

**R. P. Gogate College of Arts and Science and R. V. Jogalekar College of Commerce  
(Autonomous) Ratnagiri  
Board of Studies in Botany  
Syllabus for T. Y. B. Sc. Botany effective from the year 2023-24**

<b>Name of Programme</b>	<b>B. Sc.</b>
<b>Level</b>	UG
<b>No of Semesters</b>	06
<b>Year of Implementation</b>	2023-24
<b>Programme Specific Outcomes (PSO)</b>	<p><b>Students will be able to:-</b></p> <ol style="list-style-type: none"> <li>1. Understand details and information about the evolution, anatomy, morphology, systematics, genetics, physiology, ecology, and conservation of plants and all other forms of life such as Algae, Fungi, Bryophytes, Pteridophytes and Gymnosperms.</li> <li>2. Recall details of the unique ecological and evolutionary features of the local and Indian flora.</li> <li>3. Communicate effectively using oral and written communication skills.</li> <li>4. Generate and test hypotheses, make observations, collect data, analyze and interpret results, derive conclusions, and evaluate their significance within a broad scientific context.</li> </ol>
<b>Relevance of PSOs to the local, regional, national, and global developmental needs (200 words)</b>	<p>The students, after completion of the course will be able to understand the diversity of plants from local, regional and national level with respect to various groups like Algae, Fungi, Bryophytes, Pteridophytes, Gymnosperms and Angiosperms. The knowledge of floral diversity gained by the students will be helpful for the sustainable livelihood which is useful from local to global level.</p> <p>The students will also gain knowledge regarding the ecological and economic importance of vegetation throughout the world. The knowledge acquired by the students, regarding cultivation and processing of different varieties of agricultural crops, fruits, vegetables and other plants of commercial importance will be helpful in setting up of small scale industries and seeking jobs which will lead to improve the local, regional and national economy. Study of phytochemical analysis, extraction of essential oils from plant resources and study of microbial technology will make the students able to use the techniques effectively in the industry</p> <p>The students will be able to analyze the local and regional environmental issues like pollution, waste disposal by studying ecology.</p> <p>The students will be able to establish the relationship between the modern and traditional and indigenous knowledge system of plants of the nation.</p>

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The performance of the learners shall be evaluated into two parts. The learner's performance shall be assessed by Internal Assessment with 40% marks in the first part and by conducting the Semester End Examinations with 60% marks in the second part. **The allocation of marks for the Internal Assessment and Semester End Examinations are as shown below-**

**A) Internal Assessment: 40 % (40 Marks)**

Sr. No.	Particulars	Marks
1.	<b>One Periodical Class Test / Online Examination</b>	<b>20</b>
2.	<b>Assignments</b>	<b>20</b>
	Question Paper Pattern for Periodical Class Test/ Online Examination: Maximum Marks: 20 Duration: 50 Minutes Long answer questions/ Multiple Choice Questions	

**B) Semester End Examination: 60% (60 Marks)**

Duration: The examination shall be of 2 hours duration. Question Paper Pattern

1. There shall be four questions.
2. All questions shall be compulsory with internal options.
3. Questions may be subdivided into sub-questions a, b, c... and the allocation of marks depends on the weightage of the unit.

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**Standard of Passing**

The learner to pass a course shall have to obtain a minimum of 40% marks in aggregate for each course where the course consists of Internal Assessment and Semester End Examination. The learner shall obtain minimum of 40% marks (i.e. 16 out of 40) in the Internal Assessment and 40% marks in Semester End Examination (i.e. 24 out of 60) separately, to pass the course and minimum of Letter Grade “P” in the project component, wherever applicable to pass a particular semester. A learner will be said to have passed the course if the learner passes the Internal Assessment & Semester End Examination together.

**Performance grading**

**Letter grades and grading points:**

<b>Semester GPA/ Program CGPA Semester/Program</b>	<b>% of Marks</b>	<b>Alpha-Sign / Letter Grade Result</b>
9.00-10.00	90.0 -100	0 (Outstanding)
$8.00 \leq 9.00$	$80.0 \leq 90.0$	A+ (Excellent)
$7.00 \leq 8.00$	$70.0 \leq 80.0$	A (Very Good)
$6.00 \leq 7.00$	$60.0 \leq 70.0$	B+ (Good)
$5.50 \leq 6.00$	$55.0 \leq 60.0$	B (Above Average)
$5.00 \leq 5.50$	$50.0 \leq 55.0$	C (Average)
$4.00 \leq 5.00$	$40.0 \leq 50.0$	P (Pass)
Below 4.00	Below 40	F (Fail)
Ab (Absent)	-	Absent

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<b>Name of the Course</b>	Botany I - Plant Diversity III
<b>Course Code</b>	USBOT501
<b>Class</b>	T. Y. B. Sc.
<b>Semester</b>	05
<b>No of Credits</b>	2.5
<b>Nature</b>	Theory
<b>Type</b>	Core

**Nomenclature: PLANT DIVERSITY – III**

**Course Outcomes:**

**Students will be able to:**

- CO1:** Gain knowledge about microbial diversity and perform techniques for culturing and visualization.
- CO2:** Understand the salient features of three major groups of algae, their life cycle patterns with a suitable example.
- CO3:** Learn general characteristics and classification of two major groups of fungi.
- CO4:** Identify and learn about the life cycle of prescribed examples of fungi.
- CO5:** Understand the scope and importance of Plant Pathology and apply various control measures of commonly widespread plant diseases.

