students will be able

1. To understand core concepts of biotic and abiotic components.
2. To gain and insight in to the diverse ecosystem, related food web and ecological pyramids.
3. To prepare map of Phytogeographical regions of India.
4. Know importance of plants and plant products and their utility.
5. To know the centre of origins of different crop plants.
6. To understand importance and conservation of Germplasm.

### **Paper VIII:**

After successful completion of the course, the students will be able

1. To understand various physiological processes in plants.
2. To understand significance and mechanism of photosynthesis.
3. To know the process of respiration in higher plants.
4. To design outlines of landscaping and home gardening.
5. To propagate plants by seed and vegetative propagation.
6. To prepare different types of gardens and to know garden equipments.

**(iii) Specific Objectives:-----**

**(iv) A brief note :-** ( On expected level of study from examination and assessment point of view):- -----

**(v) Recommended Reading:**

(In MLA/APA Style Sheet Format)

- a) Basic Reading :-
- b) Additional Reading :-
- c) References :-
- d) Books

**List of Books Recommended for B. Sc. II Botany**

**Plant Systematics**

1. Singh, G. (2012). *Plant Systematics: Theory and Practice* Oxford & IBH Pvt. Ltd., New Delhi.
2. 3<sup>rd</sup> edition.
3. Jeffrey, C. (1982). *An Introduction to Plant Taxonomy*. Cambridge University Press, Cambridge.
4. Judd, W.S., Campbell, C.S., Kellogg, E.A., Stevens, P.F. (2002). *Plant Systematics-A Phylogenetic Approach*. Sinauer Associates Inc., U.S.A. 2<sup>nd</sup> edition.
5. Radford, A.E. (1986). *Fundamentals of Plant Systematics*. Harper and Row, New York.
6. Simpson, M. G. (2006). *Plant Systematics*. Elsevier.
7. Cooke, T. (1903). *The Flora of Presidency of Bombay*, I, London, (B.S.I. Repr. ed., 1958.) Botanical Survey of India, Calcutta.

**Plant Anatomy:**

1. Dickison, W.C. (2000). *Integrative Plant Anatomy*. Harcourt Academic Press, USA.
2. Fahn, A. (1974). *Plant Anatomy*. Pergmon Press, USA.
3. Mauseth, J.D. (1988). *Plant Anatomy*. The Benjamin/Cummings Publisher, USA.
4. Evert, R.F. (2006) *Esau's Plant Anatomy: Meristems, Cells, and Tissues of the Plant Body: Their Structure, Function and Development*. John Wiley and Sons, Inc.

**Genetics and Molecular biology:**

1. Watson J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M., Losick, R. (2007). *Molecular Biology of the Gene*, Pearson Benjamin Cummings, CSHL Press, New York, U.S.A. 6<sup>th</sup> edition.
2. Snustad, D.P. and Simmons, M.J. (2010). *Principles of Genetics*. John Wiley and Sons Inc., U.S.A. 5<sup>th</sup> edition.
3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). *Concepts of Genetics*. Benjamin Cummings. U.S.A. 9<sup>th</sup> edition.
4. Russell, P. J. (2010). *i-Genetics- A Molecular Approach*. Benjamin Cummings, U.S.A. 3<sup>rd</sup> edition.
5. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). *Introduction to Genetic Analysis*. W. H. Freeman and Co., U.S.A. 10<sup>th</sup> edition.

6. Kumar, H. D. (2001). Molecular Biology. Vikas Publishing House.
7. Varma, P. S. and Agrawal, V. K. (2020). Molecular Biology. S. Chand Publications.
8. Lewin, B. (2000) Gene VII. Oxford University Press.
9. Dnyansagar, V. R. (1996) Cytology and genetics. Tata McGraw-Hills Publication.

### **Plant Ecology:**

1. Kormondy, E.J. (1996). Concepts of Ecology. Prentice Hall, U.S.A. 4th edition.
2. Sharma, P.D. (2010) Ecology and Environment. Rastogi Publications, Meerut, India. 8<sup>th</sup> edition.
3. Odum, E.P. (2005). Fundamentals of ecology. Cengage Learning India Pvt. Ltd., New Delhi. 5<sup>th</sup> edition.
4. Singh, J.S., Singh, S.P., Gupta, S. (2006). Ecology Environment and Resource Conservation. Anamaya Publications, New Delhi, India.
5. Wilkinson, D.M. (2007). Fundamental Processes in Ecology: An Earth Systems Approach. Oxford University Press. U.S.A.
6. Kormondy, E.J. (1996). Concepts of ecology. PHI Learning Pvt. Ltd., Delhi, India. 4th edition.

