Estd. 1962
"A++" Accredited by NAAC (2021)
With CGPA 3.52

SHIVAJI UNIVERSITY, KOLHAPUR - 416004, MAHARASHTRA
PHONE:EPABX-2609000, www.unishivaji.ac.in, bos@unishivaji.ac.in
शिवाजी विद्यापीठ, कोल्हापूर -४१६००४,महाराष्ट्र
दूरध्वनी-ईपीएबीएक्स -२६०९०००, अभ्यासमंडळे विभाग दुरध्वनी ०२३१—२६०९०९४
०२३१—२६०९४८७

Ref.No.SU/BOS/Science/434 **Date: 15/07/2025**

To,

The Principal,
All Concerned Affiliated Colleges/Institutions
Shivaji University, Kolhapur.

Subject: Regarding revised syllabi of B.Sc. Part-II (Sem.III & IV) degree programme under the Faculty of Science and Technology as per NEP-2020 (2.0)

Ref: No.SU/BOS/Science/270 & 271 Date: 03/05/2025 Letter.

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 syllabi, nature of question paper of B.Sc. Part-II (Sem.III & IV) degree programme under the Faculty of Science and Technology as per NEP-2020 (2.0).

B.Sc.Part-II (Sem. III & IV) as per NEP-2020 (2.0)			
1.	Botany	8.	Geology
2.	Statistics	9.	Zoology
3.	Mathematics	10.	Chemistry
4.	Microbiology	11.	Electronics
5.	Plant Protection	12.	Industrial Microbiology
6.	B.A./B.A.B.Ed. Geography	13.	Biotechnology(Voc/Opt)
7.	Biotechnology(Entire)		

This syllabus, nature of question and equivalence shall be implemented from the academic year 2025-2026 onwards. A soft copy containing the syllabus is attached herewith and it is also available on university website www.unishivaji.ac.in NEP-2020@suk(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 2025 & March/April 2026. 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

Encl: As above

for Information and necessary action

Copy to:

1	Dean, Faculty of Science & Technology	6	Appointment Section A & B
2	Director, Board of Examinations and Evaluation	7	I.T.Cell /Computer Centre
3	Chairman, Respective Board of Studies	8	Eligibility Section
4	B.Sc.-M.Sc. Exam Section	9	Affiliation Section (T.1) (T.2)
5	Internal Quality Assurance Cell (IQAC Cell)	10	P.G. Seminar Section

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दूरध्वनी-ईपीएबीएक्स -२६०९०००, अभ्याससमंडळे विभाग दुरध्वनी ०२३१—२६०९०९४
०२३१—२६०९४८७

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B.Sc.Part-II (Sem. III & IV) as per NEP-2020 (2.0)			
1.	Botany	8.	Geology
2.	Physics	9.	Zoology
3.	Statistics	10.	Chemistry
4.	Mathematics	11.	Electronics
5.	Microbiology	12.	Drug Chemistry
6.	Plant Protection	13.	Industrial Microbiology
7.	Astrophysics and Space Science	14.	Sugar Technology (Entire)

This syllabus, nature of question and equivalence shall be implemented from the academic year 2025-2026 onwards. A soft copy containing the syllabus is attached herewith and it is also available on university website www.unishivaji.ac.in NEP-2020@suk(Online Syllabus)

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Yours faithfully,

By Registrar
Dr. S. M. Kubal

Encl: As above

for Information and necessary action

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SHIVAJI UNIVERSITY, KOLHAPUR.

Accredited By NAAC with 'A^{++}' Grade

Syllabus For

B. Sc. II Botany

(Faculty of Science & Technology)

Semester- III and Semester- IV

NEP-2020 (2.0)

Syllabus to be implemented from June, 2025 onwards

Shivaji University, Kolhapur
Bachelor of Science
Credit Framework

	SHIVAJIUNIVERSITY, KOLHAPUR NEP-2020: Credit Framework for UG (B. Sc.) Programme under Faculty of Science and Technology							
SEM (Level)	COURSES		**OE**	**VSC/SEC**	**AEC/VEC/ IKS**	**OJT/FP/CEP /CC/RP**	**Total Credits**	**Degree/Cum. Cr**
	MAJOR	**MINOR**						
SEM III (5.0)	Major V (2) Major VI (2) Major P III (2)	Minor V (2) Minor VI (2) Minor P III (2)	OE-3(2) (T/P)	VSC I (2) (P) (Major specific) SEC I (2) (T/P)	AEC I (2) (English)	CC-I (2)	22	**UG Diploma 88**
SEM IV (5.0)	Major VII (2) Major VIII (2) Major P IV (2)	Minor VII (2) Minor VIII (2) Minor P IV (2)	OE-4(2) (T/P)	SEC-II (2) (T/P)	AEC-II (2) (English) VEC-II (2) (Environmental studies)	CEP-I (2)	22	
Credits	**8(T)+4(P)= 12**	**8(T)+4(P)=12**	**2+2=4(T/P)**	**4(T/P) +2(P)=6**	**2+4=6**	**2+2=4**	44	**Exit Option:4 credits NSQF/Internship/Skill courses**

I. Shivaji University, Kolhapur

Revised syllabus for Bachelor of Science NEP-2020 (2.0)

1. TITLE: Subject-Botany Major

Optional under the Faculty of Science and Technology

2. YEAR OF IMPLEMENTATION: - Revised Syllabi NEP-2020 (2.0) will be implemented from June, 2025 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) 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. **One Year, Semester III and IV.**

6. PATTERN: -

Pattern of examination will be semester wise.

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 English

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

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

Sr. No.	Subjects/Papers	Theory	Practical	Internal	Total Marks
1	Major Paper – V	40		10	50
2	Major Paper – VI	40		10	50
3	Major Paper – VII	40		10	50
4	Major Paper – VIII	40		10	50
5	Major Practical – III		50		50
6	Major Practical – IV		50		50
Total					**300**

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)		
		T	P	Total	Theory	Term Work	Total
	Semester III						
1	Major Paper – V	02		02	40	10	50
2	Major Paper – VI	02		02	40	10	50
3	Practical – III (Semester)		04	04	50		50
	Semester IV						
1	Major Paper – VII	02		02	40	10	50
2	Major Paper – VIII	02		02	40	10	50
3	Practical – IV (Semester)		04	04	50		50
	Total	08	08	16			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: Unit Test and Semester IV: Oral examination/Group discussion)**
- 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:

Duration of question paper: As per University rule

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, 2025 onwards)

	Old Syllabus (Semester Pattern)		**New Syllabus (Semester Pattern)**	
Semester No.	**Paper No.**	**Title of Old Paper**	**Paper No.**	**Title of New Paper**
III	V	Plant Systematics and Anatomy	Major V	Plant Morphology and Anatomy
	VI	Genetics and Molecular Biology	Major VI	Genetics and Molecular Biology
IV	VII	Plant Ecology and Economic Botany	Major VII	Plant Physiology and Ecology
	VIII	Plant Physiology, Nursery and Gardening Techniques	Major VIII	Plant Systematics and Economic Botany

16. SPECIAL INSTRUCTIONS, IF ANY

SEMESTER-III
MAJOR PAPER V: PLANT MORPHOLOGY AND ANATOMY
CREDITS: 2, LECTURE HOURS: 2 PER WEEK, MARKS: 50

MODULE	SUB MODULE	TOPIC	LECTURE PERIOD
1		**PLANT MORPHOLOGY**	
	1a. Morphology of Root, Stem and Leaf	i. Root: Definition, Types and Modifications of roots (Conical, Fusiform, Napiform, Prop, Pneumatophore) ii. Stem: Definition and Modifications Stem- (Phylloclade, Rhizome, Corm, Tuber) iii. Leaf: Definition, Structure of typical leaf, Types of leaves-Simple and compound; Kinds of stipules; Leaf modifications-Phyllode and Leaf Tendril	**15**
	1b. Morphology of Inflorescence, Flower and Fruit	i. Inflorescence: Definition and Types-Racemose, Cymose and Special Types. ii. Flower: a) Definition, Typical flower-Hypogynous, Epigynous and perigynous, forms of corolla; Aestivation b) Androecium- Definition, Study of typical stamen; Adhesion and Cohesion of stamens c) Gynoecium- Definition, Study of typical carpel; Placentation d) Concept of floral formula and floral diagram iii. Fruits: Definition, Classification of fruits- Simple, Aggregate and Multiple	
2		**PLANT ANATOMY**	
	2a. Structure and development of plant body	i. Plant Anatomy: Introduction to internal organization of plant body ii. Organization of shoot apex: Apical cell theory iii. Organization of root apex: Quiescent centre concept iv. 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)	**15**
	2b. Secondary structure of the Plant Body	i. Primary Structure of Monocotyledonous (Maize) and Dicotyledonous (Sunflower) Root, Stem and Leaf ii. Normal secondary growth in Dicotyledonous (Sunflower) stem and root; Periderm and Lenticel ii. Abnormal secondary growth in dicot stem (*Bignonia*), monocot stem (*Dracaena*)	

SEMESTER-III
MAJOR PAPER VI: GENETICS AND MOLECULAR BIOLOGY
CREDITS: 2, LECTURE HOURS: 2 PER WEEK, MARKS: 50

MODULE	SUB MODULE	TOPIC	LECTURE PERIOD
		GENETICS	
1	1a. Mendelian Genetics	1.1 Introduction and Terminology –Allele, Dominant, Recessive, Genotype, Phenotype, Homozygous, Heterozygous etc. 1.2 Mendel's laws of Inheritance, Monohybrid cross, Dihybrid cross, Back cross, Test cross. 1.3 Linkage: Definition, Types, and significance. 1.4 Crossing over: Definition, Mechanism of crossing over, and significance. 1.5 Extra chromosomal inheritance: chloroplast inheritance in 4 0'clock plant	**15**
	1b. Chromosomal aberrations	1.6 Chromosomes: Structure and Polytene chromosome 1.7 Numerical chromosomal aberrations: Euploidy and Aneuploidy 1.8 Structural chromosomal aberrations: Deletions, Duplications, Inversions and Translocations	
		MOLECULAR BIOLOGY	
2	2a. Genetic information	2.1 Carriers of genetic information- DNA as a carrier of genetic information (Griffith's experiment) 2.2 Genome Organization- Nuclear DNA (gDNA), Packaging of DNA helix (Solenoid model). 2.3 DNA Replication – Semi-conservative DNA replication in prokaryote and eukaryotes– Introduction, mechanism, significance	**15**
	2b. Expression of genetic information	2.4 Concept of Central Dogma- Introduction, definition, Significance 2.5 Transcription (Eukaryotes)-Mechanism in brief 2.6 Translation (Eukaryotes)-Mechanism in brief 2.7. Lac Operon Concept 2.7 Concept of Genetic code- Introduction and general features	

Practical - III
(Based on Major paper V and VI)
CREDIT: 2. PRACTICAL HOURS:60 MARKS: 50

1. Study of modifications of Roots (Napiform, Stilt root, Conical), Stem (Rhizome, Bulb, Tuber) and Leaf (Phyllode and Tendril)
2. Study of types of inflorescence.
3. Study of Flower: Types of flowers (hypogynous, Perigynous and epigynous) and Aestivation.
4. Study of Flower: Types of Adhesion, Cohesion and Placentation.
5. Study of concept of floral formula and floral diagram.
6. Study of types of fruits.
7. Study of organization of shoot and root apex.
8. Study of normal secondary growth in dicot stem and root (*Parthenium*/Sunflower/ *Tinospora*) by double-stained permanent micro-preparation technique.
9. Study of abnormal secondary growth in dicot stem (*Bignonia*) and monocot stem (*Dracaena*).
10. Study of Mendel's Laws through suitable phenotypic trait in plant material.
11. Genetic problems on Linkage and Crossing over.
12. Meiotic abnormalities in *Tradescantia* sp.
13. Karyotypic study in plants using photomicrograph (any two plant materials e.g. *Allium cepa* and *Aloe vera*).
14. Study of 'DNA' as genetic material by using photographs (Griffith's experiment).
15. Study of DNA packaging into chromosome by using photographs (Solenoid model)
16. Isolation of plant genomic DNA.

