

 <p>Estd. 1962 "A++" Accredited by NAAC (2021) With CGPA 3.52</p>	<p>SHIVAJI UNIVERSITY, KOLHAPUR - 416004, MAHARASHTRA</p> <p>PHONE:EPABX-2609000, www.unishivaji.ac.in, bos@unishivaji.ac.in</p> <p>शिवाजी विद्यापीठ, कोल्हापूर - ४१६००४, महाराष्ट्र</p> <p>दूरध्वनी-ईपीएबीएक्स -२६०९०००, अभ्यासमंडळे विभाग दुरध्वनी ०२३१-२६०९०९४ ०२३१-२६०९४८७</p>		
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SU/BOS/Science/06

Date: 01/01/2024

To,

<p>The Principal, All Concerned Affiliated Colleges/Institutions Shivaji University, Kolhapur</p>	<p>The Head/Co-ordinator/Director All Concerned Department (Science) Shivaji University, Kolhapur.</p>
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Subject: Regarding syllabi of B.Sc. Part-III (Sem. V & VI) as per NEP-2020 (1.0) 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-III (Sem. V & VI) as per NEP-2020 (1.0) degree programme under the Faculty of Science and Technology.

B.Sc.-III (Sem. V & VI) as per NEP-2020 (1.0)			
1.	Mathematics	12.	Computer Science (Opt)
2.	Statistics	13.	Computer Science (Entire)
3.	Physics	14.	Information Technology (Entire)
4.	Microbiology	15.	Food Science and Technology (Entire)
5.	Industrial Microbiology	16.	Food Science
6.	Electronics	17.	Food Science and Quality Control (Entire)
7.	Chemistry	18.	Food Technology & Management (Entire)
8.	Sugar Technology (Entire)	19.	Biochemistry
9.	Geology	20.	Biotechnology (Optional/Vocational)
10.	Zoology	21.	Biotechnology (Entire)
11.	Botany	22.	Environmental Science (Entire)

This syllabus, nature of question and equivalence shall be implemented from the academic year 2024-2025 onwards. A soft copy containing the syllabus is attached herewith and it is also available on university website www.unishivaji.ac.in NEP-2020(Online Syllabus)

The question papers on the pre-revised syllabi of above-mentioned course will be set for the examinations to be held in October /November 2024 & March/April 2025. 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,


By Registrar
Dr. S. M. Kubal

Copy to:



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शिवाजी विद्यापीठ, कोल्हापूर - ४१६००४, महाराष्ट्र

दूरध्वनी-ईपीएबीएक्स -२६०९०००, अभ्यासमंडळे विभाग दुरध्वनी ०२३१-२६०९०९४
०२३१-२६०९४८७



SU/BOS/Science & Technology / 125

Date: 07/02/2024

To,

The Principal,
All affiliated colleges,
Shivaji University, Kolhapur.

Subject: Regarding minor changes in the syllabi of B.Sc.Part-III (Botany) under the Faculty of Science & Technology.

Sir/Madam,

With reference to the subject mentioned here above, I am directed to inform you that the university authorities have accepted and granted approval to the minor changes in the syllabi of B.Sc.Part-III (Botany) under the Faculty of Science & Technology.

This minor change in said Syllabus of will be implemented from the academic year 2024-25.

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

Thanking you,

Yours faithfully,


Dy. Registrar
Dr. S.M.Kubal

Copy to :-

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|---|---|----|-------------------------------|
| 1 | The Dean, Faculty of Science & Technology | 8 | Appointment Section |
| 2 | The Chairman, Respective, BOS | 9 | Centre for Distance Education |
| 3 | Exam Section | 10 | Computer Centre |
| 4 | Eligibility Section | 11 | Affiliation Section (U.G.) |
| 5 | O.E. I Section | 12 | Affiliation Section (P.G.) |
| 6 | O.E. II Section | 13 | P.G.Admission Section |
| 7 | O.E. III Section | 14 | P.G.Seminar Section |

SHIVAJI UNIVERSITY, KOLHAPUR
ACCREDITED BY NAAC WITH 'A⁺⁺' GRADE

REVISED SYLLABUS
FOR
BACHELOR OF SCIENCE (PART III)

BOTANY PART- III

**BOTANY (NEP 1.0) PATTERN SYLLABUS TO BE
IMPLEMENTED**

FROM

JUNE, 2024 ONWARDS

PAPER –IX, X, XI, XII - (SEMESTER- V)
AND
PAPER –XIII, XIV, XV, XVI - (SEMESTER-VI)

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

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 will be implemented from June 2024 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 equipment 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. To 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 being.
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 full-time 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 COURSE- B. Sc. III Botany (Optional)

THIRD YEAR (SEMESTER V/VI) (NO. OF PAPERS VIII)