**Curriculum:**

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**Semester I Plant Diversity III**

<b>Unit</b>	<b>Title</b>	<b>Learning Points</b>	<b>No of Lectures</b>
<b>1</b>	<b>Microbiology</b>	<p><b>Types of Microbes:</b> Viruses, Bacteria, Algae, Fungi, Protozoa, Mycoplasma and Actinomycetes.</p> <p><b>Culturing:</b> Sterilization, media, staining, colony characters, Pure cultures</p>	<b>15</b>
<b>2</b>	<b>Algae</b>	<p><b>Division Rhodophyta:</b> Classification and general characters, distribution, cell structure, pigments, reserve food, range of thallus, Reproduction: asexual and sexual, Alternation of Generations, Economic Importance. <b>Structure, life cycle and systematic position of</b></p> <ul style="list-style-type: none"> <li>● <i>Polysiphonia</i></li> <li>● <i>Batrachospermum</i></li> </ul> <p><b>Division Xanthophyta:</b> Classification and general characters, distribution, cell structure, pigments, reserve food, range of thallus, Reproduction: asexual and sexual, Alternation of Generations, Economic Importance. <b>Structure, life cycle and systematic position of</b></p> <ul style="list-style-type: none"> <li>● <i>Vaucheria</i>.</li> </ul> <p><b>Division Bacillariophyta:</b> Classification and general characters, distribution, cell structure, pigments, reserve food, range of thallus, Reproduction: asexual and sexual, Alternation of Generations, Economic Importance. <b>Structure, life cycle and systematic position of</b></p> <ul style="list-style-type: none"> <li>● <i>Pinnularia</i>.</li> </ul>	<b>15</b>
<b>3</b>	<b>Fungi</b>	<p><b>Basidiomycetes:</b> Classification and general characters <b>Structure, life cycle and systematic position of</b></p> <ul style="list-style-type: none"> <li>● <i>Agaricus</i></li> </ul> <p><b>Structure, life cycle and systematic position of</b></p> <ul style="list-style-type: none"> <li>● <i>Puccinia</i></li> </ul> <p><b>Deuteromycetes:</b> Classification and general characters <b>Structure, life cycle and systematic position of</b></p> <ul style="list-style-type: none"> <li>● <i>Alternaria</i></li> </ul>	<b>15</b>

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<b>4</b>	<b>Plant Pathology</b>	<b>Study of plant diseases:</b> Causative organism, symptoms, predisposing factors, disease cycle and control measures of the following. <ul style="list-style-type: none"><li>● White Rust of Crucifers – <i>Albugo candida</i></li><li>● Tikka disease of groundnut: <i>Cercospora</i></li><li>● Damping off disease: <i>Pythium</i></li><li>● Citrus canker – <i>Xanthomonas axonopodis</i> pv. <i>citri</i></li><li>● Leaf curl – Leaf Curl Virus in Papaya.</li></ul> <b>Study of Plant disease control methods :</b> <ul style="list-style-type: none"><li>● Physical</li><li>● Chemical</li><li>● Biological</li></ul>	<b>15</b>
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**Learning Resources recommended:**

- Industrial Microbiology - Cassida, New Age International, New Delhi,2022.
- Industrial Microbiology - Prescott and Dunn, AVI Publishing Company,1982.
- Botany for Degree Students - Algae - B R Vasistha , S. Chand Publication, 2010.
- Botany for Degree Students - Fungi - B R Vasistha, S. Chand Publication, 2010.
- Plant Pathology, At A Glance - U K Bhattacharya, Kalyani publishers,2014.

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**Evaluation Pattern**

**Internal Evaluation: Theory course - 40 Marks**

Method	Marks
Internal Evaluation Test	20
Assignment	20

**Semester End Evaluation (Paper Pattern)- 60 Marks**

Question No	Unit	Marks
1 A	All Units (6 MCQ)	6
B	Answer in one or two sentences (Based on all units)any three	6
2	Long answer questions from Unit 1	12
3	Long answer questions from Unit 2	12
4	Long answer questions from Unit 3	12
5	Long answer questions from Unit 4	12

<b>Name of the Course</b>
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Botany II- Plant Diversity IV
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<b>Course Code</b>	USBOT502
<b>Class</b>	T. Y. B. Sc.
<b>Semester</b>	05
<b>No of Credits</b>	2.5
<b>Nature</b>	Theory
<b>Type</b>	Core

**Nomenclature: PLANT DIVERSITY – IV**

**Course Outcomes:**

**Students will be able to**

**CO1:** Acquire knowledge of different fossil forms and understand evolution in plant groups.

**CO2:** Classify and describe the morphological and reproductive structures of prescribed families of angiosperms.

**CO3:** Identify the different examples of prescribed families of angiosperms.

**CO4:** Relate anomalies in stem structure with function and understand as well as differentiate between different types of the root-stem transition.

**CO5:** Understand pollen morphology and prescribed applications of palynology.

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**Curriculum: PLANT DIVERSITY – IV**

Unit	Title	Learning Points	No of Lectures
1	Paleobotany	<ul style="list-style-type: none"> <li>● <i>Lepidodendron</i>– All form genera : root, stem, bark, leaf, and cone</li> <li>● <i>Lyginopteris</i>– All form genera: root, stem, leaf, male and female fructification.</li> <li>● <i>Pentoxylon</i>– All form genera.</li> <li>● Contribution of Prof. Birbal Sahni to the field of paleobotany, Birbal Sahni Institute of Palaeosciences, Lucknow</li> </ul>	15
2	Angiosperms I	<p>Morphology of flower – All Parts of Flower. Bentham and Hooker system of classification with respect to the prescribed families , Merits and Demerits Study of following families with emphasis on the morphological peculiarities and economic importance of its members :</p> <ul style="list-style-type: none"> <li>● Capparidaceae</li> <li>● Umbelliferae</li> <li>● Cucurbitaceae</li> <li>● Rubiaceae</li> <li>● Solanaceae</li> <li>● Commelinaceae</li> <li>● Graminae</li> </ul>	15
3	Anatomy I	<ul style="list-style-type: none"> <li>● <b>Anomalous secondary growth in the Stems of <i>Bignonia, Salvadora, Achyranthes, Dracaena.</i></b> Storage roots of Beet, Radish</li> <li>● Root stem transition</li> <li>● Types of Stomata– Anomocytic, Anisocytic, Diacytic, Paracytic, and Graminaceous</li> </ul>	15
4.	Palynology	<p><b>Pollen Morphology</b> <b>Pollen viability</b> – pollen storage <b>Pollen germination and growth of pollen tube</b> <b>Application of Palynology:</b> in honey industry, coal and oil exploration, Aerobiology and pollen allergies, forensic science</p>	15

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**Learning Resources recommended:**

- Plant Systematics - Gurcharan Singh, Oxford and IBH Publ., 2018.
- Taxonomy of Vascular Plants - Lawrence George, H M, Oxford and IBH Publ. 2012.
- Pollen Morphology and Plant Taxonomy - G. Erdtman, Hafner Publ. Co., N.Y., 1967.
- A text Book of Palynology - K Bhattacharya, New Central Book Agency Pvt. Ltd. 2011.
- An introduction to Embryology of Angiosperms - P Maheshwari, McGraw Hill Book company,1950.
- Physiological Plant Anatomy - Haberlandt, Mac Millan and Company,1950.
- Plant Anatomy - B. P. Pandey, S. Chand Publication, 2018.