List of Books Recommended for B. Sc. II Botany

Paper V

1. Dickison, W.C. (2000). Integrative Plant Anatomy. Harcourt Academic Press, USA.
2. E. John Jothi Prakash (2006) Plant Anatomy. Emkay Publication
3. Fahn, A. (1974). Plant Anatomy. Pergmon Press, USA.
4. Mauseth, J.D. (1988). Plant Anatomy. The Benjammin/Cummings Publisher, USA.
5. 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.
6. Pandey, S.N. and Chadha, Ajantha (2015). A Textbook of Botany Vol. II (Plant Anatomy and Economic Botany). Vikas Publishing House Pvt. Ltd. Noida (U.P.), India.
7. Pandey, B. P. (2012). Plant Anatomy. S Chand Publishing, New Delhi.

Paper VI

1. Ahluwalia K. B. (2009). Genetics, New Age International Publishers, India, 2nd Edition
2. Alberts, Bruce, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter. Molecular Biology of the Cell. New York: Garland Science, 2002.
3. Cooper, Geoffrey M, and Robert E. Hausman. The Cell: A Molecular Approach. Sunderland, MA: Sinauer Associates, 2013.
4. Gardner, E.J., Simmons, M.J., Snustad, D.P. (1991). Principles of Genetics, John Wiley & sons, India. 8th 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. 10th edition.
6. Gupta P. K. (2017). Molecular Biology, Rastogi Publication, Meerut.
7. Gupta P. K. (2018) Genetics, Rastogi Publications, Meerut, 5th Edition.
8. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. Benjamin Cummings, U.S.A. 9th edition.
9. Krebs, Jocelyn E, Benjamin Lewin, Stephen T. Kilpatrick, and Elliott S. Goldstein. Lewin's Genes Xi. Burlington, Mass: Jones & Bartlett Learning, 2014.
10. Kumar, H. D. (2001). Molecular Biology. Vikas Publishing House.
11. Lewin, B. (2000) Gene VII. Oxford University Press
12. Lodish, Harvey F, Arnold Berk, Chris Kaiser, Monty Krieger, Anthony Bretscher, Hidde L. Ploegh, Angelika Amon, and Kelsey C. Martin. Molecular Cell Biology. , 2016.
13. Maniatis, Tom, Edward F. Fritsch, and Joseph Sambrook. Molecular Cloning: A Laboratory Manual. Cold Spring Harbor: Cold Spring Harbor Laboratory, 1982.

14. Russell, P. J. (2010). i-Genetics- A Molecular Approach. Benjamin Cummings, U.S.A. 3rd edition.
15. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics, John Wiley & Sons Inc., India. 5th edition.
16. Varma, P. S. and Agrawal, V. K. (2020). Molecular Biology. S. Chand Publications.

COURSE OUTCOMES:

Major Paper V:

After completing this course, students will be able to:

1. Understand the development and internal organization of the plant body, including different types of permanent tissues (simple and complex).
2. Explain the characteristics, classification, and functions of meristems, along with the organization of shoot and root apices.
3. Analyse the primary structure of monocot (Maize) and dicot (Sunflower) roots, stems, and leaves.
4. Describe normal and abnormal secondary growth in dicots and monocots, including structures like periderm, lenticels, and growth variations in different species.

Major 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 analyse genetic problems on Mendel's laws of inheritance, linkage and crossing over.
4. To know the genetic material is nucleic acids in prokaryotes and eukaryotes.
5. To understand the process of gene expression in prokaryotes and eukaryotes.
6. To summarize concept of central dogma and genetic code.

SEMESTER –III

OPEN ELECTIVE - III: ORGANIC FARMING AND BIOPESTICIDES

CREDIT: 2 PRACTICAL HOURS:60 MARKS: 50

1. **Soil Testing:** Collection of soil samples and test for pH, moisture, and nutrient levels.
2. **Compost Making:** Preparation of compost using kitchen waste, dry leaves, and manure.
3. **Mulching:** Application of organic mulch (straw, leaves) to conserve moisture and suppress weeds.
4. **Seed Treatment:** Treatment of seeds using neem extract or cow urine.
5. **Natural Pesticides:** Preparation of pest resistant seeds using neem oil spray, garlic spray, or cow dung-based pesticides.
6. **Cow Dung and Urine Fertilizer:** Preparation of Jeevamrut or Panchagavya as natural fertilizers.
7. **Broad spectrum Botanical pesticide**: Preparation of pesticide using Neem Spray (General Pest Repellent)
8. **Insect and Fungal Control:** Preparation of Garlic-Chili Spray
9. **Algae Cultivation**: Grow algae or Azolla in water trays to use as a biofertilizer or animal feed.
10. **Natural Growth Promoters:** Prepare a banana peel spray by soaking banana peels in water for 24 hours and applying it to plants as a potassium-rich solution.
11. **Aphid and Caterpillar Control:** Preparation of Tobacco Extract.
12. **General Pest Control and Growth Promoter:** Preparation of Cow Urine Biopesticide.
13. **Fungal Disease Control:** Preparation of fermented Buttermilk Spray.
14. Filed Visit to any farm.

Suggested Readings:

1. S.P. Palaniappan & K. Annadurai, (2019) Organic Farming: Theory and Practice, Scientific Publishers,
2. P.K. Gupta, (2019) Principles of Organic Farming, Scientific Publishers, 2019.
3. Arun K. Sharma **(**2019) Fundamentals of Organic Farming and Sustainable Agriculture, Scientific Publishers.
4. Opender Koul & G.S. Dhaliwal **(**2001) Biopesticides: A Bio-rational Approach to Pest Management, CRC Press.
5. L.P. Awasthi (2015) Biopesticides Handbook, CRC Press,
6. S.S. Bhooshan & A.K. Pandey (2017) Recent Advances in Biopesticides, Springer,

सेमिस्टर- ३

ओपन एलेक्टीव- ३ : सेंद्रिय शेती आणि जैव कीटकनाशके

क्रेडिट २ **६० तास** **मार्क्स: ५०**

प्रात्यक्षिक-३ : सेंद्रिय शेती आणि जैव कीटकनाशके

१. **माती परीक्षण:** मातीचे नमुने गोळा करणे आणि पीएच, आर्द्रता आणि पोषक तत्वांची पातळी तपासणे.

२. **कंपोस्ट बनवणे:** स्वयंपाकघरातील कचरा, सुकी पाने आणि खत वापरून कंपोस्ट तयार करणे.

३. **आच्छादन:** ओलावा टिकवून ठेवण्यासाठी आणि तण दाबण्यासाठी सेंद्रिय आच्छादन (पेंढा, पाने) वापरणे.

४. **बियाणे प्रक्रिया:** कडुलिंबाचा अर्क किंवा गोमूत्र वापरून बियाण्यांवर प्रक्रिया करणे.

५. **नैसर्गिक कीटकनाशके:** कडुलिंबाचे तेल स्प्रे, लसूण स्प्रे किंवा शेण-आधारित कीटकनाशके वापरून कीटक प्रतिरोधक बियाणे तयार करणे.

६. **गायीचे शेण आणि मूत्र खत:** नैसर्गिक खते म्हणून जीवामृत किंवा पंचगव्य तयार करणे.

७. **ब्रॉड स्पेक्ट्रम वनस्पति कीटकनाशक:** कडुलिंब स्प्रे (सामान्य कीटकनाशक) वापरून कीटकनाशक तयार करणे

८. **कीटक आणि बुरशी नियंत्रण:** लसूण-मिरची स्प्रे तयार करणे

९. **शैवाल लागवड:** जैवखत किंवा पशुखाद्य म्हणून वापरण्यासाठी पाण्याच्या ट्रेमध्ये शैवाल किंवा अझोला वाढवा.

१०. **नैसर्गिक वाढ प्रवर्धक:** केळीच्या साली २४ तास पाण्यात भिजवून आणि पोटॅशियमयुक्त द्रावण म्हणून झाडांना लावून केळीच्या सालीचा स्प्रे तयार करा.

११. **मावा आणि सुरवंट नियंत्रण:** तंबाखूच्या अर्काची तयारी.

१२. **सामान्य कीटक नियंत्रण आणि वाढ प्रवर्धक:** गोमूत्र जैव कीटकनाशक तयार करणे.

१३. **बुरशीजन्य रोग नियंत्रण:** आंबलेल्या ताक स्प्रेची तयारी.

१४. कोणत्याही शेताला भेट द्या.

सुचवलेले वाचन:

1. S.P. Palaniappan & K. Annadurai, (2019) Organic Farming: Theory and Practice, Scientific Publishers,
2. P.K. Gupta, (2019) Principles of Organic Farming, Scientific Publishers, 2019.
3. Arun K. Sharma (2019) Fundamentals of Organic Farming and Sustainable Agriculture, Scientific Publishers.
4. Opender Koul & G.S. Dhaliwal (2001) Biopesticides: A Bio-rational Approach to Pest Management, CRC Press.
5. L.P. Awasthi (2015) Biopesticides Handbook, CRC Press,
6. S.S. Bhooshan & A.K. Pandey (2017) Recent Advances in Biopesticides, Springer,

SEMESTER –III

SKILL ENHANCEMENT COURSE - I: FLORICULTURE

CREDIT: 2 **PRACTICAL HOURS; 60** **MARKS: 50**

List of Practical

1. Preparation of different types of nursery beds (Flat beds, raised beds, ridges and furrows, basin etc.) and pots.
2. Identification of commercially important floricultural crops: Annuals, Biennials, Perennials and Bulbous flowering plants.
3. Study of methods of propagation a) Natural Asexual or Vegetative Propagation: Runner, Sucker, Bulb, Tubers, Offset, Corms, Rhizome, Bulbs, Stolo
4. Study of methods of propagation b) Artificial Asexual or Vegetative Propagation: Stem Cutting, T-Budding, Whip Grafting and Air Layering.
5. Study of Planting and Transplanting Technique.
6. Study of pruning and training of rose.
7. Study of different plant growth regulators used for growth of ornamental flowering plants.
8. Study of methods of drying and preservation of flowers.
9. Study of methods of Packaging and Marketing of flowers.
10. Study the method of prolonging Vase life of flowers.
11. Study of methods of Techniques in Flower arrangement and floral decoration.
12. Practices in preparation of bouquets, button-holes, flower baskets, Corsages, Floral Wreaths, Garlands, Veni and Gajara. with fresh flowers.
13. Study of Common Diseases and pests of ornamental flowering plants.
14. Landscaping and Architecture of garden.
15. Report on Flower market survey/visit to flower polyhouse

Suggested Readings

1. Randhawa, G.S. and Mukhopadhyay, A. 1986. Floriculture in India. Allied Publishers.
2. Nag. K. 2019. Principles and Practices of Floriculture, Jaya Publishers.
3. Prasad S, Kumar U 2013, A Handbook of Floriculture Agrobios (India)
4. S. K. Bhattacharjee, Lakshman Chandra De 2003. Advanced commercial floriculture. Vol. 1 Aavishkar Publications, Jaipur, India.
5. S. K. Bhattacharjee, Lakshman Chandra De 2003. Advanced commercial floriculture. Vol. 2 Aavishkar Publications, Jaipur, India.

SEMESTER –III

VSC-1: NURSERY DEVELOPMENT AND MANAGEMENT

CREDIT: 2 **PRACTICAL HOURS:60** **MARKS: 50**

List of Practical

1. Designing nursery layout and drawing.
2. Study of tools and implements used in nurseries.
3. Study of irrigation methods in nursery.
4. Preparation of soil mixture for nursery beds and pots.
5. Preparation of different types of nursery beds.
6. Study of importance of Mother plant in nursery, its selection criteria and maintenance.
7. Preparation of plant material for potting and repotting.
8. Study of plantlet hardening methods in the nursery.
9. Study of different types of plants propagated in nursery: Ornamental, Indoor, Outdoor, Edge and Hedge plants.
10. Study of different type of propagation methods: Cuttings and Layering.
11. Study of different type of propagation methods: Buddings and Grafting.
12. Study of different plant growth regulators used for seed germination and vegetative propagation.
13. Study of different types of fertilizers used in nursery.
14. Study of Common nursery plant diseases and their management.
15. Visit to a plant nursery.