Sr. No.	Subjects/Papers	Theory	Internal	Total Marks
1	Paper-IX	40	10	50
2	Paper- X	40	10	50
3	Paper -XI	40	10	50
4	Paper- XII	40	10	50
5	Paper- XIII	40	10	50
6	Paper-XIV	40	10	50
7	Paper-XV	40	10	50
8	Paper-XVI	40	10	50
	Practical -I	-	-	50
	Practical- II	-	-	50
	Practical- III	-	-	50
	Practical -IV	-	-	50
Total				600

11. Structure of B. Sc. III - Semester V and VI

SEMESTER V							
Sr. No.	Subject Title	TEACHING SCHEME			PRACTICAL		
		Credits	No. of Lectures	Hours	Credits	No. of Lectures	Hours
1	DSE-E	2	3	2.4	8	20	16
2	DSE-E	2	3	2.4			
3	DSE-E	2	3	2.4			
4	DSE-E	2	3	2.4			
	TOTAL	10	16	12.8	8	20	16
SEMESTER VI							
1	DSE-F	2	3	2.4	8	20	16
2	DSE- F	2	3	2.4			
3	DSE- F	2	3	2.4			
4	DSE- F	2	3	2.4			
	TOTAL	10	16	12.8	8	20	16
GRANT TOTAL		20	32	25.6	16	40	32

12. SCHEME OF EXAMINATION:

- The theory examination shall be conducted at the end of each term for semester pattern and practical examination will be conducted annually.
- Each theory paper shall carry 40 marks.
- The evaluation of the performance of the students in theory papers shall be based on Semester Examination of 40 (University Examination) + 10 (Internal examination) marks.
- 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 & regulation for each degree.

14. NATURE OF QUESTION PAPER AND SCHEME OF MARKING:

(Unit wise weightage of marks should also be mentioned)

- Q. 1. Multiple choices questions (8-questions) --- 08 Marks
- Q.2. Attempt **any two** of the following.
(Essay type/Broad answer questions) ---- 16 Marks
- Q.3. Write short notes (**any four**) --- 16 Marks

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

(Introduced from June 2024 onwards)

Old Syllabus (Semester patter)		Revised Syllabus (Semester patter)		
Paper No.	Title of Old Paper	Sem. No.	Paper No.	Title of New Paper
IX	Genetics and Plant Breeding	V	DSE-E25	Reproductive Biology of Angiosperms
X	Microbiology, Plant Pathology and Mushroom Culture Technology		DSE-E26	Plant Metabolism and Stress Biology
XI	Cytology and Research Techniques in Biology		DSE-E27	Plant Biotechnology
XII	Horticulture and Gardening		DSE-E28	Horticulture
XIII	Plant Biochemistry and Molecular Biology	VI	DSE-F25	Plant Biochemistry and Research Methodology
XIV	Bioinformatics, Biostatistics and Economic Botany		DSE-F26	Natural Resource Management and Herbal Technology
XV	Plant Biotechnology and Palaeobotany		DSE-F27	Plant Diversity and Ethnobotany
XVI	Biofertilizers, Herbal Drug Technology		DSE-F28	Plant Breeding, Bioinformatics and Biostatistics

SEMESTER-V**B. Sc. Part-III BOTANY****CREDITS: 2, LECTURE PERIOD: 3 PER WEEK, MARKS: 40 + 10****PAPER IX: DSE-E 25****REPRODUCTIVE BIOLOGY OF ANGIOSPERMS**

Module No.	Module	Sub-module	Periods Allotted
1	Organization of flower	1.1: Concept of flower as a modified Shoot (stem nature of thalamus and leaf nature of floral parts). 1.2: Structure of a typical stamen, Structure of a tetrasporangiate anther and pollen grain. 1.3: Structure of a typical carpel, Structure of a typical ovule and its types.	08
2	Pollination and Fertilization	2.1: Definition and types of pollination: Anemophily (<i>Zea mays</i>), Entomophily (<i>Calotropis</i>), Ornithophily (<i>Bombax</i>), Chiropterophily (<i>Kigelia</i>) and Hydrophily (<i>Vallisneria</i>) 2.2: Microsporogenesis, pollen germination and development of male gametophyte 2.3: Megasporogenesis, development and structure of embryo sac: Monosporic, Bisporic and Tetrasporic. 2.4: Fertilization: Entry of pollen tube (Porogamy, Chalazogamy and Mesogamy), double fertilization and triple fusion. Significance of double fertilization.	12
3	Embryo and Endosperm Development	3.1: Structure of dicot and monocot embryo in angiosperm. 3.2 Development of endosperm and types of endosperms (Nuclear, Helobial and Cellular) 3.3: Polyembryony: Introduction, Types of polyembryony- True polyembryony (Cleavage and Adventive), False polyembryony. Causes of polyembryony, Significance of polyembryony. 3.4: Apomixis: Introduction, Causes of apomixes and Types: Gametophytic and Sporophytic, Significance of apomixis.	10