**Evaluation Pattern**

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**Internal Evaluation: Theory course - 40 Marks**

Method	Marks
Internal Evaluation Test	20
Assignment	20

**Semester End Evaluation (Paper Pattern)- 60 Marks**

Question No	Unit	Marks
1 A	All Units 6 MCQ	6
B	Answer in one or two sentences (Based on all units)any three	6
2	Long answer questions from Unit 1	12
3	Long answer questions from Unit 2	12
4	Long answer questions from Unit 3	12
5	Long answer questions from Unit 4	12

**Name of the Course**

Botany III- Form And Function III

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<b>Course Code</b>	USBOT503
<b>Class</b>	T. Y. B. Sc.
<b>Semester</b>	05
<b>No of Credits</b>	2.5
<b>Nature</b>	Theory
<b>Type</b>	Core

**Nomenclature: FORM AND FUNCTIONS- III**

**Course Outcomes:**

**Students will be able to:**

- CO1:** Understand structure and function of nucleus and vacuole, molecular mechanisms of translation.
- CO2:** Understand water relations of plants, inorganic and organic solute transport.
- CO3:** Apply the knowledge to manage mineral nutrition and survival of plants in challenging abiotic stress conditions.
- CO4:** Learn the succession in plant communities and remediation technologies applied for cleanup of polluted sites.
- CO5:** Get exposure to the principles and techniques of plant tissue culture used in the field of agriculture and horticulture.

**Curriculum:FORM AND FUNCTIONS- II**

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Unit	Title	Learning Points	No of Lectures
1	<b>Cytology and Molecular Biology</b>	<ul style="list-style-type: none"> <li>● Structure and function of nucleus</li> <li>● Structure and function of vacuole</li> <li>● Structure and function of giant chromosomes</li> <li>● The genetic code: Characteristics of the genetic code</li> <li>● Translation in Prokaryotes and Eukaryotes</li> </ul>	15
2	<b>Plant Physiology I</b>	<p><b>Water relations:</b> Water Potential, osmosis, transpiration, imbibition,</p> <p><b>Solute transport:</b> Transport of ions across cell membranes, active and passive transport, carriers, channels and pumps.</p> <p><b>Translocation of solutes:</b> Composition of phloem sap, girdling experiment.</p> <p><b>Pressure flow model (Munch's hypothesis):</b> Phloem loading and unloading, anatomy of sieve tube elements and mechanisms of sieve tube translocation.</p> <p><b>Mineral Nutrition:</b> Role of Macro and Micro nutrients, physiological functions and deficiency symptoms.</p>	15
3	<b>Environmental Botany</b>	<p><b>Bioremediation:</b> Principles, factors responsible and microbial population in bioremediation.</p> <p><b>Phytoremediation:</b> Metals, Organic Pollutants</p> <p><b>Plant succession:</b> Hydrosere and Xerosere – Formation of Barren Space, Succession on the land citing different Seres leading up to the climax, Succession in water, Ecesis, Poly and Mono-climax theories.</p>	15
4.	<b>Plant Tissue Culture</b>	<p><b>Aspects of Micro-propagation with reference to Floriculture:</b> Detailed study of Orchid Cultivation.</p> <p><b>Plant cell suspension cultures for the production of secondary metabolites:</b> With special reference to Shikonin production. Somatic Embryogenesis and Artificial Seeds.</p> <p><b>Protoplast Fusion and Somatic Hybridization:</b> i) Concept, Definition and various methods of Protoplast Fusion ii) Applications of Somatic Hybridization in Agriculture.</p>	15

**Learning Resources recommended:**

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- Introduction to Plant Physiology - Noggle and Fritz, Prentice Hall Publishers,2002.
- Plant Physiology - Salisbury and Ross, CBS Publishers,1950.
- Plant Physiology - Taiz and Zeiger, Sinauer Associates Inc. Publishers,2002.
- A handbook of Ethnobotany - S.K. Jain, V. Mudgal, Messrs Bishen Singh Mahendra Pal Singh Publishers and Distributors, 1999.
- Genetics - Russel Peter Adison, Wesley Longman Inc.,2000.
- An introduction to Genetic analysis - J. F. Griffiths, Griffith Freeman and Company 2000.
- Ecology and Environment - P.D. Sharma, Rastogi publications, 2018.

**Evaluation Pattern**

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**Internal Evaluation: Theory course - 40 Marks**

<b>Method</b>	<b>Marks</b>
<b>Internal Evaluation Test</b>	<b>20</b>
<b>Assignment</b>	<b>20</b>

**Semester End Evaluation (Paper Pattern)- 60 Marks**

<b>Question No</b>	<b>Unit</b>	<b>Marks</b>
<b>1 A</b>	<b>All Units 6 MCQ</b>	<b>6</b>
<b>B</b>	<b>Answer in one or two sentences (Based on all units)any three</b>	<b>6</b>
<b>2</b>	<b>Long answer questions from Unit 1</b>	<b>12</b>
<b>3</b>	<b>Long answer questions from Unit 2</b>	<b>12</b>
<b>4</b>	<b>Long answer questions from Unit 3</b>	<b>12</b>
<b>5</b>	<b>Long answer questions from Unit 4</b>	<b>12</b>

**Name of the Course**

**Botany IV - Current Trends In Plant Sciences II**

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<b>Course Code</b>	USBOT504
<b>Class</b>	T. Y. B. Sc.
<b>Semester</b>	05
<b>No of Credits</b>	2.5
<b>Nature</b>	Theory
<b>Type</b>	Core

**Nomenclature: CURRENT TRENDS IN PLANT SCIENCES – II**

**Course Outcomes:**

**Students will be able to :**

- CO1:** Get exposure to the technique of mushroom cultivation and explore the possibility of entrepreneurship in mushroom cultivation.
- CO2:** Learn applications of ethnobotany in the prescribed areas and will gain the knowledge of various medicinal plants used in treatment of prescribed ailments by the tribals in maharashtra.
- CO3:** Gain knowledge about the latest molecular biology techniques used for isolation and characterization of genes.
- CO4:** Learn principles and application of colorimetry, spectrophotometry, chromatography techniques.
- CO5:** Learn pharmacognostic analysis of prescribed medicinal plants.