Suggested Reading:

1. Krishnan, P. R., Kalia, R. K., Tewari, J. C., & Roy, M. M. (2014). *Plant nursery management: principles and practices*. Central Arid Zone Research Institute, Jodhpur, 40.
2. Ray, P.K. (2012). *Plant Nursery Management: How to Start and Operate a Plant Nursery*. Scientific Publishers.
3. Hartmann, H.T., Kester D.E., Davis, F.T and R.L Geneve (2010) *Plant Propagation: Principles and practices* (8th Edition)
4. Mason, J. (2004). Nursery management. Landlinks Press. 5. Sharma, R.R and Srivastav M (2004): *Plant propagation and nursery management* (First Edition) International Book Distributing Co.
6. Bose, T.K. Sanyal, D and Sandhu, M.L. (1998) *Propagation of Horticultural crops*. Naya Prakash Publishers, Kolkatta .
7. K. K. Nanda and V.K. Kochhar (1985). *Vegetative propagation of plants*. Kalyani Publisher- New Delhi-Ludhiana.

Learning Outcomes:

On successful completion of this course students will be able to;

1. Understand the importance of a plant nursery and basic infrastructure to establish it.
2. Explain the basic material, tools and techniques required for nursery.
3. Demonstrate expertise related to various practices in a nursery.
4. Comprehend knowledge and skills to get an employment or to become an entrepreneur in plant nursery sector.

Practical Examination:

1. Practical Examination will be conducted at the end of Semester.
2. Practical paper carries 50 Marks.
3. Duration of Practical Examination: 4 Hrs.

SEMISTER IV

SEMESTER-IV
MAJOR PAPER VII: PLANT PHYSIOLOGY AND ECOLOGY
CREDITS: 2, LECTURE HOURS: 2 PER WEEK, MARKS: 50

MODULE	SUB MODULE	TOPIC	LECTURE PERIOD
1	**PLANT PHYSIOLOGY**		
	1a. 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, cyclic and non-cyclic Photophosphorylation) b) Dark Reaction: C3, C4 and CAM pathways	**15**
	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	
2	**PLANT ECOLOGY**		
	2a. Plant Ecology	2.1 Introduction: Basic concepts; Levels of organization in ecology, Ecosystems: Structure-biotic and abiotic components, Trophic organization, Food chains and Food web; Ecological pyramids. 2.2 Energy flow in Ecosystem: Box and pipe model 2.3 Biogeochemical cycles; Gaseous and sedimentary cycles- Nitrogen and Phosphorus 2.4 Succession – Hydrosere and Xerosere	**15**
	2b. Phytogeography	2.5 Phytogeographical regions of India. (D. Chatterjee, 1962) 2.6 Endemism: Concept and Endemic plants in Sahyadri Ranges	

SEMESTER-IV

MAJOR PAPER VIII: PLANT SYSTEMATICS AND ECONOMIC BOTANY

CREDITS: 2, LECTURE HOURS: 2 PER WEEK, MARKS: 50

MODULE	SUB MODULE	TOPIC	LECTURE PERIOD
1	**PLANT SYSTEMATICS**		
	1a. Plant Systematics	1.1 Introduction to systematics, Functions of taxonomy- Plant identification, Classification, Nomenclature 1.2 Principles and rules of ICN 1.3 Bentham and Hookers system of classification (up to order), Merits and Demerits 1.4 Study of diagnostic characters (vegetative and floral characters), classification, inter-relationship and economic importance of the following families: Polypetalae: Malvaceae Gamopetalae: Solanaceae Apetalae: Nyctaginaceae Monocot: Liliaceae	**15**
	1b. Taxonomic hierarchy	1.5 Concept of taxa (family, genus, Taxonomical and biological concept of species), Categories and taxonomic hierarchy.	
	1c. Herbaria and Botanical Gardens	1.6 Herbarium: Concept and functions, Virtual herbarium (POWO: Plants of the World Online) 1.7 Botanical gardens: Introduction and functions, Royal Botanical Garden, Kew; Acharya Jagdish Chandra Bose Indian Botanical Garden, Kolkata; Lead Botanical Garden, Shivaji University, Kolhapur.	
2	**ECONOMIC BOTANY**		
	2a. Origin of Cultivated Plants	2.1 Centers of Origin of cultivated plants with reference to Vavilov's work.	**15**
	2b. Cereals, Legumes, Fatty Oils and vegetable fats	2.2 Origin, Botanical description, Sources and Economic importance of a. Cereal: Wheat b. Millet: Finger millet. c. Legumes: Chick pea d. Fatty Oils: Groundnut e. Vegetable fats: Soybean	
	2c. Spices Beverages and fiber	2.3 Botanical description, Sources and Economic importance of a. Spices: Clove b. Beverages: Lemon c. Fiber yielding plants: Cotton	
	2d. Sources of sugars and starches	2.4 Sugarcane: products-Sugar, Jaggary; by-products- molasses, alcohol, bagasse. Products of potato.	

Practical - IV
(Based on Major Paper VII and VIII)
CREDIT: 2. PRACTICAL HOURS:60 MARKS: 50

1. To study evolution of oxygen during photosynthesis.
2. Separation of Photosynthetic pigments by thin layer chromatography.
3. Study of respiration in germinating seeds by using Ganong's respirometer.
4. Study of ecological pyramids from the given data.
5. Study of Phytogeographical regions of India.
6. Study of any five endemic plants in Sahyadri Ranges.
7. to 10. Study of vegetative and floral characters of the following families:

   Polypetalae: Malvaceae

   Gamopetalae: Solanaceae

   Apetalae: Nyctaginaceae

   Monocot: Liliaceae

11. Preparation of herbarium specimens and searching of digital or e-herbarium specimen at virtual herbarium (POWO)
12. and 13 Study of source and economic importance in cereals and legumes (as per theory)
14. and 15 Study of source and economic importance in Oil crops and fiber yielding crops (as per theory).
16. Field / Industrial visit

List of Books Recommended for B. Sc. II Botany
Paper VII

1. Taiz, L., Zeiger, E., Møller, I. M., & Murphy, A. (2018). Plant Physiology and Development (6th ed.). Sinauer Associates, Sunderland, MA.
2. Buchanan, B. B., Gruissem, W., & Jones, R. L. (2015). Biochemistry & Molecular Biology of Plants (2nd ed.). Wiley-Blackwell, Hoboken, NJ.
3. Heldt, H.-W., & Piechulla, B. (2021). Plant Biochemistry (5th ed.). Academic Press, London.
4. Hall, D. O., & Rao, K. K. (1999). Photosynthesis (6th ed.). Cambridge University Press, Cambridge.
5. Govindjee, & Raghavendra, A. S. (2006). Photosynthesis: A Comprehensive Treatise. Cambridge University Press, Cambridge.

6. Odum, E. P., & Barrett, G. W. (2004). Fundamentals of Ecology (5th ed.). Brooks Cole, Belmont, CA.
7. Smith, T. M., & Smith, R. L. (2020). Elements of Ecology (10th ed.). Pearson, Boston.
8. Lomolino, M. V., Riddle, B. R., & Brown, J. H. (2017). Biogeography (5th ed.). Oxford University Press, Oxford.
9. Cain, S. A. (1944). Foundations of Plant Geography. Harper & Brothers, New York.
10. Good, R. (1974). The Geography of Flowering Plants (4th ed.). Longman, London.
11. Cox, C. B., & Moore, P. D. (2010). Biogeography: An Ecological and Evolutionary Approach (8th ed.). Wiley-Blackwell, Hoboken, NJ.

Paper VIII

1. Plant Systematics (2nd edition). Jones, S.B. Jr. and Luchsinger, A.E. 1986. McGraw-Hill Book Co., New York.
2. Plant Systematics: Theory and practice. G. Singh, 1999. Oxford & IBH Pvt., Ltd. New Delhi.
3. An Introduction to Plant Taxonomy. C. Jeffrey, 1982. Cambridge University Press, Cambridge London.
4. Plant Taxonomy and Biosystematics. C.A. Stace, 1989. 2nd ed. Edward Arnold, London. Contemporary Plant Systematics. D.E. Woodland. 1991. Prentice Hall, New Jersay.
5. Plant Systematics for 21st Century. B. Nordenstam, El-Gazaly, G. and Kassas. M. 2000, Portland Press Ltd., London.
6. Current Concepts in Plant Taxonomy. V.H. Heywood and D.M. Moore 1984. Academic Press, London.
7. A Textbook of Modern Economic Botany. 1st edition, CAS publishers and Distributors Pvt, Ltd.
8. Economic Botany. 1st edition, Aahyayan Publishers and Distributors.

Course Outcomes

Major Paper VII:

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 understand significance and mechanism of respiration.
4. To understand core concepts of biotic and abiotic components.
5. To gain and insight in to the diverse ecosystem, related food web and ecological pyramids.

6. To prepare map of Phytogeographical regions of India.

Major Paper VIII:

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

1. To know the scope and importance of 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 know the centre of origins of different crop plants.
5. To know importance of plants and plant products and their utility.

Study Tour/ Excursion:

One teacher along with a batch not more than 20 students is taken for excursions to places of study 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 3 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 – III and IV are to be covered in 15 practical's each. These practical's 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 of practical course and completion of the same signed by the concerned teacher and Head of the Department.

II. 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 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:

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 hypoglycaemic condition or in extreme weakness of student or a person concerned.

3. GENERAL SAFETY RULES FOR LABORATORY WORK

1) List of equipment 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.

b) 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's, 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 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 practical's 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 practical should be followed for conducting practical in plant biochemistry /microbiology.

9. Operational manuals for equipment 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.

SEMESTER –IV

OPEN ELECTIVE - IV: FRUIT PROCESSING AND MANAGEMENT

CREDIT: 2. PRACTICAL HOURS:60 MARKS: 50

1. Study of common fruit processing equipment's (Pulper, sealers, juice extracting machines, autoclaves, corking machines).
2. Study of methods of packaging, packaging materials and packaging technology for export of fruits.
3. Study of fruit preservation methods (Natural agent: sugar, salt and chemical agents: sodium benzoate, calcium propionate, Cold storage)
4. Study of preservation of coconut shreds using humectants.
5. Study of various methods of drying: sun drying, cabinet drying and solar drying.
6. Study of effect of growth regulators in fruit ripening in banana/mango/grapes.
7. Study of preparation of fruit juices with/without addition of preservatives.
8. Study of Tomato processing: juices, puree, ketchups, sauces, soup, chutney etc.
9. Preparation of different types of pickles from locally available fruits.
10. Preparation of jam, jelly and Marmalades from locally available fruits.
11. Preparation of Amla juice, Amla pickle and Amla candy.
12. Study of food safety standards (GMP, FSSAI, ISO22000, HACCP).
13. Visit to fruit processing industry.

Suggested Readings:

1. Giridhari, Lal, Siddapa, G.S. and Tandon, G. L. (1998) Preservation of fruit and vegetables, Publication and information division, ICAR.
2. Srivastava, R. P., Sanjeev Kumar, (2006) Fruits and vegetable preservation, International book distributing Co. Lucknow.
3. Chanda, K. L. and Pareek, O. P. (1996) Advances in Horticulture, Vol. IV. Malhotra Publ. House, Kriti Nagar, Delhi.
4. Prasad and Kumar, (2024) Principles of Horticulture 2nd Edn. Agrobios (India).
5. Neeraj Pratap Singh, (2005) Basic concept of fruit science, 1st Eds. IBDC Publishers.
6. Salunkhe, D. K. and Kadam, S. S., (2013) A Handbook of Fruit Science and Technology, CRC Press.
7. Prasad, S. and Kumar, U. (2010) A Handbook of Fruit Production, Agrobios (India).

सेमिस्टर-४

ओपन एलेक्टीव- ४ : फळ प्रक्रिया आणि व्यवस्थापन

क्रेडिट २ ६० तास मार्क्स: ५०

प्रात्यक्षिक -४ : फळ प्रक्रिया आणि व्यवस्थापन

1. सामान्य फळ प्रक्रिया उपकरणांचा अभ्यास करणे (पल्पर, सीलर्स, रस काढणारी मशीन, ऑटोक्लेव्ह, कॉर्किंग मशीन).