SEMESTER- V**B. Sc. Part-III BOTANY****CREDITS: 2, LECTURE PERIOD: 3 PER WEEK, MARKS: 40 + 10****PAPER X: DSE-E 26****PLANT METABOLISM AND STRESS BIOLOGY**

Module No.	Module	Sub-module	Periods Allotted
1	Plant water relationship	1.1: Introduction, Physiological importance of water. 1.2: Water transport process: Mechanism of water absorption: active and passive absorption theories, water transport through xylem and tracheid. 1.3. Translocation in the phloem: Experimental evidence showing phloem as a site of sugar translocation (Girdling/Ringing experiment). Concepts of Pressure flow model, Phloem loading and unloading, Source sink relationship. 1.4: Transpiration: Definition, Types of transpiration, Mechanism of stomatal movement, Starch-sugar interconversion hypothesis, Factors affecting transpiration, Significance of transpiration.	12
2	Mineral nutrition	2.1: Introduction, Macro and Micronutrients 2.2: Criteria of essentiality 2.3: Mineral nutrient uptake- Passive uptake (Diffusion), Active uptake (Carrier Concept) 2.4: Role and Deficiency Disorders of Macronutrients (P, K, Ca, Mg) and Micronutrients (Fe, Mn) in plants and its recovery.	08
3	Stress Biology	3.1: Defining plant stress, Acclimation and adaptation. 3.2: Biotic factors: Pathogenesis Related (PR) proteins and Systemic Acquired Resistance (SAR); 3.3: Abiotic factors (Water stress and Salinity stress). 3.4: Concept of stress sensing mechanisms in plants.	10

SEMESTER- V**B. Sc. Part-III BOTANY****CREDITS: 2, LECTURE PERIOD: 3 PER WEEK, MARKS: 40 + 10****PAPER XI: DSE-E 27****PLANT BIOTECHNOLOGY**

Module No.	Module	Sub-module	Periods Allotted
1	Introduction to Plant Biotechnology	1.1: Principles and laboratory requirement for plant tissue culture. 1.2: Composition of media; Nutrient and hormone requirements (role of vitamins and hormones). 1.3: Totipotency and Cellular Differentiation. 1.4: Applications of plant tissue culture: Micropropagation, Virus elimination, Secondary metabolite production, Haploid production, Somatic hybridization, Germplasm conservation.	10
2	Techniques in Plant Tissue Culture	2.1: Callus culture 2.2: Organogenesis: Principle, Protocol, Factors affecting. 2.3: Embryogenesis: Principle, Protocol, Factors affecting. 2.4: Method of protoplast isolation and Protoplast Culture. 2.5: Protoplast fusion, selection of somatic hybrids. 2.6 Production of Cybrids and Synthetic seeds	10
3	Transgenics	3.1: Introduction to transgenics (GMO) 3.2: Methods of gene transfer: Agrobacterium-mediated, Electroporation, Microinjection, Microprojectile bombardment 3.3: Selection of transgenics– selectable marker and reporter genes (Luciferase, GUS, GFP). 3.4: Transgenic with improved quality traits (Golden rice)	10

SEMESTER- V**B. Sc. Part-III BOTANY****CREDITS: 2, LECTURE PERIOD: 3 PER WEEK, MARKS: 40 + 10****PAPER XII: DSE-E 28****HORTICULTURE**

Module No.	Module	Sub-module	Periods Allotted
1	Importance and Horticultural practices	1.1: Introduction and importance of horticulture 1.2: Divisions of Horticulture – Pomology, Olericulture, Floriculture, Landscape gardening 1.3: Applications of organic manure, synthetic fertilizers, PGRs, Biofertilizers and Biopesticides. 1.4: Irrigation methods (drip irrigation, surface irrigation, sprinklers irrigation). 1.5: Concept of Hydroponics.	10
2	Floriculture and fruit preservation	2.1: Floriculture: a) Cultivation of Rose, Gerbera, management of their important pests and diseases b) Flower arrangements, Packing and Marketing of cut flowers. 2.2: Fruit preservation technology: a) Physical - Drying, freezing, heat, b) Chemical - sugar, salt and other chemical preservatives.	10
3	Horticultural crops-conservation and management	3.1: Methods of documentation and conservation of germplasm. 3.2: Methods of cultivation practices, disease management and marketing of Brinjal and Grape. 3.3 : Role of IPR in floriculture. 3.4 : Role of Indian Institute of Horticultural Research (IIHR) and National Horticulture Board (NHB) in Horticulture.	10

SEMESTER- VI**B. Sc. Part-III BOTANY****CREDITS: 2, LECTURE PERIOD: 3 PER WEEK, MARKS: 40 + 10****PAPER XIII: DSE-F 25****PLANT BIOCHEMISTRY AND RESEARCH METHODOLOGY**