**Curriculum: CURRENT TRENDS IN PLANT SCIENCES – II**

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Unit	Title	Learning Points	No of Lectures
1	<b>Ethnobotany and Mushroom Industry</b>	<p><b>Ethnobotany-</b> Definition, history, sources of data and methods of study.</p> <p><b>Applications of ethnobotany:</b></p> <ul style="list-style-type: none"> <li>● Ethno-medicines.</li> <li>● Agriculture.</li> <li>● Edible plants.</li> <li>● Famine related plants</li> <li>● Toxic plants and antidotes</li> </ul> <p><b>Medicinal plants used by tribals in Maharashtra towards :</b></p> <ul style="list-style-type: none"> <li>● Skin ailments: <i>Rubia cordifolia</i>, <i>Santalum album</i></li> <li>● Liver ailments: <i>Phyllanthus amarus</i>, <i>Andrographis paniculata</i></li> <li>● Wound healing and Anti-ageing: <i>Centella asiatica</i>, <i>Typha angustata</i>, <i>Terminalia sp.</i>, <i>Tridax procumbens</i>.</li> <li>● Fever: <i>Vitex negundo</i>, <i>Tinospora cordifolia</i></li> <li>● Diabetes: <i>Momordica charantia</i>, <i>Syzygium cuminii</i></li> </ul> <p><b>Mushroom industry:</b></p> <ul style="list-style-type: none"> <li>● Detailed general account of production of mushrooms with respect to methods of composting, spawning, casing, harvesting of mushroom.</li> <li>● Cultivation of <i>Pleurotus</i>, <i>Agaricus</i> and <i>Volvariella</i></li> <li>● General account of mushrooms: Nutritional value, picking and packaging, economic importance.</li> </ul>	15
2	<b>Plant Biotechnology I</b>	<ul style="list-style-type: none"> <li>● Construction of genomic DNA libraries, Chromosome libraries and c- DNA libraries.</li> <li>● Identification of specific cloned sequences in c-DNA libraries and Genomic libraries</li> </ul> <p><b>Analysis of genes and gene transcripts</b> – Restriction enzyme, analysis of cloned DNA sequences, Hybridization (Southern Hybridization)</p>	15
3	<b>Instrumentation</b>	<p><b>Colorimetry and Spectrophotometry (Visible, UV and IR) :</b> Instrumentation, working, principle and applications.</p> <p><b>Chromatography:</b> General account of Column chromatography. Principle and bedding material involved in adsorption and partition chromatography, ion exchange chromatography, molecular sieve chromatography.</p>	15

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<b>4.</b>	<b>Pharmacognosy and Medicinal Botany</b>	Monographs of drugs with reference to biological sources, geographical distribution, common varieties, macro and microscopic characters, chemical constituents, therapeutic uses, adulterants- <i>Strychnos</i> seeds, <i>Senna</i> leaves, Clove buds, <i>Allium sativum</i> , <i>Acorus calamus</i> and <i>Curcuma longa</i>	<b>15</b>
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**Learning Resources recommended:**

- Molecular Biology and Biotechnology - K. Ramawat, S. Chand Publications , 2010.

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- Comprehensive Biotechnology - K. Ramawat, S. Chand Publications, 2008.
- Biotechnology: Secondary Metabolites Plants and Microbes - K. G. Ramawat and J. M. Merillon, CRC Press, 2007.
- Principles of biochemistry\_ David Nelson, Michael Cox, WH Freeman, 2017.
- Ayurveda Ahar - P H Kulkarni, Sri Satguru publication, 2002.
- Pharmacognosy - Kokate, Purohit and Gokhale, Nirali Publications, 2007.
- Introduction to ethnobotany new concepts and approaches - Jain, Biotech book, 2013..
- Plant Biotechnology & Genetics: Principles, Techniques and Applications. Stewart, John Wiley & Sons Inc. U.S.A., 2008.

**Evaluation Pattern**

**Internal Evaluation: Theory course - 40 Marks**

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<b>Method</b>	<b>Marks</b>
<b>Internal Evaluation Test</b>	<b>20</b>
<b>Assignment</b>	<b>20</b>

**Semester End Evaluation (Paper Pattern)- 60 Marks**

<b>Question No</b>	<b>Unit</b>	<b>Marks</b>
<b>1 A</b>	<b>All Units 6 MCQ</b>	<b>6</b>
<b>B</b>	<b>Answer in one or two sentences (Based on all units) any three</b>	<b>6</b>
<b>2</b>	<b>Long answer questions from Unit 1</b>	<b>12</b>
<b>3</b>	<b>Long answer questions from Unit 2</b>	<b>12</b>
<b>4</b>	<b>Long answer questions from Unit 3</b>	<b>12</b>
<b>5</b>	<b>Long answer questions from Unit 4</b>	<b>12</b>

<b>Name of the Course</b>	Botany Practical
<b>Course Code</b>	USBOTP05

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<b>Class</b>	T. Y. B. Sc.
<b>Semester</b>	05
<b>No of Credits</b>	3
<b>Nature</b>	Practical
<b>Type</b>	Core

**Course outcomes:**

**Students will be able to:**

- CO1:** Identify and differentiate aero microbiota by petri plate method.
- CO2:** Identify and classify the members from Rhodophyta and Xanthophyta of Algae.
- CO3:** Identify and classify the members from Basidiomycetes and Deuteromycetes of Fungi.
- CO4:** Differentiate between stages in the life cycle of prescribed Algae and Fungi.
- CO5:** Learn about the prescribed fungal diseases.
- CO6:** Identify the prescribed fossil types.
- CO7:** Describe the morphological features of flowers.
- CO8:** Understand the morphological peculiarities and economic importance of the members from prescribed families of angiosperms.
- CO9:** Gain proficiency in the use of keys and identification manuals for identification of unknown plants to species level.
- CO10:** Relate anomalies in internal stem structure of prescribed plants and understand the secondary growth pattern in prescribed plants and learn types of stomata.
- CO11:** Describe various types of pollen grains by prescribed method.
- CO12:** Apply the knowledge of prescribed palynological data to grade the honey .