### **Economic Botany:**

1. Singh, D. & Manivannan, S. (2009). Genetic Resources of Horticultural Crops. Ridhi International, Delhi, India.
2. Swaminathan, M.S. and Kochhar, S.L. (2007). Groves of Beauty and Plenty: An Atlas of Major Flowering Trees in India. Macmillan Publishers, India.
3. Capon, B. (2010). Botany for Gardeners. 3rd Edition. Timber Press, Portland, Oregon.
4. Pande, B. P. (1999). Economic Botany. S Chand Publications.
5. Kochhar, S. L. (2011) Economic Botany in the Tropics. MacMillan Publishers Ltd., New Delhi. 4<sup>th</sup> Edn.

### **Plant Physiology**

1. Hopkins, W. G. 1995. Introduction to Plant Physiology. John Wiley and Sons, Inc., New York, USA.
2. Moore, T. C. 1989. Biochemistry and Physiology of Plant Hormones. (2<sup>nd</sup> edition). Springer – Verlag, New York, USA.
3. Salisbury, F.B. and Ross, C. W. 1992. Plant Physiology. (4<sup>th</sup> edition). Wadsworth Publishing Co., California, USA. 19
4. Taiz, L. and Zeiger, E. 1998. Plant Physiology. (2<sup>nd</sup> edition) Sinauer Associates, Inc., Publishers, Massachusetts, USA.
5. R.C. Grewal – Plant Physiology. Campus Books International 483/24, Prahiadstreet Ansari Road, Darya ganj, New Delhi – 110002.
6. V.K. Jain – Fundamentals of Plant Physiology. S. Chand and Company Ltd. Ramnagar, New Delhi – 110055.
7. Salisbury Ross – Plant Physiology. CBS, Publishers and Distributions 485/ Jain Bhawan, Bhole Nath Nagar, Shahdara, New Delhi – 110032.
8. G. Ray Noggle / G. Fritz- Introductory Plant Physiology. Prentice Hall of India Ltd. New Delhi – 110001.



9. V.Verma. Text Book of Plant Physiology.Emkay Publications., B-19, East KrishnaNagar, Delhi-1100051.
10. D.O.halland K.K. Rao. Photosynthesis. Edward Arnold, East Street, Baltimore, Mary-land-21202,U.S.A.
11. Jain, V.K. (2000): Fundamentals of Plant Physiology ,S.Chand and Co, New Delhi.
12. Pandey, S.N. (1991): Plant Physiology, Vikas Publishing House (P) Ltd., New Delhi, India.
13. Verma, V. (2007): Text Book of Plant Physiology. Ane Books India, New Delhi.
14. Taiz, L. and Zeiger, E. 2006. Plant Physiology. 4<sup>th</sup> Edition. Sinnauers Associates, Saunders land, Massachusetts, USA
15. Emil Tmog, Mineral Nutrition of Plants. Oxford and IBH Publishing House, Bombay/ New Delhi.
16. S. Sundararajan- Plants Physiology. Anmol Publications, Pvt. Ltd .New Delhi.110002.

### **Nursery and Gardening:**

1. Gardening in India- Perey Lancaster (1997) Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi.
2. Gardening in India- Bose T. K. and Mukharjee, D. (1972), Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi.
3. Plant Propagation – Principles and Practices by H. T. Hartmann, D.E. Kester, F. T. Davies and R. L. Geneve (1997) Published by Prentice-Hall Inc., New Jersey 07458, USA.
4. Complete Home Gardening- Dej, S. C. (2003) Agrobias, Jodhpur, India.
5. Horticulture and Gardening- Khan M. R. (1995) Nirali Prakashan, Pune, India.
6. Gardening for everyone- Pramila Mehra. Hand pocketbook private limited, New Delhi.
7. Principles and Techniques for Plant Scientists- Dhopate, A. M. (2003) Agrobios, Jodhpur,
8. Plant Propagation-Sandhu M. K. (1989) Wile Eastern Ltd., Bangalore, Madras.