Module No.	Module	Sub-module	Periods Allotted
1	Carbohydrate Metabolism	1.1: Introduction, Classification of Carbohydrates; Properties of Monosaccharides - Glucose/ Ribose 1.2: Properties of Oligo saccharides Sucrose / Lactose. 1.3: Properties of Polysaccharides -Starch and Cellulose 1.5: Significance of Carbohydrates.	10
2	Lipid Metabolism	2.1: Introduction, classification of lipids; 2.2 Properties and examples of Saturated fatty acids. 2.3: Properties and examples of Unsaturated fatty acids 2.4: General out-line of fatty acid biosynthesis. 2.5: Significance of lipids	10
3	Research Methodology	3.1: Research-definition and types of research (Descriptive vs analytical; applied vs fundamental; quantitative vs qualitative). 3.2: Literature-review and its consolidation; Library research; field research; laboratory research. 3.3: Outline of Research paper writing; oral and poster presentation; plagiarism 3.4: Techniques of Micrometry, Camera Lucida and Photomicrography.	10

SEMESTER- VI**B. Sc. Part-III BOTANY****CREDITS: 2, LECTURE PERIOD: 3 PER WEEK, MARKS: 40 + 10****PAPER XIV: DSE-F 26****NATURAL RESOURCE MANAGEMENT AND HERBAL TECHNOLOGY**

Module No.	Module	Sub-module	Periods Allotted
1	Natural Resource Management	1.1: Natural resources: Definition and types; sustainable utilization and management of land and water. 1.2: Biological Resources: Major and minor forest products; Depletion; Management. 1.3: Contemporary practices in resource management: GIS, Carbon credit, Resource accounting (Green audit).	08
2	Herbal Medicines	2.1: Definition, Importance of herbal medicines 2.2: Identification, authentication, collection, processing and storage of medicinal plants. 2.3: Introduction to general methods of extraction. 2.4: Medicinal uses of <i>Tinospora cordifolia</i> , <i>Aloe vera</i> <i>Withania sominifera</i> , <i>Phyllanthus emblica</i> . 2.5: Adulteration: Definition, Types and evaluation of drugs by morphological and chemical methods.	12
3	Herbal Technology	3.1: Applications of herbs in cosmetics: Shampoo (<i>Sapindus laurifolius</i> , <i>Senegalia concinna</i>), hair dye (<i>Lawsonia inermis</i>) 3.2: Facemask (<i>Santalum album</i>) and perfume (<i>Rosa indica</i>).	10

SEMESTER- VI**B. Sc. Part-III BOTANY****CREDITS: 2, LECTURE PERIOD: 3 PER WEEK, MARKS: 40 + 10****PAPER XV: DSE-F 27****PLANT DIVERSITY AND ETHNOBOTANY**

Module No.	Module	Sub-module	Periods Allotted
1	Plant Diversity	1.1: Introduction and types of plant diversity (Genetic diversity, Species diversity, Ecological diversity). 1.2: Values and uses of Plant diversity: Ethical and aesthetic values. 1.3: Causes of loss of Plant diversity.	06
2	Conservation of Plant Diversity	2.1: Conservation of Plant diversity: genetic, species and ecosystem diversity. 2.2: <i>In-situ</i> and <i>Ex-situ</i> conservation. 2.3: Social approaches to conservation (Sacred grove), Plant diversity awareness programmes. 2.4: Role of organizations in Plant diversity conservation (IUCN, BSI, NBPGR). 2.5: Concept of Biodiversity Act 2002.	12
3	Ethnobotany	3.1: Introduction, scope and objectives. 3.2: Morphology and uses of following ethnomedicinal plants a) <i>Andrographis paniculata</i> b) <i>Vitex negundo</i> c) <i>Gloriosa superba</i> d) <i>Tribulus terrestris</i> e) <i>Pongamia pinnata</i> f) <i>Abrus precatorius</i> g) <i>Plumbago zeylanica</i> h) <i>Rauwolfia serpentina</i> i) <i>Artemisia annua</i> j) <i>Boerhavia diffusa</i> 3.3: Role of ethnic groups in conservation of plant genetic resources.	12

SEMESTER- VI**B. Sc. Part-III BOTANY****CREDITS: 2, LECTURE PERIOD: 3 PER WEEK, MARKS: 40 + 10****PAPER XVI: DSE-F 28****PLANT BREEDING, BIOINFORMATICS AND BIOSTATISTICS**