	<b>USBOTP5</b>	<b>L.</b>	<b>Cr.</b>
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		<b>45</b>	<b>3</b>
Sr.No.	<b>PRACTICAL Paper I – PLANT DIVERSITY III</b>		1.5
<b>Microbiology</b>			
1.	Study of Aeromicrobiota by petri plate exposure method <ul style="list-style-type: none"> <li>● Fungal culture</li> <li>● Bacterial culture</li> </ul>		
2.	Determination of Minimum Inhibitory Concentration (MIC) of sucrose against selected micro organism		
3.	Study of antimicrobial activity by the disc diffusion method.		
<b>Algae</b>			
4.	Study of stages in the life cycle of the following Algae from fresh / preserved material and permanent slides <ul style="list-style-type: none"> <li>● <i>Polysiphonia</i></li> <li>● <i>Batrachospermum</i></li> <li>● <i>Vaucheria</i></li> <li>● <i>Pinnularia</i></li> </ul>		
<b>Fungi</b>			
5.	Study of stages in the life cycle of the following Fungi from fresh / preserved material and permanent slides <ul style="list-style-type: none"> <li>● <i>Agaricus</i></li> <li>● <i>Puccinia</i></li> <li>● <i>Alternaria</i></li> </ul>		
<b>Plant Pathology</b>			
6.	Study of the following fungal diseases: <ul style="list-style-type: none"> <li>● White rust of Crucifers</li> <li>● Tikka disease of Groundnut</li> <li>● Damping off disease</li> <li>● Citrus canker</li> <li>● Leaf curl of Papaya</li> </ul>		

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<b>PRACTICAL Paper II – PLANT DIVERSITY IV</b>		L	Cr 1.5
<b>Paleobotany</b>			
1.	Study of the following form genera with the help of permanent slides/ photomicrographs. <ul style="list-style-type: none"> <li>● <i>Lepidodendron</i></li> <li>● <i>Lyginopteris</i></li> <li>● <i>Pentoxylon</i></li> </ul>		
<b>Angiosperms I</b>			
2.	Morphology of Flower – All Parts of Flower (Calyx, corolla, androecium and gynoecium)		
3.	Study of one plant from each of the following Angiosperm families <ul style="list-style-type: none"> <li>● Capparidaceae</li> <li>● Umbelliferae</li> <li>● Cucurbitaceae</li> <li>● Rubiaceae</li> <li>● Solanaceae</li> <li>● Commelinaceae</li> <li>● Graminae</li> </ul>		
4.	Study of morphological peculiarities and economic importance of the members of the above-mentioned angiosperm families		
5.	Identification of the genus and species of a plant with the help of flora.		
<b>Anatomy I</b>			
6.	Study of anomalous secondary growth in the stems of the following plants using double staining technique: <ul style="list-style-type: none"> <li>● <i>Bignonia</i></li> <li>● <i>Salvadora</i></li> <li>● <i>Achyranthes</i></li> <li>● <i>Dracaena</i></li> </ul>		
7.	Study of anomalous secondary growth in the roots of <ul style="list-style-type: none"> <li>● Beet</li> <li>● Radish</li> </ul>		
8.	Study of types of Stomata <ul style="list-style-type: none"> <li>● Anomocytic</li> <li>● Anisocytic</li> <li>● Diacytic</li> </ul>		

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	<ul style="list-style-type: none"> <li>● Paracytic</li> <li>● Graminaceous</li> </ul>		
<b>Palynology</b>			
9.	Study of pollen morphology (NPC Analysis) of the following by Chitale's Method : <ul style="list-style-type: none"> <li>● <i>Hibiscus</i></li> <li>● <i>Datura</i></li> <li>● <i>Ocimum</i></li> <li>● <i>Panocratium</i></li> <li>● <i>Canna</i></li> </ul>		
10.	Determination of pollen viability.		
11.	Pollen analysis from honey sample – unifloral and multifloral honey.		
12.	Study of effect of varying concentration of sucrose on in vitro pollen germination		

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<b>Name of the Course</b>	Botany Practical
<b>Course Code</b>	USBOTP06
<b>Class</b>	T. Y. B. Sc.
<b>Semester</b>	05
<b>No of Credits</b>	3
<b>Nature</b>	Practical
<b>Type</b>	Core

**Course outcomes:**

**Students will be able to:**

- CO1:** Mount and identify Giant chromosomes in *Chironomous* larvae.
- CO2:** Sequence amino acids by using knowledge of translation in protein synthesis.
- CO3:** Estimate Phosphate Phosphorus and Iron by using plant acid extract.
- CO4:** Understand physico - chemical properties of water prescribed in the syllabus.
- CO5:** Learn and prepare stock solutions for preparation of MS media used in plant tissue \ culture.
- CO6:** Identify and acquire knowledge of prescribed ethnomedicinal plants.
- CO7 :**Identify different stages in mushroom cultivation.
- CO8:** Understand technique for plasmid DNA isolation and their separation by AGE technique.
- CO9:** Solve problems on restriction mapping.
- CO10 :**Learn the technique of Ion Exchange Chromatography.
- CO11:** Evolve the concept of separation of plant pigments by using a silica gel column.
- CO12:** Analyze macroscopic and microscopic characters as well as active constituents in prescribed medicinal plants.