2. फळांच्या निर्यातीसाठी पॅकेजिंगच्या पद्धती, पॅकेजिंग साहित्य आणि पॅकेजिंग तंत्रज्ञानाचा अभ्यास करणे.

3. फळ संरक्षण पद्धतींचा अभ्यास करणे (नैसर्गिक एजंट: साखर, मीठ आणि रासायनिक घटक: सोडियम बेंझोएट, कॅल्शियम प्रोपियोनेट, कोल्ड स्टोरेज).

4. ह्युमेक्टंट्स वापरून नारळाच्या तुकड्यांच्या जतनाचा अभ्यास करणे.

5. कोरडे करण्याच्या विविध पद्धतींचा अभ्यास: सूर्य प्रकाशात वाळवणे, कॅबिनेट पद्धतीने कोरडे करणे आणि सौर पद्धत करणे

6. केळी/आंबा/द्राक्षे मध्ये फळे पिकवण्यामध्ये वाढ नियंत्रकांच्या (growth regulators in fruit ripening) प्रभावाचा अभ्यास करणे.

7. प्रिझर्व्हेटिव्ह्ज सोबत/शिवाय फळांचे रस तयार करण्याचा अभ्यास करणे.

8. टोमॅटो प्रक्रियेचा अभ्यास करणे: रस, प्युरी, केचअप, सॉस, सूप व चटणी

9. स्थानिक उपलब्ध फळांपासून विविध प्रकारचे लोणचे तयार करणे.

10. स्थानिक उपलब्ध फळांपासून जॅम, जेली आणि मुरंबा तयार करणे.

11. आवळा रस, आवळा लोणचे आणि आवळा कँडी तयार करणे.

12. अन्न सुरक्षा मानकांचा अभ्यास करणे (GMP, FSSAI, ISO22000, HACCP).

13. फळ प्रक्रिया उद्योगाला भेट.

सुचवलेले वाचन:

1. Giridhari, Lal, Siddapa, G.S. and Tandon, G. L. (1998) Preservation of fruit and vegetables, Publication and information division, ICAR.
2. Srivastava, R. P., Sanjeev Kumar, (2006) Fruits and vegetable preservation, International book distributing Co. Lucknow.
3. Chanda, K. L. and Pareek, O. P. (1996) Advances in Horticulture, Vol. IV. Malhotra Publ. House, Kriti Nagar, Delhi.
4. Prasad and Kumar, (2024) Principles of Horticulture 2nd Edn. Agrobios (India).
5. Neeraj Pratap Singh, (2005) Basic concept of fruit science, 1st Eds. IBDC Publishers.
6. Salunkhe, D. K. and Kadam, S. S., (2013) A Handbook of Fruit Science and Technology, CRC Press.
7. Prasad, S. and Kumar, U. (2010) A Handbook of Fruit Production, Agrobios (India).

COURSE OUTCOMES

OPEN ELECTIVE - III: ORGANIC FARMING AND BIOPESTICIDES

After completing this course, students will be able to:

1. Demonstrate the ability to collect and analyze soil samples for pH, moisture, and nutrient levels.
2. Prepare compost using organic waste materials such as kitchen waste, dry leaves, and manure.
3. Apply organic mulching techniques to conserve soil moisture and suppress weed growth.
4. Perform seed treatment using natural methods like neem extract and cow urine to enhance germination and disease resistance.
5. Formulate and use natural pesticides, including neem oil spray, garlic spray, and cow dung-based pesticides.
6. Prepare organic fertilizers such as Jeevamrut and Panchagavya for soil enrichment.
7. Prepare cow urine biopesticide for general pest control and as a plant growth promoter.
8. Utilize fermented buttermilk spray to control fungal diseases in plants.
9. Analyze sustainable farming practices through field visits to farms

हा अभ्यासक्रम पूर्ण केल्यानंतर, विद्यार्थ्यांमध्ये खालील क्षमता विकसीत होतील:

१. पीएच, आर्द्रता आणि पोषक तत्वांच्या पातळीसाठी मातीचे नमुने गोळा करण्याची आणि त्यांचे विश्लेषण करण्याची क्षमता प्रदर्शित करणे.

२. स्वयंपाकघरातील कचरा, सुकी पाने आणि खत यासारख्या सेंद्रिय टाकाऊ पदार्थांचा वापर करून कंपोस्ट तयार करणे.

३. मातीतील ओलावा टिकवून ठेवण्यासाठी आणि तणांची वाढ रोखण्यासाठी सेंद्रिय मल्चिंग तंत्रांचा वापर करणे.

४. उगवण आणि रोग प्रतिकारशक्ती वाढविण्यासाठी कडुलिंबाचा अर्क आणि गोमूत्र यासारख्या नैसर्गिक पद्धतींचा वापर करून बियाणे प्रक्रिया करणे.

५. कडुलिंबाच्या तेलाचा स्प्रे, लसूण स्प्रे आणि शेणावर आधारित कीटकनाशकांसह नैसर्गिक कीटकनाशके तयार करा आणि वापर करणे.

६. माती समृद्ध करण्यासाठी जीवामृत आणि पंचगव्य सारखी सेंद्रिय खते तयार करणे.

७. सामान्य कीटक नियंत्रणासाठी आणि वनस्पतींच्या वाढीस चालना देण्यासाठी गोमूत्र जैव कीटकनाशके तयार करणे.

८. शेतांना भेटी देऊन शाश्वत शेती पद्धतींचे विश्लेषण करणे.

OPEN ELECTIVE - IV: FRUIT PROCESSING AND MANAGEMENT

After completing this course, students will be able to:

1. Identify and understand the working principles of common fruit processing equipment such as pulpers, sealers, juice extractors, autoclaves, and corking machines.
2. Analyze different packaging methods and preservation techniques as well as cold storage methods.
3. Evaluate different drying methods, including sun drying, cabinet drying, and solar drying, for fruit preservation.
4. Examine the effect of growth regulators on fruit ripening in banana, mango, and grapes.
5. Prepare fruit juices with and without the addition of preservatives.
6. Demonstrate the processing of tomatoes into various products such as juice, puree, ketchup, sauces, soup, and chutney.
7. Prepare different types of pickles, jam, jelly, and marmalades using locally available fruits.

हा अभ्यासक्रम पूर्ण केल्यानंतर, विद्यार्थ्यांमध्ये खालील क्षमता विकसीत होतील:

१. पल्पर, सीलर, ज्यूस एक्स्ट्रॅक्टर, ऑटोक्लेव्ह आणि कॉर्किंग मशीन यासारख्या सामान्य फळ प्रक्रिया उपकरणांच्या कार्य तत्त्वांची ओळख पटवा आणि समजून घ्या.

२. वेगवेगळ्या पॅकेजिंग पद्धती आणि जतन तंत्रांचे तसेच कोल्ड स्टोरेज पद्धतींचे विश्लेषण करा.

३. फळांच्या जतनासाठी उन्हात वाळवणे, कॅबिनेट वाळवणे आणि सौर वाळवणे यासारख्या वेगवेगळ्या वाळवण्याच्या पद्धतींचे मूल्यांकन करा.

४. केळी, आंबा आणि द्राक्षांमध्ये फळ पिकण्यावर वाढीच्या नियामकांचा परिणाम तपासा.

५. प्रिझर्व्हेटिव्ह्जसह आणि त्याशिवाय फळांचे रस तयार करा.

६. रस, प्युरी, केचप, सॉस, सूप आणि चटणी अशा विविध उत्पादनांमध्ये टोमॅटोची प्रक्रिया कशी करावी हे दाखवा.

७. स्थानिक पातळीवर उपलब्ध असलेल्या फळांचा वापर करून विविध प्रकारचे लोणचे, जाम, जेली आणि मुरंबा तयार करा.

Practical Examination:

1. Practical Examination will be conducted at the end of each Semester.

2. Practical Examination carries 50 Marks.

Nature of Question Paper: As per board of studies in Botany

SEMESTER –IV

SKILL ENHANCEMENT COURSE - II: ETHNOBOTANY

CREDIT: 2 **PRACTICAL HOURS:60** **MARKS: 50**

List of Practical

1) Study of Food plants: Morphology and uses of Rice [*Oryza sativa* L.] and Jowar [*Sorghum bicolor* (L.) Moench].
2) Study of Beverages: Morphology and uses of Kokam [*Garcinia indica* (Thou.)] Sharbat, Vala [*Vetiveria zizanioides* (L.) Nash.] Sharbat.
3) Study of Oil yielding plants: Morphology and uses of Coconut [*Cocos nucifera* L.], Groundnut [*Arachis hypogea* L.].
4) Study of drugs obtained from root and stem. Root: - Ashwagandha [*Withania somnifera* L. Dunal], Stem- Gulvel [*Tinospora cordifolia* (Willd.) Miers.]
5) Study of drugs obtained from leaf and flower. Leaf- Korphad [*Aloe vera* (L.) Burm.f.], Flower- Clove [*Syzygium aromaticum* (L.) Merr. & Perry]
6) Study of herbal cosmetics: Hair dye-Mehandi [*Lawsonia inermis* L.], Facemask-Chandan [*Santalum album* L.], Bath oil- Deshi-Gulab [*Rosa cymosa* Tratt. and Perfume-[*Jasminum sambac* (L.) Sol.]
7) Study of herbal preparation of Churn: Triphalachurna- Awala [*Emblica officinalis* Gaertn.], Hirada [*Terminalia chebula* Retz.], and Behada [*Terminalia bellirica* (Gaertn.) Roxb.] and Kadha/Decoction- Adulsa [*Justicia adhatoda* L.]
8) Study of herbal preparation of Hair oil-Maka [*Eclipta prostrata* (L.) L. and Shampoo-Ritha [Sapindus trifoliatus Vahl.] and Shikakai- [*Acacia concinna* (Willd.) DC]
9) Study of Biochemical tests for drug adulteration of Haldi [*Curcuma longa* L.] and Hing [*Ferula asafoetida* (Falc.) H. Karst.], Camphor [*Cinnamomum camphora* (L.) J. Presl] and Saffron [*Crocus sativus* L.*]*
10) Study of preliminary phytochemical tests for Alkaloids, Tannins, Saponins and Terpenoids.
11) Organoleptic study of Tulsi [*Ocimum tenuiflorum* L.], Ginger [*Zingiber officinale* Roscoe], Methi [*Trigonella foenum-graecum* L.] and Avala [*Phyllanthus emblica* L.]
12) Study of Endangered Ethnomedicinal plants.
13) Study of distribution of tribal/ethnic communities of India
14) Visit to herbal industry/villages for collection of ethnobotanical knowledge

Suggested Readings

1. Jain, S.K. (1991). Dictionary of Indian Folk Medicine and Ethnobotany. Deep Publications, New Delhi.
2. Jain, S.K. and Mudgal, V. (1999). *A Handbook of Ethnobotany*. Bishen Singh Mahendra Pal Singh, Dehradun.
3. Rastogi, P.R. and Mehrotra, B.N. (1993). *Compendium of Indian Medicinal Plants*. CDRI, Lucknow.
4. Jain, S.K. (2010). *Ethnobotany in India: A Status Report*. Deep Publications, New Delhi.
5. Martin, G. J. (2004). *Ethnobotany: A Methods Manual*, Earthscan, London.
6. Balick, M. J. and Cox, P. A. (1996). *Plants, People, and Culture: The Science of Ethnobotany*, Scientific American Library, New York.

Course Outcomes

SKILL ENHANCEMENT COURSE - I: FLORICULTURE

After completing this course, students will be able to:

1. Prepare different types of nursery beds (flat beds, raised beds, ridges, furrows, and basins) and pots for effective plant propagation.
2. Apply various propagation methods, including vegetative (grafting, layering, cuttings, offsets, and budding), asexual, and sexual propagation for key ornamental plants.
3. Demonstrate proper techniques for planting and transplanting different flower crops to ensure high survival and growth rates.
4. Perform training and pruning practices in rose cultivation to improve plant structure, health, and flowering efficiency.
5. Evaluate the role of plant growth regulators (PGRs) in enhancing the quality and yield of flower crops.
6. Apply drying and preservation techniques to maintain the aesthetic and commercial value of flowers.
7. Implement packaging and marketing strategies for fresh and preserved flowers to meet market demands.
8. Identify and manage common diseases and pests affecting ornamental and flowering plants.