Module No.	Module	Sub-module	Periods Allotted
1	Plant Breeding	1.1 Introduction, Definition, aims and objectives of plant breeding 1.2. Methods of plant breeding a) Introduction and acclimatization b) Selection- i) Mass selection ii) Pure line selection iii) Clonal selection c) Hybridization techniques in self and cross-pollinated crops. d) Male sterility and its significance e) Mutation breeding- Gamma Garden	10
2	Bioinformatics	2.1 Introduction, Aim, Scope and Branches of Bioinformatics 2.2 Biological Databases: Classification Format and Retrieval system of Biological Database, National Center for Biotechnological Information (NCBI), Basic Local Alignment Search Tool (BLAST) concept. 2.3 Protein Information Resource (PIR) - Concept, Resources, Databases and Data Retrieval 2.4 Applications of Bioinformatics- Molecular Phylogeny (Concept, Methods, Analysis and Consistency)	08
3	Biostatistics	3.1. Introduction, definition, terminology. 3.2. Collection and presentation of data: Types of data, techniques of data collection- Census method, sampling method- simple random, stratified and systematic sampling. Classification, tabulation, graphical representation- Histogram and polygon. 3.3. Measures of central tendency and Dispersion: Arithmetic mean, Mode, Median, Range, Deviation, Mean deviation, Standard Deviation, Coefficient of Variation. 3.4. Statistical methods for testing the hypothesis: Chi-square test.	12

Shivaji University, Kolhapur
B. Sc. III Botany (CBCS Syllabus)
Practical I

(Based on Paper IX and Paper XIV)

1. Study of primitive characters of flowers of angiosperms (As per Ranaian Concept).
2. Study of T.S. of a typical tetrasporangiate anther (*Datura sp.*, *Ipomoea sp.*, *Catharanthus sp.* or any suitable material).
3. To calculate the pollen germination percentage by hanging drop method.
4. Study of pollen viability with any suitable method.
5. Study of structure of dicot embryo with the help of photograph/model/staining method.
6. Study of structure of monocot embryo with the help of photograph/model/staining method.
7. Dissection of dicot embryo from any suitable material
8. Study of types of ovules in angiosperms.
9. Study of types of endosperms in angiosperms.
10. Estimation of carbonates and bicarbonates from polluted and non-polluted water samples.
11. & 12. Estimation of BOD, COD and DO from polluted and non-polluted water samples.
- 13 Study of morphology, source, identification characters and uses of major forest products (Tannin: *Terminalia chebula*; Vit. C: *Emblica officinalis*, Dye: *Bixa orellana*; Timber: *Tectonagrandis*).
- 14 Study of morphology, source, identification characters and uses of minor forest products (Saponin: *Senegalia concinna*; Gum: *Vachellia nilotica*; Khair: *Senegalia catechu*; Jute: *Agave sp.*).
- 15 Herbal Preparations of Churn (Triphala Churna) and Kadha/Decoction (Adulsa)
- 16 Herbal Preparations of Hair oil (Maka) and Shampoo (Ritha, Shikakai).
- 17 Herbal Preparation of perfume from any suitable plant material
- 18 Herbal preparation of face mask from any suitable plant material
- 19 Morphological/Biochemical test for drug adulteration of:
 - a) **Morphological:** Mustard (*Brassica juncea* + *Argemone mexicana*); Black Pepper (*Piper nigrum* + *Carica papaya*)
 - b) **Biochemical:** Haladi (*Curcuma longa* + *Zea mays*); Coconut (*Cocos nucifera* + *Solanum tuberosum*).
- 20 Analysis of Carbon sequestration of standing trees.
- 21 Study of remote sensing technique with the help of satellite images.
- 22 Study of morphology, source and uses of *Tinospora cordifolia*, *Aloe vera*, *Withania somnifera*.
23. Visit to Herbal cosmetics industry/Pharma industry or Institute (Separate handwritten report to be submitted by student).

Shivaji University, Kolhapur
B. Sc. III Botany (CBCS Syllabus)
Practical II
(Based on Paper X and Paper XIII)

1. Demonstration of endosmosis and exosmosis.
2. Demonstration of ascent of sap in plants.
3. Study of structure of stomata of healthy and stressed plant.
4. Determination of stomatal density.
5. Study of stomatal and cuticular transpiration by Cobalt chloride paper method.
6. & 7. Study of role and deficiency symptoms of Phosphorus, Potassium, Calcium, Magnesium, Iron and Manganese.
8. Estimation of proline from plant material.
9. Estimation of polyphenols from plant material.
10. To study the effect of salinity on seed germination.
11. Determination of Fatty acid value of oil sample.
12. Qualitative test for sugar in plant material.
13. Qualitative test for Starch and cellulose in plant material.
14. Qualitative test for protein.
15. Qualitative test for Lipids.
16. Identification of Sugars by circular paper chromatography.
17. To study the writing skill of a research article (Outline of Manuscript).
18. Micrometry techniques.
19. Study of Photomicrography techniques.
20. Illustrate the given specimen with the help of camera lucida technique.
21. Preparation and presentation of poster on any topic (should be presented at the time of examination)
22. To write scientific research proposal to funding agency.