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	<b>USBOTP06</b>	<b>L.</b>	<b>Cr.</b>
	<b>PRACTICAL - Paper III FORM AND FUNCTION II</b>		1.5
<b>CYTOLOGY AND MOLECULAR BIOLOGY</b>			
1.	Mounting of Giant chromosomes from <i>Chironomous</i> larvae		
2.	Smear preparation from <i>Tradescantia</i> buds to study stages of meiosis.		
3.	Amino acid sequencing in prokaryotic and eukaryotic cells during translation.		
<b>PHYSIOLOGY</b>			
4.	Estimation of Phosphate Phosphorus (Plant acid extract).		
5.	Estimation of Iron (Plant acid extract).		
<b>ENVIRONMENTAL BOTANY</b>			
6.	Estimation of the following in given water sample <ul style="list-style-type: none"> <li>● Dissolved oxygen demand</li> <li>● Biological oxygen demand</li> <li>● Hardness</li> <li>● Salinity and Chlorinity</li> </ul>		
<b>MICROPROPAGATION</b>			
7.	Plant Tissue culture: Identification – Multiple shoot culture, hairy root culture, somatic embryogenesis		
8.	Preparation of stock solutions for preparation of MS medium (Note: Concept of preparation of specified molar solutions should be taught and problems based on preparation of stock solutions for tissue		

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	culture media will be given)		
	<b>PAPER IV CURRENT TRENDS IN PLANT SCIENCES II</b>		1.5
<b>ETHNOBOTANY AND MUSHROOM INDUSTRY</b>			
1.	Study of medicinal plants mentioned in theory for Ethnobotany.		
2.	Mushroom cultivation (To be demonstrated).		
3.	Identification of various stages involved in mushroom cultivation – spawn, pinhead stage, mature/ harvest stage of <i>Agaricus</i> , <i>Pleurotus</i> , <i>Volvariella</i>		
<b>BIOTECHNOLOGY I</b>			
4.	Growth curve of <i>E. coli</i> .		
5.	Plasmid DNA isolation and Separation of DNA using AGE.		
6.	Restriction mapping (problems) and Southern blotting.		
<b>INSTRUMENTATION</b>			
7.	Demonstration of Beer Lambert's Law.		
8.	Demonstration of ion exchange chromatography.		
9.	Separation of plant pigments using column chromatography technique.		
<b>PHARMACOGNOSY</b>			
10	Study of macroscopic/ microscopic characters and Chemical tests for active constituents of the following plants <ul style="list-style-type: none"> <li>● <i>Allium sativum</i></li> <li>● <i>Acorus calamus</i></li> <li>● <i>Curcuma longa</i></li> <li>● <i>Senna angustifolia</i></li> <li>● <i>Strychnos nux-vomica</i></li> <li>● <i>Eugenia caryophyllata</i></li> </ul>		

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**T.Y.B.SC. BOTANY SEMESTER V (USBOTP5)**

**Practical Paper – I**

Duration: 9:00 am to 11:00 am

Max. Marks:30

- Q.1 Perform the given Microbiological Experiment ' A' . 09
- Q.2 Identify, Classify and Describe Specimens B, C and D. Sketch neat and labeled diagrams of Morphological / Microscopical structures seen in the specimens. 12
- Q.3 Identify and describe slides / specimens E, F and G. 09

**KEY:**

A– Any one microbiology experiment as prescribed in the syllabus.

B & C– Algae.

D– Fungi.

E, F & G– Plant Pathology, Algae or Fungi not asked above in random order.

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**Evaluation Pattern**

**Internal Evaluation: Practical course**

**Total marks 40**

**Continuous internal evaluation: 10 marks**

Each practical will have 05 marks as continuous internal evaluation. the distribution of 05 marks is as follows:

01 mark: attendance, 02 marks: methodology, 02 marks: analysis and result.

The total marks of all practicals will be converted to 05 at the end of semester.

For the remaining 05 marks the distribution is as follows:

Practical paper I- Journal 05 marks

**Internal Evaluation Test: 10 marks**

**Semester End Evaluation (Practical exam Pattern)**

**Practical Paper I:30 marks**

**Practical Paper II: 30 marks**

**Practical Paper III:30 marks**

**Practical Paper IV: 30 marks**

**Practical Paper I:**

Question No	Unit	Marks
1	Based on Microbiological Experiment	09
2	Based on Practical Algae , Fungi.	12
3	Based on Practical Plant Pathology, Algae , Fungi	09

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**T.Y.B.SC. BOTANY SEMESTER V (USBOTP5)**

**Practical Paper – II**

Duration: 9:00 am to 11:00 am

Max. Marks:30

- Q. 1A. Classify specimen 'A' up to their families giving reasons. Give the floral formula.  
Sketch neat and labeled diagrams of L. S. of flower and T.S. ovary. 05
- Q. 1B. Identify genus and species of given specimen 'B' using flora. 03
- Q.2 Make a temporary double stained preparation of T.S. specimen 'C' and comment  
on the type of secondary growth. 05
- Q.3 Perform the Palynology experiment 'D' allotted to you. 05
- Q.4 Identify and describe slide/ specimen 'E', 'F', 'G' & 'H'. 12

**KEY**

A– Families as prescribed in syllabus

B– Plants from F.Y & S.Y. B. Sc Families to be included

C– Anatomy- Anomalous Secondary Growth

D– Palynology experiment

E, F, G & H– Fossils, Types of Stomata, Morphology of flower and Morphology of Fruits –  
in random order

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### **Evaluation Pattern**

#### **Internal Evaluation: Practical course**

**Total marks 40**

**Continuous internal evaluation: 10 marks** Each practical will have 05 marks as continuous internal evaluation. the distribution of 05 marks is as follows:

01 mark: attendance, 02 marks: methodology, 02 marks: analysis and result

The total marks of all practicals will be converted to 05 at the end of semester.