### **C] OTHER FEATURES:**

#### **1. INTAKE CAPACITY / NUMBER OF STUDENTS:-**

As per university rules.

#### **2. TEACHERS QUALIFICATIONS:-**

- As prescribed by norms.
  - However required number of core faculty should be given for particular course along with paper wise and Specialization wise work load allocation.
  - Work load details should be as per Apex body/UGC/State Govt./University norms.
3. The Board of studies should clearly mention the required Books, Journals and specific Equipments necessary for the Course.

**(A) LIBRARY:** Library be equipped with the required Reference and Text Books, Journals and Periodicals for higher and advanced studies as per stated in revised syllabus and approved by BOS.

#### **(B) SPECIFIC EQUIPMENTS:**

T.V., V.C.R. V.C.P., L.C.D., Overhead Projector, Computers and necessary software and operating systems etc. are necessary to run the course

**(C) LABORATORY SAFETY EQUIPMENTS:**

1. Fire extinguishers at least two sets in each laboratory of 600 sq.ft. Area.
2. Leakage of gases be avoided.
3. First aid kit be made available.
4. Sugar / Glucose –500gm pack- a pinch of sugar and a cup of drinking water in hypoglycemic condition or in extreme weakness of student or a person concerned.

**B) GENERAL SAFETY RULES FOR LABORATORY WORK****1) List of equipments needed for Laboratory Safety:-**

1. Fire extinguisher
2. First Aid Kit
3. Good ear thing and insulated wirings for electrical supply.
4. Emergency exit
5. Apron and goggles wherever necessary
6. Fuming Chambers
7. Masks flows and shoes while handling hazardous chemicals & gases (Good valves, manometers and regulators for gas supply)
8. Operational manuals for instruments (handling to be made as suggested.)
9. Rules of animals and blanks ethics.
10. Leakage of gases to be avoided.
11. Cylinders or flow pipes to handle Acids.
12. No weighing for NaOH and hygroscopic substances.
13. Stabilized supply in the laboratory.

**2) There is No Substitute for Safety:**

1. Any injury no matter how small, it must be reported to teacher immediately.
2. a) In case any chemical enters your eyes go immediately to eye- wash facility and flush your eyes and face with large amount of water.  
b) For acid or phenol split, do not use water instead put some bicarbonate.
3. In case of fire, immediately switch of all gas connections in the laboratory and pour sand on the source of fire or cover it with asbestos or cement sheet.
4. While leaving laboratory, make sure that gas, water taps and electricity are switched off.
5. Remove your lab coat. Gloves and clean your hands before leaving laboratory.
6. Make your workplace clean before leaving the laboratory.
7. Keep your hands away from your face, while working in laboratory.
8. Each laboratory must have a first aid box.
9. Know what to do in case of emergency - e.g.

- a) Know the place of fire extinguisher and first aid box.
- 10. Don't use cell phones in the laboratory.
- a) Remember important phone numbers

### **3) DO's**

1. Always wear lab coat, shoes in the laboratory. Every student must have their weight box, a napkin etc.
2. Maintain separate record book for each subject.
3. Keep your belongings at the place allotted for the same.
4. Maintain silence, order, cleanliness and discipline in the laboratory.
5. Work at the place allotted to you or specially used for certain operations.
6. Keep the working table clean.
7. Handle the laboratory equipments, glassware and chemical with great care.
8. Use only required quantities of material and apparatus of essential size.
9. Perform the test in their proper order.
10. Know the location of eye wash fountain and water shower.
11. Minimize your exposure to organic solvents.
12. The Metal like sodium should be kept under kerosene or liquid paraffin layer in a vessel with a cork stopper.
13. Sodium metal should be cut on dry filter paper. The cut off pieces of sodium should be immediately collected in a vessel containing kerosene or liquid paraffin.
14. Always pour acid into water when diluting and stir slightly.
15. All operations involving poisonous flammable gases and vapours should be carried out in the flame chamber (with exhaust facility)
16. Ladies should avoid wearing saree. If it is there, apron is essential.