Shivaji University, Kolhapur
B. Sc. III Botany (CBCS Syllabus)
Practical III

Based on Paper XII and Paper XV

1. Study of organic manures (FYM, Green manure, Vermicompost one example of each).
2. Preparation of Jeevamrut fertilizer.
3. To study the effect of PGRs (GA and IAA) on plants.
4. Study of Biofertilizers.
5. Study of some common weeds with respect to morphology and control measures from horticulture crops (any two).
6. Preparation of biopesticide by using any suitable plant material.
7. Study of Irrigation methods (drip, sprinkler, surface).
8. Study of Hydroponics technique for cultivation of horticulture crops.
9. Study the fungal diseases of Rose, Gerbera and Marigold (Any one on each crop).
10. Demonstration of Flower arrangements- Flower pot/floral bouquet and flower rangoli.
11. Study the methods of fruit preservation in Amla.
12. To study different methods of germplasm preservation by using various plant parts (Rhizome, tuber, stem/leaf cutting and seeds).
13. To study the package of practices in Brinjal and Grapes.
14. Determination of frequency and density of different species in quadrats (list quadrat).
15. to 17. Study of ethnomedicinal plants (as per theory) with respect to botanical name, common/vernacular name, morphology, plant parts used and uses.
18. To study IUCN categories with suitable examples.
19. Study of plant species diversity in campus.
20. *Ex situ* conservation of endemic plants (Any five).
21. Collection and submission of wild fruits (Any five).
22. Visit to nursery/Sacred grove.

Shivaji University, Kolhapur
B. Sc. III Botany (CBCS Syllabus)
Practical IV
(Based on Paper XI and Paper XVI)

1. To study the instruments used in Plant Tissue Culture Laboratory.
2. Preparation of plant tissue culture medium (M.S.).
3. Demonstration of techniques of Micropropagation using suitable ex-plant.
4. Demonstration of callus culture.
5. Isolation of Protoplast by mechanical method.
6. Preparation of synthetic seeds.
7. Study of steps in genetic engineering for the production of Golden rice with the help of photographs.
8. To study the tools used in Plant Breeding techniques.
9. Mounting of floral parts.
10. Methods of emasculation.
11. Hybridization techniques in self-pollinated crops (Fabaceae).
12. Hybridization techniques in cross-pollinated crops (Poaceae).
13. Study of World map to show Vavilov's centers of origin of cultivated plants.
14. Measures of central tendency of given data.
15. Study of frequency distribution and its graphical representation
16. Determination of Standard deviation of the given data.
17. To study the effect of UV radiations on seed germination.
18. To browse NCBI data base for biological sequences.
19. Demonstration of Gamma Garden model.
20. To study the structures of a protein (with the help of photograph or model).
21. Submission of PPT on the basis gene transfer method.

List of Books recommended for B. Sc. III Botany

Reproductive Biology of Angiosperms:

1. Principles of Angiosperm Taxonomy – P. H. Davis, Heywood V. M. (1963)
2. The evolution and classification of flowering plants. – A. Cronquist, 1968. Thomas Nelson (Printers) Ltd., London & Edinburgh.
3. Plant Diversification. Delevoryas, Th. 1965 Modern Biology Series, Half Rinehart & Winston, New York.
4. The Morphology of Angiosperms. -- K. R. Sporne, 1977. B.I. Publication, Bombay.
5. The Embryology of Angiosperms. -- S.S. Bhojwani and Bhatnagar, S.P. 2000. 4th revised and enlarged edition. Vikas Publishing House, Delhi.
6. Embryology of Angiosperms. -- B.M. Johri, 1984. Springer-Verlag Berlin.
7. Molecular Embryology of Flowering Plants. V. Raghvan, 1997. Cambridge University Press New York.
8. Principles of Angiosperm Taxonomy. -- P.H. Davis and V.H. Haywood, 1963. Oliver and Royd, London.
9. Current Concepts in Plant Taxonomy. -- V.H. Heywood and D.M. Moore 1984. Academic Press, London.
10. Plant Systematics (2nd edition). -- Jones, S.B. Jr. and Luchsinger, A.E. 1986. McGraw-Hill Book Co., New York.
11. Taxonomy of Vascular Plants. -- G.H.M. Lawrance, 1951. MacMillan, New York.
12. Taxonomy of Angiosperms. -- V.N. Naik, 1984. Tata McGraw Hill, New York.
13. Fundamentals of Plant Systematics -- A.E. Radford, 1986. Harper and Row, New York.
14. Plant Systematics: Theory and practice -- G. Singh, 1999. Oxford & IBH Pvt., Ltd. New Delhi.
15. Plant Taxonomy and Biosystematics. -- C.A. Stace, 1989. 2nd ed. Edward Arnold, London.
16. Contemporary Plant Systematics. -- D.E. Woodland. 1991. Prentice Hall, New Jersey.
17. Plant Systematics for 21st Century -- B. Nordenstam, El-Gazaly, G. and Kassas. M. 2000. Portland Press Ltd., London.
18. Embryogenesis in Angiosperms: A Development and Experimental Study. V. Raghavan. Cambridge University Press New York. USA. 1986.
19. Taxonomy of the Angiosperms -- A. J. Eames.
20. Text book of systematic botany. -- R. N. Sutaria.
21. An Introduction to Embryology of Angiosperms. -- P. Maheshwari.