For the remaining 05 marks the distribution is as follows:

Practical paper II- field report 05 marks

**Internal Evaluation Test: 10 marks**

**Internal Evaluation Test: 10 marks per paper**

#### **Semester End Evaluation (Practical exam Pattern)**

**Practical Paper I: 30 marks**

**Practical Paper II: 30 marks**

**Practical Paper III: 30 marks**

**Practical Paper IV: 30 marks**

#### **Practical Paper II:**

<b>Question No</b>	<b>Unit</b>	<b>Marks</b>
<b>1</b>	Practical on families and Identification of Genus- Species using flora	<b>05 And 03</b>
<b>2</b>	Practical on Anatomy	<b>05</b>
<b>3</b>	Practical on Palynology	<b>05</b>
<b>4</b>	Identify and describe	<b>12</b>

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**T.Y.B.SC. BOTANY SEMESTER V (USBOTP6)**

**Practical Paper – III**

Duration: 9:00 am to 11:00 am

Max. Marks:30

- Q.1 Make a smear preparation of material 'A' and show the slide to the Examiner. Comment on your observation / Expose the giant chromosomes from the salivary glands of *Chironomous* larvae. 07
- Q. 2 Perform the experiment 'B' allotted to you (Physiology). 07
- Q. 3 Perform the experiment 'C' allotted to you (Ecology). 07
- Q. 4. Calculate concentration of media 'D' to prepare the required solution. 05
- Q. 5. Identify and describe slide/specimen 'E' & 'F'. 04

**KEY**

B– Physiology experiment.

C– Ecology experiment.

D– Plant Tissue Culture.

E & F– Multiple shoot culture, Hairy root culture, Somatic embryogenesis, Amino acid sequencing.

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### **Evaluation Pattern**

#### **Internal Evaluation: Practical course**

**Total marks 40**

**Continuous internal evaluation: 10 marks**

Each practical will have 05 marks as continuous internal evaluation. the distribution of 05 marks is as follows:

01 mark: attendance, 02 marks: methodology, 02 marks: analysis and result

The total marks of all practicals will be converted to 05 at the end of semester.

Paper III- Journal 05 marks

**Internal Evaluation Test: 10 marks**

#### **Semester End Evaluation (Practical exam Pattern)**

**Practical Paper I: 30 marks**

**Practical Paper II: 30 marks**

**Practical Paper III:30 marks**

**Practical Paper IV: 30 marks**

#### **Practical Paper III:**

<b>Question No</b>	<b>Unit</b>	<b>Marks</b>
<b>1</b>	Practical on Molecular Biology	<b>07</b>
<b>2</b>	Practical on Physiology	<b>07</b>
<b>3</b>	Practical on Ecology	<b>07</b>
<b>4</b>	Practical Plant tissue culture	<b>05</b>
<b>5</b>	Identify and describe	<b>04</b>

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**T.Y.B.SC. BOTANY SEMESTER V (USBOTP6)**

**Practical Paper – IV**

Duration: 9:00 am to 11:00 am

Max. Marks:30

- Q.1. Perform the experiment A– Growth curve of E.coli / Isolate plasmid DNA and separate using AGE. 07
- Q.2. Perform the experiment ‘B’ allotted to you. 07
- Q.3. Describe macroscopical /microscopical character with the help of neat and labeled sketches of specimens ‘C’ and ‘D’. Perform the chemical test / TLC to identify the active constituents. 10
- Q. 4 Identify and explain the specimens/ photographs ‘E’, ‘F’ and ‘G’. 06

**KEY**

B– Experiment based on Beer- Lambert’s Law Experiment on separation of dyes/pigments using silica gel column chromatography

C & D– *Allium sativum*, *Acorus calamus*, *Curcuma longa*, *Senna angustifolia*, *Strychnos nux-vomica*, *Eugenia caryophyllata*

E, F & G– any stage of mushroom cultivation, any Plant from ethnobotany, problems on restriction mapping

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### **Evaluation Pattern**

#### **Internal Evaluation: Practical course**

**Total marks 40**

**Continuous internal evaluation: 10 marks**

Each practical will have 05 marks as continuous internal evaluation. the distribution of 05 marks is as follows:

01 mark: attendance, 02 marks: methodology, 02 marks: analysis and result

The total marks of all practicals will be converted to 05 at the end of semester.

Paper IV- Viva 05 marks

**Internal Evaluation Test: 10 marks**

#### **Semester End Evaluation (Practical exam Pattern)**

**Practical Paper I:30 marks**

**Practical Paper II: 30 marks**

**Practical Paper III:30 marks**

**Practical Paper IV: 30 marks**

#### **Practical Paper IV:**

<b>Question No</b>	<b>Unit</b>	<b>Marks</b>
<b>1</b>	Practical on Biotechnology	<b>07</b>
<b>2</b>	Practical on Instrumentation	<b>07</b>
<b>3</b>	Practical on Pharmacognosy	<b>10</b>
<b>4</b>	Identify and describe	<b>06</b>

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<b>Name of the Course</b>	Horticulture and gardening
<b>Course Code</b>	USACHO501
<b>Class</b>	T. Y. B. Sc.
<b>Semester</b>	06
<b>No of Credits</b>	2
<b>Nature</b>	Theory
<b>Type</b>	Core

**Nomenclature: HORTICULTURE AND GARDENING –I**

**Course Outcomes:**

**Students will be able to**

**CO1:** Understand importance and objectives of Horticulture, branches of horticulture.

**CO2:** Learn important manures, horticultural plant diseases and their control measures.

**CO3:** Understand an important Horticulture Research Institutes in India and about the government schemes.

**CO4:** Learn methods of plant propagation practices.

**CO5:** Enhance entrepreneurship by knowing horticulture consultancy and its importance.

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**Curriculum: HORTICULTURE AND GARDENING –I**