9. Design and implement landscaping and garden architecture principles for aesthetic and functional purposes.

SKILL ENHANCEMENT COURSE - II: ETHNOBOTANY

After completing this course, students will be able to:

1) Understand the relationship between humans and plants.

2) Identify socially, economically and culturally useful plants.

3) Apply ethnobotanical knowledge in biodiversity conservation and socio-economic development.

4) Explain which parts of the plants are important for usage.

5) Distinguish traditional and modern healthcare.

6) Ethnobotany courses help students to learn about the traditional uses of plants, and how to apply this knowledge in modern contexts.

7) Detect adulterations in drugs.

Practical Examination:

1. Practical Examination will be conducted at the end of each Semester.
2. Each practical paper carries 50 Marks.
3. Duration of Practical Examination: 4 Hrs.

SHIVAJI UNIVERSITY, KOLHAPUR.

Accredited By NAAC with 'A^{++}' Grade

Syllabus For

B. Sc. II Botany Minor

(Faculty of Science and Technology)

Semester- III and Semester- IV

NEP-2020 (2.0)

Syllabus to be implemented from June, 2025 onwards

Shivaji University, Kolhapur
Bachelor of Science
Credit Framework

	SHIVAJIUNIVERSITY, KOLHAPUR NEP-2020: Credit Framework for UG (B. Sc.) Programme under Faculty of Science and Technology							
SEM (Level)	COURSES		**OE**	**VSC/SEC**	**AEC/VEC/ IKS**	**OJT/FP/CEP /CC/RP**	**Total Credits**	**Degree/Cum. Cr**
	MAJOR	**MINOR**						
SEM III (5.0)	Major V (2) Major VI (2) Major P III (2)	Minor V (2) Minor VI (2) Minor P III (2)	OE-3(2) (T/P)	VSC I (2) (P) (Major specific) SEC I (2) (T/P)	AEC I (2) (English)	CC-I (2)	22	**UG Diploma 88**
SEM IV (5.0)	Major VII (2) Major VIII (2) Major P IV (2)	Minor VII (2) Minor VIII (2) Minor P IV (2)	OE-4(2) (T/P)	SEC-II (2) (T/P)	AEC-II (2) (English) VEC-II (2) (Environmental studies)	CEP-I (2)	22	
Credits	**8(T)+4(P)= 12**	**8(T)+4(P)=12**	**2+2=4(T/P)**	**4(T/P) +2(P)=6**	**2+4=6**	**2+2=4**	44	**Exit Option:4 credits NSQF/Internship/Skill courses**

I. Shivaji University, Kolhapur

New syllabus for Bachelor of Science NEP-2020 (2.0)

1. TITLE: Subject-Botany Minor

Optional under the Faculty of Science and Technology

2. YEAR OF IMPLEMENTATION: - New Syllabi NEP-2020 (2.0) will be implemented from June, 2025 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) 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. **One Year, Semester III and IV.**

6. PATTERN: -

Pattern of examination will be semester wise.

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 English

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

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

Sr. No.	Subjects/Papers	Theory	Practical	Internal	Total Marks
1	Minor Paper – V	40		10	50
2	Minor Paper – VI	40		10	50
3	Minor Paper – VII	40		10	50
4	Minor Paper – VIII	40		10	50
5	Minor Practical – III		50		50
6	Minor Practical – IV		50		50
Total					**300**

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)		
		T	P	Total	Theory	Term Work	Total
	Semester III						
1	Minor Paper – V	02		02	40	10	50
2	Minor Paper – VI	02		02	40	10	50
3	Practical – III (Semester)		04	04	50		50
	Semester IV						
1	Minor Paper – VII	02		02	40	10	50
2	Minor Paper – VIII	02		02	40	10	50
3	Practical – IV (Semester)		04	04	50		50
	Total	08	08	16			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: Unit Test and Semester IV: Oral examination/Group discussion)**
- 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:

Duration of question paper: As per University rule

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, 2025 onwards)

	New Syllabus (Semester Pattern)	
Semester No.	**Paper No.**	**Title of New Paper**
III	Minor V	Horticulture
	Minor VI	Plant Physiology and Biochemistry
IV	Minor VII	Biological techniques
	Minor VIII	Plant genetics and plant resource utilization

16. SPECIAL INSTRUCTIONS, IF ANY

SEMESTER-III
MINOR PAPER V: HORTICULTURE
CREDITS: 2, LECTURE HOURS: 2 PER WEEK, MARKS: 50

MODULE	SUB MODULE	TOPIC	LECTURE PERIOD
1		**INTRODUCTION TO HORTICULTURE AND PROPAGATION OF HORTICULTURAL PLANTS**	**15**
	1a. Introduction to Horticulture	1.1 Introduction, definition, importance and scope of horticulture 1.2 Terminology used in horticulture – Pomology, Olericulture, Floriculture, Arboriculture, Silviculture Landscape horticulture, Home Gardening.	
	1b. Propagation of horticultural plants	1.3 Introduction and definition of propagation 1.4 Methods of plant propagation–Sexual and asexual methods 1.5 Sexual methods (seed propagation): Introduction, definition, merits and demerits, criterion for selection of seeds. 1.6 Asexual (Vegetative) propagation: Definition, types Natural and artificial. 1.6.1 Natural methods of vegetative propagation: Introduction and definition, Merits and demerits; bulbs, tubers, rhizomes, bulbils. 1.6.2 Propagation by Artificial Methods: i) Cutting: Stem cutting. ii) Layering: Air layering/Gootee (Marcottage). iii) Grafting: whip. iv) Budding: T and patch budding.	
2	**2a Landscape Gardening**	2.1 Definition, scope and objectives of landscape gardening. 2.2 Indoor Garden - Terrarium, Hanging garden. 2.3 Outdoor Garden – Preparation and importance of lawn and Terrace Garden. 2.4 Important aesthetic Gardens of India: i) Lalbagh garden, Bangalore i) Lead Botanical Garden (Shivaji University, Kolhapur)	**15**
	2b Nursery Development	2.5 Objective and scope of nursery. 2.6 Types of nursery beds and preparation of nursery beds. 2.7. Techniques of seedling raising.	

SEMESTER-III
MINOR PAPER VI: PLANT PHYSIOLOGY AND BIOCHEMISTRY
CREDITS: 2, LECTURE HOURS: 2 PER WEEK, MARKS: 50

MODULE	SUB MODULE	TOPIC	LECTURE PERIOD
1		**PLANT PHYSIOLOGY**	15
	1a. Plant growth	1.1: Plant growth –Introduction and definition, Phases of growth, Growth curve. 1.2. Flowering Physiology: Photoperiodism –Introduction and definition, Classification of plants based on photoperiodism- Short Day Plants, Long Day Plants and Day Neutral Plants, flowering hormone- Florigen.	
	1b. Seed Dormancy and Seed germination:	1.3. Introduction and definition of Seed, Typical structure of monocot and dicot seed. 1.4. Seed dormancy: Introduction and definition, causes and methods of breaking of seed dormancy- Mechanical scarification and Chemical Scarification. 1.5. Seed germination – Introduction and types of seed germination-Epigeal, Hypogeal and Viviparous. 1.6. Biochemical changes during seed germination.	
2		**Plant Biochemistry**	15
	2a. Plant Biochemistry	2. Plant Biochemistry 2.1 Introduction to Plant Biochemistry Definition and importance of plant biochemistry 2.2 Primary Metabolites: introduction, structure and functions Organic acids: e. g. Citric acid, Malic acid Vitamins: e.g. Vitamin C, B complex Role of primary metabolites in plants 2.3 Secondary Metabolites: introduction, structure and functions: Alkaloids: Nicotine and Caffeine Terpenoids: Limonene, Carotenoids Role of secondary metabolites in plants	
	2b. Enzymes	2.4. Introduction, definition and Classification 2.5. Nomenclature of enzyme. 2.6 Mechanism of enzyme action: Lock and Key hypothesis. 2.7. Factors affecting enzyme activity- temperature and P^H.	

Practical - III
(Based on Minor Paper V and VI)

CREDIT: 2. PRACTICAL HOURS:60 MARKS: 50

1. Study of propagules from suitable materials-Tubers, Bulbs, Rhizome, Corms,
2. Propagation of horticultural plants by stem cutting and air layering.
3. Propagation of horticultural plants by whip grafting.
4. Propagation of horticultural plants by 'T' and Patch budding.
5. Demonstration of Bottle Garden/Terrarium/Hanging Baskets.
6. Preparation of nursery beds.
7. Analysis of vegetative growth by measuring seedling height
8. Study of effect of P^H on enzyme activity of catalase.

09. Study of effect of temperature on enzyme activity of malate dehydrogenase

10. Breaking of seed dormancy by Chemical and Mechanical Scarification.
12. Study of different types of Seed germination as per theory.
13 Estimation of Citric Acid from Lemon by Titration
14 Estimation of Vitamin C by Titration Method
15 Qualitative test for Alkaloid – (Dragendorff's Reagent)
16 Qualitative Test for Terpenoids (Salkowski Test)
17. Visit to nursery/ Aesthetic Garden/Exhibition/Places of botanical interest (Separate report to be submitted by students).

REFERENCES:

1. Horticulture: V. L Sheela, MJP Publications.
2. Gardening in India: Perey Lancaster (1997) Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.
3. Plant Propagation, Principles and Practices: 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), Agrobios, Jodhpur, India.
5. Horticulture and Gardening-Khan, M.R. (1995) Nirali Prakashan, Pune, India.
6. Gardening for everyone- Pramila Mehra. Hand Pocketbook Pvt. Ltd. New Delhi.
7. Principles of Horticulture and Fruit Growing: Y. N Kunte, M.P Kawathalkar and K.S
8. Yawalkar (Agri- Horticultural Publication House, Nagpur).
9. Commercial Flowers, Naya Prokash: Bose T. K & Yadav L. P.
10. Advances in Horticulture Vol. IV Malhotra Publications: Chadha K. L &Pareek O. P.
11. Post Harvest Technology of Horticultural Crops New Delhi Publications: Sudheer K. P and Indira V.
12. Principles of Horticulture, 4th Edt. Elsevier Publication, 2004: Adams C. R.
13. Introduction to ornamental horticulture. Kalyani Publishers, Ludhiana, India.: Arora, JS.1999.
14. Design Elements of Landscape Gardening. Nambisan, KMP.1992.: Oxford & IBH.
15. Floriculture and Landscaping-Bose TK, Maiti RG, Dhua RS and Das P. 1999:Naya

Prokash.
16. Introduction to Horticulture – N. Kumar (Oxford & IBH).
17. Ornamental Horticulture" – S. C. Dey (Pointer Publishers).
18. Horticulture – Principles and Practices – George Acquaah (Pearson).
19. Plant Propagation: Principles and Practices – Hartmann & Kester (Prentice Hall).
20. Propagation of Horticultural Crops – S. K. Sadhu (New Age International).
21. Nursery Management" – L. C. De (Oxford & IBH).
22. Fruit Science (Fundamentals and Practices)" – V. K. Chattopadhyay (Kalyani Publishers).
23. Advances in Fruit Production" – R. R. Sharma (New India Publishing Agency).
24. A Textbook of Vegetable Crops" – T. S. Rana (Kalyani Publishers.
25. Vegetable Crops" – Bose, Som & Kabir (Naya Udyog).
26. Floriculture in India" – G. S. Randhawa & A. Mukhopadhyay (Allied Publishers).
27. Post-Harvest Technology of Horticultural Crops" – K. P. Sudhakar Rao (Agrotech Publishing).
28. Protected Cultivation of Horticultural Crops" – S. Prabhakar Rao (Kalyani Publishers).
29. Handbook of Horticulture" – (ICAR Publication)- K. L. Chadha.
30. Fundamentals of Horticulture. – Jitendra Singh (Kalyani Publishers).
31. Taiz, L., Zeiger, E., Møller, I. M., & Murphy, A. (2018). Plant Physiology and Development (6th ed.). Sinauer Associates, Sunderland, MA.
32. Buchanan, B. B., Gruissem, W., & Jones, R. L. (2015). Biochemistry & Molecular Biology of Plants (2nd ed.). Wiley-Blackwell, Hoboken, NJ.
33. Heldt, H.-W., & Piechulla, B. (2021). Plant Biochemistry (5th ed.). Academic Press, London.
34. Hall, D. O., & Rao, K. K. (1999). Photosynthesis (6th ed.). Cambridge University Press, Cambridge.
35. Govindjee, & Raghavendra, A. S. (2006). Photosynthesis: A Comprehensive Treatise. Cambridge University Press, Cambridge.