Plant Metabolism and Stress Biology:

1. Plant Physiology-Mukharji and Ghosh. New Central Book Agency(P)Ltd. Kolkata. 2006
2. Biochemistry and Molecular Biology of Plants. Buchanan. B.B. Grussem. W. and Jones. R.L. 2000. American Society of Plant Physiologists, Maryland, USA.
3. Plant Melabolism. Collins. H.A. and Edwards D.H. Lefebvre. D.D. and Layzell. D.B. (eds) 1997. (2nd Edition) Longman, Essex, England.
4. Plant Biochemistry and Molecular Biology -- Lea. P.J. and Leegood, R.C. 1999. (2nd Edition). John Wiley and Sons, Chichester, England.
5. Molecular Cell Biology-- Lodish. H.Berk, A. Zipursky. S.L. Matsudaira. P. Baltimore. D. and Darnel. J. 2000. (4th Edition) W.H. Freeman and Co. New York USA.
6. Fundamental Laboratory Approaches for Biochemistry and Biotechnology. --Ninfa A. J. and Ballou D. P. 1998. Fitzgerald Science Press. Inc., Maryland USA.
7. Techniques and Practices of Chromatography--Scott. R.P.W. 1995. Marcel Dekker, Inc. New Work.
8. Plant growth substances. -- H. N. Krishnamurty
9. Introduction to Practical Biochemistry. D. T. Plummee 9. Introduction to Plant Physiology. Neggle and Fritz (New Edition)
10. A text book of plant Physiology.-- V. Varma
11. Plant Physiology- Malik and Shrivastava (S. Chanda Co.)
12. Latest Portfolio of Theory and Practice in Plant Physiology- Susheela M. Das. Dominant publisher and distributor-New Delhi 2003.
13. Plant Physiology- S. N. Pandey and B. K. Sinha. (4th edition). Vikas Publishing House Pvt. Ltd., New Delhi.
14. The Physiology of flowering – W.S. Hiiman.

Horticulture:

1. Percy Lancaster (1997) Oxford & I B H Publishing Co. Pvt. Ltd, New Delhi.
2. Floriculture: Fundamentals & Practices. - Alex Laurie and Ries V.C. (2003)
3. Percy Lancaster's Gardening in India. Bose, T.K. and Mukherjee, D. (1997) (Ed.)Oxford and IBH Publ. (P.) Ltd., New Delhi, India.
4. An Art of Miniature Plant Culture. - Day, S.C. (2003) Agrobias. Jodhpur, India.
5. Complete Home Gardening. -Dej, S.C. (2003) Agrobias, Jodhpur, India.
6. Principles and Techniques for Plant Scientists. -Dhopte, A.M. (2003) Agrobios, Jodhpur, India.
7. Horticulture and Gardening. Khan, M.R. (1995) Nirali Prakashan, Pune. India.

8. Gardening for every one- Pramila Mehra. Hind pocket book private limited, New Dehli.
9. Kumarsen V. Horticulture, Saras Publication
10. Bose T.K. & Mukherjee, D., 1972, Gardening in India, Oxford & IBH Publishing Co., New Delhi.
11. Sandhu, M.K., 1989, Plant Propagation, Wile Eastern Ltd., Bangalore, Madras.
12. Kumar, N., 1997, Introduction to Horticulture, Rajalakshmi Publications, Nagercoil.
13. Edmond Musser & Andres, Fundamentals of Horticulture, McGraw Hill Book Co., New Delhi.
14. Agrawal, P.K. 1993, Hand Book of Seed Technology, Dept. of Agriculture and Cooperation, National Seed Corporation Ltd., New Delhi.
15. Janick Jules. 1979. Horticultural Science. (3rd Ed.), W.H. Freeman and Co., San Francisco, USA.
16. Randhawa, G.S. and Mukhopadhyay, A. 1986. Floriculture in India. Allied Publishers.

Plant Biotechnology:

1. Elements Of Biotechnology- P. K. Gupta (Second Edition); Rastogi Publications
2. Plant Tissue Culture - Kalyan Kumar De; New Central Book Agency (P) Ltd.
3. Introduction to Plant Tissue Culture - M. K. Razdan (Second Edition); Oxford & IBH Publishing Co. Pvt. Ltd.
4. Practical Biotechnology and Plant Tissue Culture - Prof. Santosh Nagar, Dr. Madhuri Adhav; S. Chand & Co. Ltd.
5. Dubey, R. C., 2005 A Text book of Biotechnology S. Chand & Co, New Delhi.
6. Kumaresan, V. 2005, Biotechnology, Saras Publications, New Delhi.
7. John Jothi Prakash, E. 2004. Outlines of Plant Biotechnology. Emkay –Publication, New Delhi.