### **4) DON'T**

1. Don't work alone in the laboratory
2. Don't leave the glass wares unwashed.
3. Don't take apparatus, chemicals out of lab.
4. Don't leave any substance in a vessel or bottle without label.
5. Don't weigh the reagent directly on the balance pan.
6. Don't throw the cut off pieces of sodium metal in sink or water. Transfer it immediately in its container.
7. Don't take sodium metal with hands. Use forceps.
8. Don't panic and run in case of fire. Use the fire extinguishers or sand buckets.
9. Don't breathe the vapours of organic solvents.
10. Don't pour any unused reagent back in its stock bottle.
11. Don't eat or drink any food in laboratory.

12. Don't use inflammable solvents like benzene, ether, chloroform, acetone and alcohol around flame.
13. Don't distill to dryness.
14. Don't exchange stoppers of flasks and bottles containing different reagents.
15. Don't leave reagent bottle lying on the table.
16. Don't disturb the order of reagent bottles in which they are placed.
17. Don't bring reagent on your working table from the general shelf.
18. Don't throw burning matchstick into dustbin.
19. Don't leave the laboratory without permission.

## **5) LABORATORY / FIELD WORK CARE AND SAFTY FOR BOTANY STUDENTS**

1. Unnecessary wastage of plant material during practicals should be avoided.
2. During study tour / personal collection, more emphasis be given on study of plants in nature and collection of wild plants should not be carried out.
3. If at all the collection of the plant material in needed, it should be carried out under supervision of concerned teacher. Collection of poisonous plants / poisonous mushrooms should be avoided.
4. Oral intake of unknown plant material, out of curiosity, during practical or collection tour is strictly prohibited.
5. If there is any allergic reaction while handling the plants / plant parts / pollen grains / fungal specimens it should be immediately brought to the notice of the concerned teacher and reported to the registered medical purloiner.
6. Wearing of hand gloves (and mask) is essential while handling poisonous plants / herbarium sheets / toxic and hazardous chemicals / reagents / strong acids / strong alkalis during the experiment should be made with vacuum pipette / auto pipette / burette under the supervision of concerned teacher / lab assistant.
7. Highly inflammable organic solvents (alcohol, acetone etc.) should not be kept in vicinity of spirit lamp.
8. The laboratory safety measures adopted for handling of hazardous chemicals in chemistry practicals should be followed for conducting practicals in plant biochemistry / microbiology.
9. Operational manuals for equipments such or centrifuge, autoclave, spectrophotometer should be followed.
10. In case of minor injuries, preliminary treatment should be undertaken with the help of first aid kit available in the laboratory. In case of serious injury, concerned teacher should be immediately contacted for consultation to the physician.
11. The instruction report for breeding, experimentation will be submitted in a week period.

(Which are laid down by Ministry of Social Justice & Empowerment and Ministry of Environment and Forests, Govt. of India).

### **PROGRAM SPECIFIC OUTCOMES (PSO) OF BOTANY:**

In life science plant sciences is one of the most important basic and applied subjects. Plants synthesize their own food material using water and carbon dioxide in presence of sunlight and releasing oxygen as a byproduct. Plants are basis of biodiversity and they fulfill basic needs of all living organism viz. food, oxygen, etc. We can't imagine life on earth without plants. This course has been designed to give the fruitful knowledge and commercial skills in the various aspects of plant science. After successful completion of this program students will be able

**PSO 1:** To understand the various aspect of plant systematics and anatomical features of higher plant.

**PSO 2:** To understand the basics of genetics and molecular biology.

**PSO 3:** To understand the plant ecology, phytogeography, centre of origin of cultivated plants and utilization of plants.

**PSO 4:** To understand vital physiological processes in plants and skills of nursery and garden technique.

### **List of skill enhancement courses:**

1. Gardening skills
2. Nursery techniques
3. Plant identification and herbarium technique
4. Plant resources
5. Collection and preservation technique of Indian native seeds or land races
6. Soil and water analysis
7. Germplasm conservation (in-vivo)

**Link for information about SEC courses from National Skills Qualification Framework (NSQF):** <https://nqr.gov.in/national-skills-qualification-framework>

(You may add or delete any courses as per available facilities)