COURSE OUTCOMES:

Minor Paper V:

After completing this course, students will be able to:

1. Understand importance of horticulture.
2. Students will become familiar with different branches of Horticulture.
3. Students will understand Different sexual and Asexual methods of Propagation
4. Students will understand different gardening technique.

5. Students will understand different gardening technique.

Minor Paper VI:

1. After successful completion of the course, the students will be able
2. to understand the process of plant growth.
3. to understand the role of light in the reproductive growth.
4. to understand the cause of seasonal diversity in flowering plants.
5. to understand the concept of seed dormancy.
6. to understand causes of seed dormancy and methods to overcome seed dormancy.
7. to understand the process of seed germination.
8. to understand importance of enzymes in plant metabolism.
9. to understand process of biological nitrogen fixation.

SEMESTER –III

OPEN ELECTIVE - III: ORGANIC FARMING AND BIOPESTICIDES

CREDIT: 2 **PRACTICAL HOURS:60** **MARKS: 50**

1. **Soil Testing:** Collection of soil samples and test for pH, moisture, and nutrient levels.
2. **Compost Making:** Preparation of compost using kitchen waste, dry leaves, and manure.
3. **Mulching:** Application of organic mulch (straw, leaves) to conserve moisture and suppress weeds.
4. **Seed Treatment:** Treatment of seeds using neem extract or cow urine.
5. **Natural Pesticides:** Preparation of pest resistant seeds using neem oil spray, garlic spray, or cow dung-based pesticides.
6. **Cow Dung and Urine Fertilizer:** Preparation of Jeevamrut or Panchagavya as natural fertilizers.
7. **Broad spectrum Botanical pesticide**: Preparation of pesticide using Neem Spray (General Pest Repellent)
8. **Insect and Fungal Control:** Preparation of Garlic-Chili Spray
9. **Algae Cultivation**: Grow algae or Azolla in water trays to use as a biofertilizer or animal feed.
10. **Natural Growth Promoters:** Prepare a banana peel spray by soaking banana peels in water for 24 hours and applying it to plants as a potassium-rich solution.
11. **Aphid and Caterpillar Control:** Preparation of Tobacco Extract.
12. **General Pest Control and Growth Promoter:** Preparation of Cow Urine Biopesticide.
13. **Fungal Disease Control:** Preparation of fermented Buttermilk Spray.
14. Filed Visit to any farm.

Suggested Readings:

1. S.P. Palaniappan & K. Annadurai, (2019) Organic Farming: Theory and Practice, Scientific Publishers,
2. P.K. Gupta, (2019) Principles of Organic Farming, Scientific Publishers, 2019.
3. Arun K. Sharma **(**2019) Fundamentals of Organic Farming and Sustainable Agriculture, Scientific Publishers.
4. Opender Koul & G.S. Dhaliwal **(**2001) Biopesticides: A Bio-rational Approach to Pest Management, CRC Press.
5. L.P. Awasthi (2015) Biopesticides Handbook, CRC Press,
6. S.S. Bhooshan & A.K. Pandey (2017) Recent Advances in Biopesticides, Springer,

सेमिस्टर- ३

ओपन एलेक्टीव- ३ : सेंद्रिय शेती आणि जैव कीटकनाशके

क्रेडिट २ **६० तास** **मार्क्स: ५०**

प्रात्यक्षिक-३ : सेंद्रिय शेती आणि जैव कीटकनाशके

१. **माती परीक्षण:** मातीचे नमुने गोळा करणे आणि पीएच, आर्द्रता आणि पोषक तत्वांची पातळी तपासणे.

२. **कंपोस्ट बनवणे:** स्वयंपाकघरातील कचरा, सुकी पाने आणि खत वापरून कंपोस्ट तयार करणे.

३. **आच्छादन:** ओलावा टिकवून ठेवण्यासाठी आणि तण दाबण्यासाठी सेंद्रिय आच्छादन (पेंढा, पाने) वापरणे.

४. **बियाणे प्रक्रिया:** कडुलिंबाचा अर्क किंवा गोमूत्र वापरून बियाण्यांवर प्रक्रिया करणे.

५. **नैसर्गिक कीटकनाशके:** कडुलिंबाचे तेल स्प्रे, लसूण स्प्रे किंवा शेण-आधारित कीटकनाशके वापरून कीटक प्रतिरोधक बियाणे तयार करणे.

६. **गायीचे शेण आणि मूत्र खत:** नैसर्गिक खते म्हणून जीवामृत किंवा पंचगव्य तयार करणे.

७. **ब्रॉड स्पेक्ट्रम वनस्पति कीटकनाशक:** कडुलिंब स्प्रे (सामान्य कीटकनाशक) वापरून कीटकनाशक तयार करणे

८. **कीटक आणि बुरशी नियंत्रण:** लसूण-मिरची स्प्रे तयार करणे

९. **शैवाल लागवड:** जैवखत किंवा पशुखाद्य म्हणून वापरण्यासाठी पाण्याच्या ट्रेमध्ये शैवाल किंवा अझोला वाढवा.

१०. **नैसर्गिक वाढ प्रवर्धक:** केळीच्या साली २४ तास पाण्यात भिजवून आणि पोटॅशियमयुक्त द्रावण म्हणून झाडांना लावून केळीच्या सालीचा स्प्रे तयार करा.

११. **मावा आणि सुरवंट नियंत्रण:** तंबाखूच्या अर्काची तयारी.

१२. **सामान्य कीटक नियंत्रण आणि वाढ प्रवर्धक:** गोमूत्र जैव कीटकनाशक तयार करणे.

१३. **बुरशीजन्य रोग नियंत्रण:** आंबलेल्या ताक स्प्रेची तयारी.

१४. कोणत्याही शेताला भेट द्या.

सुचवलेले वाचन:

1. S.P. Palaniappan & K. Annadurai, (2019) Organic Farming: Theory and Practice, Scientific Publishers,
2. P.K. Gupta, (2019) Principles of Organic Farming, Scientific Publishers, 2019.
3. Arun K. Sharma (2019) Fundamentals of Organic Farming and Sustainable Agriculture, Scientific Publishers.
4. Opender Koul & G.S. Dhaliwal (2001) Biopesticides: A Bio-rational Approach to Pest Management, CRC Press.
5. L.P. Awasthi (2015) Biopesticides Handbook, CRC Press,
6. S.S. Bhooshan & A.K. Pandey (2017) Recent Advances in Biopesticides, Springer,

SEMESTER –III

SKILL ENHANCEMENT COURSE - I: FLORICULTURE

CREDIT: 2 **PRACTICAL HOURS; 60** **MARKS: 50**

List of Practical

1. Preparation of different types of nursery beds (Flat beds, raised beds, ridges and furrows, basin etc.) and pots.
2. Identification of commercially important floricultural crops: Annuals, Biennials, Perennials and Bulbous flowering plants.
3. Study of methods of propagation a) Natural Asexual or Vegetative Propagation: Runner, Sucker, Bulb, Tubers, Offset, Corms, Rhizome, Bulbs, Stolo
4. Study of methods of propagation b) Artificial Asexual or Vegetative Propagation: Stem Cutting, T-Budding, Whip Grafting and Air Layering.
5. Study of Planting and Transplanting Technique.
6. Study of pruning and training of rose.
7. Study of different plant growth regulators used for growth of ornamental flowering plants.
8. Study of methods of drying and preservation of flowers.
9. Study of methods of Packaging and Marketing of flowers.
10. Study the method of prolonging Vase life of flowers.
11. Study of methods of Techniques in Flower arrangement and floral decoration.
12. Practices in preparation of bouquets, button-holes, flower baskets, Corsages, Floral Wreaths, Garlands, Veni and Gajara. with fresh flowers.
13. Study of Common Diseases and pests of ornamental flowering plants.
14. Landscaping and Architecture of garden.
15. Report on Flower market survey/visit to flower polyhouse

Suggested Readings

1. Randhawa, G.S. and Mukhopadhyay, A. 1986. Floriculture in India. Allied Publishers.
2. Nag. K. 2019. Principles and Practices of Floriculture, Jaya Publishers.
3. Prasad S, Kumar U 2013, A Handbook of Floriculture Agrobios (India)
4. S. K. Bhattacharjee, Lakshman Chandra De 2003. Advanced commercial floriculture. Vol. 1 Aavishkar Publications, Jaipur, India.
5. S. K. Bhattacharjee, Lakshman Chandra De 2003. Advanced commercial floriculture. Vol. 2 Aavishkar Publications, Jaipur, India.

SEMESTER –III

VSC-1: NURSERY DEVELOPMENT AND MANAGEMENT

CREDIT: 2 **PRACTICAL HOURS:60** **MARKS: 50**

List of Practical

1. Designing nursery layout and drawing.
2. Study of tools and implements used in nurseries.
3. Study of irrigation methods in nursery.
4. Preparation of soil mixture for nursery beds and pots.
5. Preparation of different types of nursery beds.
6. Study of importance of Mother plant in nursery, its selection criteria and maintenance.
7. Preparation of plant material for potting and repotting.
8. Study of plantlet hardening methods in the nursery.
9. Study of different types of plants propagated in nursery: Ornamental, Indoor, Outdoor, Edge and Hedge plants.
10. Study of different type of propagation methods: Cuttings and Layering.
11. Study of different type of propagation methods: Buddings and Grafting.
12. Study of different plant growth regulators used for seed germination and vegetative propagation.
13. Study of different types of fertilizers used in nursery.
14. Study of Common nursery plant diseases and their management.
15. Visit to a plant nursery.

Suggested Reading:

1. Krishnan, P. R., Kalia, R. K., Tewari, J. C., & Roy, M. M. (2014). *Plant nursery management: principles and practices*. Central Arid Zone Research Institute, Jodhpur, 40.
2. Ray, P.K. (2012). *Plant Nursery Management: How to Start and Operate a Plant Nursery*. Scientific Publishers.
3. Hartmann, H.T., Kester D.E., Davis, F.T and R.L Geneve (2010) *Plant Propagation: Principles and practices* (8th Edition)
4. Mason, J. (2004). Nursery management. Landlinks Press. 5. Sharma, R.R and Srivastav M (2004): *Plant propagation and nursery management* (First Edition) International Book Distributing Co.
6. Bose, T.K. Sanyal, D and Sandhu, M.L. (1998) *Propagation of Horticultural crops*. Naya Prakash Publishers, Kolkatta .

7. K. K. Nanda and V.K. Kochhar (1985). *Vegetative propagation of plants*. Kalyani Publisher- New Delhi-Ludhiana.

Learning Outcomes:

On successful completion of this course students will be able to;

1. Understand the importance of a plant nursery and basic infrastructure to establish it.
2. Explain the basic material, tools and techniques required for nursery.
3. Demonstrate expertise related to various practices in a nursery.
4. Comprehend knowledge and skills to get an employment or to become an entrepreneur in plant nursery sector.

Practical Examination:

1. Practical Examination will be conducted at the end of Semester.
2. Practical paper carries 50 Marks.
3. Duration of Practical Examination: 4 Hrs.