Plant Biochemistry and Research Methodology:

1. Biochemistry and Molecular Biology of Plants. Buchanan. B.B. Grussem. W. and Jones. R.L. 2000. American Society of Plant Physiologists, Maryland, USA.
2. Plant Melabolism. Collins. H.A. and Edwards D.H. Lefebvre. D.D. and Layzell. D.B. (eds) 1997. (2nd Edition) Longman, Essex, England.
3. Plant Biochemistry and Molecular Biology -- Lea. P.J. and Leegood, R.C. 1999. (2nd Edition). John Wiley and Sons, Chichester, England.
4. Introduction to Practical Biochemistry. D. T. Plummee 9. Introduction to Plant Physiology. Neggle and Fritz (New Edition)

Natural Resource Management and Herbal Technology:

1. Kocchar, S. L. 1998. Economic Botany in Tropics, 2nd edition. Mac Millan India Ltd., New Delhi.
2. Sambamurthy, A. V. and Subramanyam, N. S. 1989. A Textbook of Economic Botany-- Wiley Eastern Ltd., New Delhi.
3. Sharma, O. P. 1996. Hill's Economic Botany. Tata McGraw Hill Publishing Company Ltd., New Delhi.
4. Simpson, B. B. and Conner-Ogorzaly, M. 1986. Economic Botany - Plants in Our World. McGraw Hill, New York.
5. Chopra R.N., S. L. Nayar and I. C. Chopra, 1956. Glossary of Indian medicinal plants C.S.I.R, New Delhi.
6. Dey and Raj Bahadur, 1984. The indigenous drugs of India, Kanny, Lall. International Book Distributors.

Plant Diversity and Ethnobotany:

1. Naik, V. N. 1996. Taxonomy of angiosperms, Mc Grath Publications, New Delhi.
2. Kocchar, S. L. 1998. Economic Botany in Tropics, 2nd edition. Mac Millan India Ltd., New Delhi.
3. Sambamurthy, A. V. and Subramanyam, N. S. 1989. A Textbook of Economic Botany-- Wiley Eastern Ltd., New Delhi.
4. Sharma, O. P. 1996. Hill's Economic Botany. Tata McGraw Hill Publishing Company Ltd., New Delhi.
5. Simpson, B. B. and Conner-Ogorzaly, M. 1986. Economic Botany - Plants in Our World. McGraw Hill, New York.

Plant Breeding, Bioinformatics and Biostatistics:

1. Introduction to Bioinformatics – S. Sundara Rajan, R. Balaji; Himalaya Publishing House.
2. Fundamentals of Biochemistry- J. L. Jain, Sunjay Jain, Nitin Jain; S. Chand & Company Ltd.
3. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology- P. S. Verma, V. K. Agarwal; S. Chand & Company Ltd.
4. Biological Techniques- Srivastava, H. S. (1999).

Details of Practical Examination

- A. Every candidate must produce a certificate from Head of the Dept. in his/her college, stating that he/she has completed practical course in satisfactory manner as per guidelines 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 year. Candidates have to produce their certificated journal and tour report at the time of practical examination. Candidate is not "allowed to appear" for the practical examination without a certified journal/a certificate from Head of Botany Dept. regarding the same.
- B. Practical Examination shall be of Five hours duration and shall test a candidate in respect of the following.
1. Practical study of external and internal structures of different plant types and their classification. Making temporary stained preparations and identification.
 2. Identification and setting of physiological and biochemical experiments.
 3. Study of plant families as per syllabus.
 4. Spotting of the specimens as per syllabus.

Botanical Excursions:

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

Practical Course:

B. Sc. III Botany Practical course is to be covered in eighty practicals. These practicals are to be performed by the students. Each practical is to be supplemented by permanent slides, preserved/fresh specimens/materials, charts, herbarium sheets, etc. wherever necessary.

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.
- The Board of studies should clearly mention the required Books, Journals and specific Equipment 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:**

- ii) Fire extinguishers at least two sets in each laboratory of 600 sq. ft. Area.
- iii) Leakage of gases be avoided.
- iv) First aid kit be made available.
- v) 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 equipment's needed for Laboratory Safety:

1. Fire extinguisher
2. First Aid Kit
3. Good earthing 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.

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 equipment, 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.

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 distil 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 reports 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).

Course Outcomes

- CO1. Students will able to Recognize morphology of reproductive organs and development in the reproduction of angiosperms.
- CO2. Students will able to identify the plants
- CO3. Students will be able to understand the methods to present a scientific research paper.
- CO4. Students will be able to identify the natural resources in the Western Ghats, India. Also, student will understand the recent biotechnological advances in the biology.
- CO5. Students will be able to explain the various stress factors in the plants and also to effects of stress factors on the plant and to overcome these factors.
- CO6. Students will be able to explain the skills of bio-fertilizer production, herbal preparations, breeding techniques and different analytical techniques used in the plant science.