SEMISTER IV

SEMESTER-IV
MINOR PAPER VII: BIOLOGICAL TECHNIQUES
CREDITS: 2, LECTURE HOURS: 2 PER WEEK, MARKS: 50

MODULE	SUB MODULE	TOPIC	LECTURE PERIOD
1	**BIOLOGICAL TECHNIQUES**		**15**
	1.a Principles and applications Microscopy and micro-technique	1.1 Light microscopy 1.2 Stereo microscopy 1.3 Hand refractometer 1.4 Micrometry 1.5 Camera lucida 1.6 Herbarium Technique.	
	1.b. Principles and applications Chromatography	1.7 Paper Chromatography- Ascending. 1.8 Thin layer Chromatography.	
2	2. a Culture media technique.	2.1 Definition, types and preparation of culture media- Natural- Coconut milk, Semisynthetic-PDA, Synthetic-NA 2.2 Sterilization technique-Autoclave and Hot air Oven. 2.3 Pure culture Techniques-pour plate method and streak plate method.	**15**
	2.b. Biological stains	2.4 Introduction 2.5 Types of biological stains- 2.6 Preparation of common laboratory stains- Saffranine, light green, cotton blue, Acetocarmine and Janus green. 2.8 Mounting media and its Applications -Temporary (- Water, Glycerin, lactophenol) and Permanent-(DPX and Canda balsam)	

SEMESTER-IV

MINOR PAPER VIII: PLANT GENETICS AND PLANT UTILIZATION

CREDITS: 2, LECTURE HOURS: 2 PER WEEK, MARKS: 50

MODULE	SUB MODULE	TOPIC	LECTURE PERIOD
1	PLANT GENETICS	1.1 Concept of Genetics, Biography of Mendel and his experiments: Mendel's terminologies, Mendels seven traits. 1.2 Mendel's Laws of Dominance, Segregation and independent assortment. 1.3 Monohybrid cross, Dihybrid cross, Back cross and Test cross. 1.4 Chromosomal theory of inheritance. 1.5 Extrachromosomal (Cytoplasmic) inheritance in Mirabilis jalapa.	15
2	PLANT UTILIZATION	2.1. Study the following plants with reference to Botanical name, Morphology, biological source and economic importance of: 2.2. Underutilized fruits - *Carrisa* 2.3 Edible Oils - Soyabean 2.4 Spices - Ginger 2.5 Medicinal - *Adhatoda* 2.6 Aromatic plants – Eucalyptus 2.7 Fodder - Elephant grass 2.8 Fiber Crops – Cotton 2.9 Timber – Teak 2.10. Green Manure – *Crotalaria*	15

Practical - IV
(Based on Minor Paper VII and VIII)
CREDIT: 2. PRACTICAL HOURS:60 MARKS: 50

1. Study of Stereo microscope.
2. Study of micrometry technique by using any suitable material
3. Study of Herbarium technique
4. Measurement of sugar percentage by Hand refractometer
5. Separation of amino acids by thin layer chromatography technique
6. Preparation of culture media as per theory.
7. Study of different types of stains used in biology.
8. Study of Mendelian traits of pea plants (Photographs)
9. Genetic Problems on Monohybrid cross and Dihybrid cross.
10. Study the morphology, biological source and importance of underutilized fruit plant- *Carissa* and oil yielding plant - Soyabean
11. Study the morphology, biological source and importance of Spices - Ginger and Medicinal plant *Adhatoda*
12. Study the morphology and importance of Aromatic plant – *Eucalyptus*
13. Study the morphology and importance of Fodder crop - Elephant grass and Green Manure plant – *Crotalaria*
14. Study the morphology and importance of Fibre crop – Cotton and Timber plant - Teak
15. Report on field visit to study wild plant resources.

List of Books Recommended for B. Sc. II Botany
Paper VII

1.Essentials of Practical Microbiology* by JaypeeDigital: This book covers microscopy, simple staining, Gram staining, and special staining techniques (1).
2.Springer Handbook of Microscopy*: A comprehensive resource edited by Peter W. Hawkes and John C. H. Spence, covering various microscopy techniques [1].
3.Encyclopedia of Chromatography* by Jack Cazes: A thorough guide to chromatography techniques, including paper and thin-layer chromatography [1].
4.Essentials of Practical Microbiology* (mentioned earlier): Covers simple staining, Gram staining, and special staining techniques (1).
5. The TLC-Bioautography as a Tool for Rapid Enzyme Inhibitors Detection—A Review*: An article discussing bioautography detection in thin-layer chromatography .
6. Harekrushna Sahoo: Discusses optical spectroscopy and microscopy techniques, which might be useful for understanding principles of microscopy [1].
7.Field Manual on Herbarium Techniques* by H.B. Singh and B. Subramaniam.
8.The Herbarium Handbook*: Published by Kew Gardens.

Paper VIII

1. K. V. Peter, (2004) Handbook of Herbs and Spices, CRC Press, Boca Raton.
2. J. E. Simon, J. A. Duke, and E. A. L. Bobilya, (1990) Handbook of Edible Weeds, CRC Press, Boca Raton.
3. J. Smartt and N. Haq, (2016) Handbook of Industrial Crops, Springer, New York.

4. P. N. Ravindran, (2017) The Encyclopaedia of Herbs and Spices, CABI, Wallingford. Beryl B. Simpson (2010) Economic Botany: Plants in Our World, Academic Press, London.
5. Michael J. Balick and Paul Alan Cox (1996) Plants, People, and Culture: The Science of Ethnobotany, Scientific American Library, New York.
6. Ben-Erik van Wyk (2016) Food Plants of the World: An Illustrated Guide, Timber Press, Portland.
7. Jo Homan (2012) Plants That Changed History, Chartwell Books, New York.
8. Gary J. Martin (2004) Ethnobotany: A Methods Manual, Earthscan Publications, London.
9. Plant Propagation, Principles and Practices: H.T. Hartmann, D.E. Kester, F.T. Davies and R.L. Geneve (1997) Published by Prentice Hall Inc., New Jersey 07458, USA.
10. Principles of Horticulture and Fruit Growing: Y. N Kunte, M.P Kawathalkar and K.S
11. Yawalkar (Agri- Horticultural Publication House, Nagpur).
12. Commercial Flowers, Naya Prokash: Bose T. K & Yadav L. P.
13. Advances in Horticulture Vol. IV Malhotra Publications: Chadha K. L &Pareek O. P.
14. Post Harvest Technology of Horticultural Crops New Delhi Publications: Sudheer K. P and Indira V.
15. Introduction to ornamental horticulture. Kalyani Publishers, Ludhiana, India.: Arora, JS.1999.
16. Introduction to Horticulture – N. Kumar (Oxford & IBH).
17. Plant Propagation: Principles and Practices – Hartmann & Kester (Prentice Hall).
18. Fruit Science (Fundamentals and Practices)" – V. K. Chattopadhyay (Kalyani Publishers).
19. Advances in Fruit Production" – R. R. Sharma (New India Publishing Agency).
20. A Textbook of Vegetable Crops" – T. S. Rana (Kalyani Publishers.
21. Vegetable Crops" – Bose, Som & Kabir (Naya Udyog).
22. S. K. Jain and R. A. Jain, (2015) Handbook of Plant Resources, Springer, New York.
23. H. Panda and A. K. Padhi, (2017) Medicinal Plants and Their Utilization, Springer, Singapore.
24. G.E. Wickens (1998) Economic Botany: Principles and Practices, Chapman & Hall, London.
25. S.L. Kochhar (1990) The Economic Botany of the Tropics, Macmillan, London. V. Reference Books

Course Outcomes

Minor Paper VII:

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

1. Understand fundamental biological laboratory techniques
2. Develop practical skills in laboratory settings
3. Apply biological techniques to research and problem-solving
4. Analyze and interpret data from biological experiments
5. Demonstrate laboratory safety and best practices

Minor Paper VIII:

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

1. Students will able to understand the fundamental principles of inheritance.
2. Able to analyse the pedigree charts to determine the inheritance pattern.
3. Gain the basic knowledge of modern genetic tools.
4. Understand the importance of plants in human health.
5. Recognize and classify economically important plants.
6. Understand the use of plants in the industries.

Study Tour/ Excursion:

One teacher along with a batch not more than 20 students is taken for excursions to places of study 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 3 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 – III and IV are to be covered in 15 practical's each. These practical's 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. No marks will be given for Incomplete and non-certified

journal. Otherwise, a candidate must produce a separate certificate of his/her regular attendance of practical course and completion of the same signed by the concerned teacher and Head of the Department.

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 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:

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 hypoglycaemic condition or in extreme weakness of student or a person concerned.

3. GENERAL SAFETY RULES FOR LABORATORY WORK

1) List of equipment 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.

b) 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's, 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 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 practical's 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 practical should be followed for conducting practical in plant biochemistry /microbiology.

9. Operational manuals for equipment 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.

SEMESTER –IV

OPEN ELECTIVE - IV: FRUIT PROCESSING AND MANAGEMENT

CREDIT: 2. PRACTICAL HOURS:60 MARKS: 50

1. Study of common fruit processing equipment's (Pulper, sealers, juice extracting machines, autoclaves, corking machines).
2. Study of methods of packaging, packaging materials and packaging technology for export of fruits.
3. Study of fruit preservation methods (Natural agent: sugar, salt and chemical agents: sodium benzoate, calcium propionate, Cold storage)
4. Study of preservation of coconut shreds using humectants.
5. Study of various methods of drying: sun drying, cabinet drying and solar drying.
6. Study of effect of growth regulators in fruit ripening in banana/mango/grapes.
7. Study of preparation of fruit juices with/without addition of preservatives.
8. Study of Tomato processing: juices, puree, ketchups, sauces, soup, chutney etc.
9. Preparation of different types of pickles from locally available fruits.
10. Preparation of jam, jelly and Marmalades from locally available fruits.
11. Preparation of Amla juice, Amla pickle and Amla candy.
12. Study of food safety standards (GMP, FSSAI, ISO22000, HACCP).
13. Visit to fruit processing industry.

Suggested Readings:

1. Giridhari, Lal, Siddapa, G.S. and Tandon, G. L. (1998) Preservation of fruit and vegetables, Publication and information division, ICAR.
2. Srivastava, R. P., Sanjeev Kumar, (2006) Fruits and vegetable preservation, International book distributing Co. Lucknow.
3. Chanda, K. L. and Pareek, O. P. (1996) Advances in Horticulture, Vol. IV. Malhotra Publ. House, Kriti Nagar, Delhi.
4. Prasad and Kumar, (2024) Principles of Horticulture 2nd Edn. Agrobios (India).
5. Neeraj Pratap Singh, (2005) Basic concept of fruit science, 1st Eds. IBDC Publishers.
6. Salunkhe, D. K. and Kadam, S. S., (2013) A Handbook of Fruit Science and Technology, CRC Press.
7. Prasad, S. and Kumar, U. (2010) A Handbook of Fruit Production, Agrobios (India).

सेमिस्टर-४

ओपन एलेक्टीव- ४ : फळ प्रक्रिया आणि व्यवस्थापन

क्रेडिट २ ६० तास मार्क्स: ५०

प्रात्यक्षिक -४ : फळ प्रक्रिया आणि व्यवस्थापन

1. सामान्य फळ प्रक्रिया उपकरणांचा अभ्यास करणे (पल्पर, सीलर्स, रस काढणारी मशीन, ऑटोक्लेव्ह, कॉर्किंग मशीन).

2. फळांच्या निर्यातीसाठी पॅकेजिंगच्या पद्धती, पॅकेजिंग साहित्य आणि पॅकेजिंग तंत्रज्ञानाचा अभ्यास करणे.

3. फळ संरक्षण पद्धतींचा अभ्यास करणे (नैसर्गिक एजंट: साखर, मीठ आणि रासायनिक घटक: सोडियम बेंझोएट, कॅल्शियम प्रोपियोनेट, कोल्ड स्टोरेज).

4. ह्युमेक्टंट्स वापरून नारळाच्या तुकड्यांच्या जतनाचा अभ्यास करणे.

5. कोरडे करण्याच्या विविध पद्धतींचा अभ्यास: सूर्य प्रकाशात वाळवणे, कॅबिनेट पद्धतीने कोरडे करणे आणि सौर पद्धत करणे

6. केळी/आंबा/द्राक्षे मध्ये फळे पिकवण्यामध्ये वाढ नियंत्रकांच्या (growth regulators in fruit ripening) प्रभावाचा अभ्यास करणे.

7. प्रिझर्व्हेटिव्ह्ज सोबत/शिवाय फळांचे रस तयार करण्याचा अभ्यास करणे.

8. टोमॅटो प्रक्रियेचा अभ्यास करणे: रस, प्युरी, केचअप, सॉस, सूप व चटणी

9. स्थानिक उपलब्ध फळांपासून विविध प्रकारचे लोणचे तयार करणे.

10. स्थानिक उपलब्ध फळांपासून जॅम, जेली आणि मुरंबा तयार करणे.

11. आवळा रस, आवळा लोणचे आणि आवळा कँडी तयार करणे.

12. अन्न सुरक्षा मानकांचा अभ्यास करणे (GMP, FSSAI, ISO22000, HACCP).

13. फळ प्रक्रिया उद्योगाला भेट.

सुचवलेले वाचन:

1. Giridhari, Lal, Siddapa, G.S. and Tandon, G. L. (1998) Preservation of fruit and vegetables, Publication and information division, ICAR.
2. Srivastava, R. P., Sanjeev Kumar, (2006) Fruits and vegetable preservation, International book distributing Co. Lucknow.
3. Chanda, K. L. and Pareek, O. P. (1996) Advances in Horticulture, Vol. IV. Malhotra Publ. House, Kriti Nagar, Delhi.
4. Prasad and Kumar, (2024) Principles of Horticulture 2nd Edn. Agrobios (India).
5. Neeraj Pratap Singh, (2005) Basic concept of fruit science, 1st Eds. IBDC Publishers.
6. Salunkhe, D. K. and Kadam, S. S., (2013) A Handbook of Fruit Science and Technology, CRC Press.
7. Prasad, S. and Kumar, U. (2010) A Handbook of Fruit Production, Agrobios (India).

COURSE OUTCOMES

OPEN ELECTIVE - III: ORGANIC FARMING AND BIOPESTICIDES

After completing this course, students will be able to:

1. Demonstrate the ability to collect and analyze soil samples for pH, moisture, and nutrient levels.
2. Prepare compost using organic waste materials such as kitchen waste, dry leaves, and manure.
3. Apply organic mulching techniques to conserve soil moisture and suppress weed growth.
4. Perform seed treatment using natural methods like neem extract and cow urine to enhance germination and disease resistance.
5. Formulate and use natural pesticides, including neem oil spray, garlic spray, and cow dung-based pesticides.
6. Prepare organic fertilizers such as Jeevamrut and Panchagavya for soil enrichment.
7. Prepare cow urine biopesticide for general pest control and as a plant growth promoter.
8. Utilize fermented buttermilk spray to control fungal diseases in plants.
9. Analyze sustainable farming practices through field visits to farms

हा अभ्यासक्रम पूर्ण केल्यानंतर, विद्यार्थ्यांमध्ये खालील क्षमता विकसीत होतील:

१. पीएच, आर्द्रता आणि पोषक तत्वांच्या पातळीसाठी मातीचे नमुने गोळा करण्याची आणि त्यांचे विश्लेषण करण्याची क्षमता प्रदर्शित करणे.

२. स्वयंपाकघरातील कचरा, सुकी पाने आणि खत यासारख्या सेंद्रिय टाकाऊ पदार्थांचा वापर करून कंपोस्ट तयार करणे.

३. मातीतील ओलावा टिकवून ठेवण्यासाठी आणि तणांची वाढ रोखण्यासाठी सेंद्रिय मल्चिंग तंत्रांचा वापर करणे.

४. उगवण आणि रोग प्रतिकारशक्ती वाढविण्यासाठी कडुलिंबाचा अर्क आणि गोमूत्र यासारख्या नैसर्गिक पद्धतींचा वापर करून बियाणे प्रक्रिया करणे.

५. कडुलिंबाच्या तेलाचा स्प्रे, लसूण स्प्रे आणि शेणावर आधारित कीटकनाशकांसह नैसर्गिक कीटकनाशके तयार करा आणि वापर करणे.

६. माती समृद्ध करण्यासाठी जीवामृत आणि पंचगव्य सारखी सेंद्रिय खते तयार करणे.

७. सामान्य कीटक नियंत्रणासाठी आणि वनस्पतींच्या वाढीस चालना देण्यासाठी गोमूत्र जैव कीटकनाशके तयार करणे.

८. शेतांना भेटी देऊन शाश्वत शेती पद्धतींचे विश्लेषण करणे.

OPEN ELECTIVE - IV: FRUIT PROCESSING AND MANAGEMENT

After completing this course, students will be able to:

1. Identify and understand the working principles of common fruit processing equipment such as pulpers, sealers, juice extractors, autoclaves, and corking machines.
2. Analyze different packaging methods and preservation techniques as well as cold storage methods.
3. Evaluate different drying methods, including sun drying, cabinet drying, and solar drying, for fruit preservation.
4. Examine the effect of growth regulators on fruit ripening in banana, mango, and grapes.
5. Prepare fruit juices with and without the addition of preservatives.
6. Demonstrate the processing of tomatoes into various products such as juice, puree, ketchup, sauces, soup, and chutney.
7. Prepare different types of pickles, jam, jelly, and marmalades using locally available fruits.

हा अभ्यासक्रम पूर्ण केल्यानंतर, विद्यार्थ्यांमध्ये खालील क्षमता विकसीत होतील:

१. पल्पर, सीलर, ज्यूस एक्स्ट्रॅक्टर, ऑटोक्लेव्ह आणि कॉर्किंग मशीन यासारख्या सामान्य फळ प्रक्रिया उपकरणांच्या कार्य तत्त्वांची ओळख पटवा आणि समजून घ्या.

२. वेगवेगळ्या पॅकेजिंग पद्धती आणि जतन तंत्रांचे तसेच कोल्ड स्टोरेज पद्धतींचे विश्लेषण करा.

३. फळांच्या जतनासाठी उन्हात वाळवणे, कॅबिनेट वाळवणे आणि सौर वाळवणे यासारख्या वेगवेगळ्या वाळवण्याच्या पद्धतींचे मूल्यांकन करा.

४. केळी, आंबा आणि द्राक्षांमध्ये फळ पिकण्यावर वाढीच्या नियामकांचा परिणाम तपासा.

५. प्रिझर्व्हेटिव्ह्जसह आणि त्याशिवाय फळांचे रस तयार करा.

६. रस, प्युरी, केचप, सॉस, सूप आणि चटणी अशा विविध उत्पादनांमध्ये टोमॅटोची प्रक्रिया कशी करावी हे दाखवा.

७. स्थानिक पातळीवर उपलब्ध असलेल्या फळांचा वापर करून विविध प्रकारचे लोणचे, जाम, जेली आणि मुरंबा तयार करा.

Practical Examination:

1. Practical Examination will be conducted at the end of each Semester.

2. Practical Examination carries 50 Marks.

Nature of Question Paper: As per board of studies in Botany

SEMESTER –IV

SKILL ENHANCEMENT COURSE - II: ETHNOBOTANY

CREDIT: 2 **PRACTICAL HOURS:60** **MARKS: 50**

List of Practical

1) Study of Food plants: Morphology and uses of Rice [*Oryza sativa* L.] and Jowar [*Sorghum bicolor* (L.) Moench].
2) Study of Beverages: Morphology and uses of Kokam [*Garcinia indica* (Thou.)] Sharbat, Vala [*Vetiveria zizanioides* (L.) Nash.] Sharbat.
3) Study of Oil yielding plants: Morphology and uses of Coconut [*Cocos nucifera* L.], Groundnut [*Arachis hypogea* L.].
4) Study of drugs obtained from root and stem. Root: - Ashwagandha [*Withania somnifera* L. Dunal], Stem- Gulvel [*Tinospora cordifolia* (Willd.) Miers.]
5) Study of drugs obtained from leaf and flower. Leaf- Korphad [*Aloe vera* (L.) Burm.f.], Flower- Clove [*Syzygium aromaticum* (L.) Merr. & Perry]
6) Study of herbal cosmetics: Hair dye-Mehandi [*Lawsonia inermis* L.], Facemask-Chandan [*Santalum album* L.], Bath oil- Deshi-Gulab [*Rosa cymosa* Tratt. and Perfume-[*Jasminum sambac* (L.) Sol.]
7) Study of herbal preparation of Churn: Triphalachurna- Awala [*Emblica officinalis* Gaertn.], Hirada [*Terminalia chebula* Retz.], and Behada [*Terminalia bellirica* (Gaertn.) Roxb.] and Kadha/Decoction- Adulsa [*Justicia adhatoda* L.]
8) Study of herbal preparation of Hair oil-Maka [*Eclipta prostrata* (L.) L. and Shampoo-Ritha [Sapindus trifoliatus Vahl.] and Shikakai- [*Acacia concinna* (Willd.) DC]
9) Study of Biochemical tests for drug adulteration of Haldi [*Curcuma longa* L.] and Hing [*Ferula asafoetida* (Falc.) H. Karst.], Camphor [*Cinnamomum camphora* (L.) J. Presl] and Saffron [*Crocus sativus* L.*]*
10) Study of preliminary phytochemical tests for Alkaloids, Tannins, Saponins and Terpenoids.
11) Organoleptic study of Tulsi [*Ocimum tenuiflorum* L.], Ginger [*Zingiber officinale* Roscoe], Methi [*Trigonella foenum-graecum* L.] and Avala [*Phyllanthus emblica* L.]
12) Study of Endangered Ethnomedicinal plants.
13) Study of distribution of tribal/ethnic communities of India
14) Visit to herbal industry/villages for collection of ethnobotanical knowledge

Suggested Readings

1. Jain, S.K. (1991). Dictionary of Indian Folk Medicine and Ethnobotany. Deep Publications, New Delhi.
2. Jain, S.K. and Mudgal, V. (1999). *A Handbook of Ethnobotany*. Bishen Singh Mahendra Pal Singh, Dehradun.
3. Rastogi, P.R. and Mehrotra, B.N. (1993). *Compendium of Indian Medicinal Plants*. CDRI, Lucknow.
4. Jain, S.K. (2010). *Ethnobotany in India: A Status Report*. Deep Publications, New Delhi.
5. Martin, G. J. (2004). *Ethnobotany: A Methods Manual*, Earthscan, London.
6. Balick, M. J. and Cox, P. A. (1996). *Plants, People, and Culture: The Science of Ethnobotany*, Scientific American Library, New York.

Course Outcomes

SKILL ENHANCEMENT COURSE - I: FLORICULTURE

After completing this course, students will be able to:

1. Prepare different types of nursery beds (flat beds, raised beds, ridges, furrows, and basins) and pots for effective plant propagation.
2. Apply various propagation methods, including vegetative (grafting, layering, cuttings, offsets, and budding), asexual, and sexual propagation for key ornamental plants.
3. Demonstrate proper techniques for planting and transplanting different flower crops to ensure high survival and growth rates.
4. Perform training and pruning practices in rose cultivation to improve plant structure, health, and flowering efficiency.
5. Evaluate the role of plant growth regulators (PGRs) in enhancing the quality and yield of flower crops.
6. Apply drying and preservation techniques to maintain the aesthetic and commercial value of flowers.
7. Implement packaging and marketing strategies for fresh and preserved flowers to meet market demands.
8. Identify and manage common diseases and pests affecting ornamental and flowering plants.
9. Design and implement landscaping and garden architecture principles for aesthetic and functional purposes.

SKILL ENHANCEMENT COURSE - II: ETHNOBOTANY

After completing this course, students will be able to:

1) Understand the relationship between humans and plants.

2) Identify socially, economically and culturally useful plants.

3) Apply ethnobotanical knowledge in biodiversity conservation and socio-economic development.

4) Explain which parts of the plants are important for usage.

5) Distinguish traditional and modern healthcare.

6) Ethnobotany courses help students to learn about the traditional uses of plants, and how to apply this knowledge in modern contexts.

7) Detect adulterations in drugs.

Practical Examination:

1. Practical Examination will be conducted at the end of each Semester.
2. Each practical paper carries 50 Marks.
3. Duration of Practical Examination: 4 Hrs.