Unit	Title	Learning Points	No of Lectures	No. of Credits
			60	02
1	<b>INTRODUCTION TO HORTICULTURE</b>	<p>Definition, importance and objectives of Horticulture, branches of Horticulture, Pomology, Olericulture, Landscape Gardening, Nurseries and development</p> <ul style="list-style-type: none"> <li>• .Allied branches – Apiculture – Bee box, honey bee life cycle and role of apiculture in pollination, Sericulture – Silkworm life cycle, different types with host plant, Social Forestry, Exhibition: aims and objectives.</li> <li>• Important Horticulture Research Institutes and Government Schemes for strategy plantations <ul style="list-style-type: none"> <li>● Konkan Krishi Vidyapeeth – Dapoli</li> <li>● National Research Centre for grapes.</li> <li>● Regional Fruit Research center Pune</li> <li>● Horticulture Training Centre (H.T.C.) – Talegaon.</li> <li>● Central Potato Tuber Research Institute ( CPTRI) – Shimla</li> </ul> </li> <li>• Horticulture Consultancy</li> <li>• Strategy plantation – Lakhibaug Yojana</li> </ul>	15	
2	<b>PROPAGATION PRACTICES</b>	<ul style="list-style-type: none"> <li>• <b>By Seeds</b> Advantages and disadvantages, method of seed propagation Production of seeds, Handling, Collection and Storage Sowing, Transplanting of seedlings and Hardening Seed treatment to control diseases Seedling diseases and their control.</li> <li>• <b>By specialized Vegetative structures</b> Bulbs, Tubers, Corms, Rhizomes, Root stock, runners, Offsets and suckers.</li> <li>• <b>Artificial methods of plant propagation</b> o <b>Cutting</b>– Root cutting, Stem cuttings, and leaf cuttings. Use of PGR's for rooting.</li> </ul>	15	

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		<p><b>o Layering</b> – Definition, Types: Simple, compound, (Serpentine) Tip, Trench, Mound, Air Layering.</p> <p><b>o Grafting</b>-Definition, advantages and disadvantages. Types: Splice, Whip/ Tongue, side, veneer, cleft, bark, epicotyls, approach, repair grafting – enarching, bridge and bracing.</p> <p><b>o Budding</b> – Definition, advantages and disadvantages. Types: T budding, shield, patch, ring budding.</p> <p><b>o Developing new varieties:</b> Technique of Emasculation and bagging, role of polyploidy in production of seedless varieties in plants.</p> <p>Application of Tissue Culture in relation to Horticulture.</p>		
3	<b>MANURES, FERTILIZERS AND DISEASES</b>	<p>Manures: Definition, importance, important manures FYM (compost), oil cakes, green manure, organic manures and vermicompost.</p> <p>• <b>Fertilizers:</b> Definition, Types – Straight, Compound and mixed. Nitrogenous (<math>\text{NH}_4</math>)<sub>2</sub>SO<sub>4</sub>, Urea, Ca (NO<sub>3</sub>)<sub>2</sub>, NH<sub>4</sub>Cl, Phosphatic (Superphosphate, Bone meal), Potassic (Muriate of potash, K<sub>2</sub>SO<sub>4</sub>)</p> <p>• <b>Biofertilizers:</b> Bacteria, Cyanobacteria, Mycorrhiza, Sea weeds.</p> <p>• <b>Diseases:</b> Horticultural plant diseases and their control. Fungal diseases-Rust, Smut, Powdery mildew. Bacterial – Citrus canker, Bacterial wilt. Viral – TMV, Leaf curl.</p> <p>• <b>Pests</b> – common pests on horticultural crops – Aphids, beetle, stem borer, caterpillars and rats.</p> <p>• <b>Friends of farmers:</b> Earthworm, snakes and predaceous fungi.</p>	15	
4.	<b>GARDEN OPERATIONS FOR HORTICULTURE</b>	<p>Selection of site, Preparation of soils for garden</p> <ul style="list-style-type: none"> <li>• Mulching, top-dressing, blanching</li> <li>• Sowing, transplanting, tree transplanting,</li> <li>• Irrigation, - Overhead, Surface, Underground</li> <li>• Weeding and pruning, - Principles, Objectives and general technique.</li> <li>• Water management and conservation through horticulture, Dry land Horticulture.</li> <li>• Organic Farming Definition, Scope, Indian scenario, Future scope</li> </ul>	15	

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**Learning Resources recommended:**

- Basic Horticulture - Jitendra singh (First edition) Kalyani publication,2008.
- Propagation practices - M K Sadhu,New age international,1989.
- Floriculture in India - G S Randhawa and A. Mukhopadhyay ,Allied publishers private limited,2015.
- Indoor gardening - S C Dey,Agrobios (india),2003.
- Plant propagation and nursery management -Dr. Arun kumar singh,Arun kumar,S k Kataria and sons publication,2023.
- Instant horticulture- S N Gupta,Jain Brothers,2023.
- Introductory ornamental horticulture and landscape gardening,Rajneesh Singh,Bijendra Kumar Singh,Bio green Books,2020
- Basics of horticulture - K.V.Peter,New India Publishing Agency (NIPA),2021.

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**Evaluation Pattern**

**Internal Evaluation: Theory course - 40 Marks**

<b>Method</b>	<b>Marks</b>
<b>Internal Evaluation Test</b>	<b>20</b>
<b>Assignment</b>	<b>20</b>

**Semester End Evaluation (Paper Pattern)- 60 Marks**

<b>Question No</b>	<b>Unit</b>	<b>Marks</b>
<b>1 A</b>	<b>All Units 6 MCQ</b>	<b>6</b>
<b>B</b>	<b>Answer in one or two sentences (Based on all units)any three</b>	<b>6</b>
<b>2</b>	<b>Long answer questions from Unit 1</b>	<b>12</b>
<b>3</b>	<b>Long answer questions from Unit 2</b>	<b>12</b>
<b>4</b>	<b>Long answer questions from Unit 3</b>	<b>12</b>
<b>5</b>	<b>Long answer questions from Unit 4</b>	<b>12</b>

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<b>Name of the Course</b>	Horticulture and gardening
<b>Course Code</b>	USACHO5P1
<b>Class</b>	T. Y. B. Sc.
<b>Semester</b>	06
<b>No of Credits</b>	2
<b>Nature</b>	Practical
<b>Type</b>	Core

**Course Outcomes:**

**Students will be able to**

**CO1:** Understand garden implements and their uses .

**CO2:** Identify prescribed horticultural plant diseases, insects and pests.

**CO3:** Acquire the skills of plant propagation by studying prescribed methods of propagation.

**CO4:** Get knowledge about different types of pots used for plantation.

**CO5:** Identify prescribed types of fertilizers, manures and biofertilizers.

**CO6:** Prepare natural insecticides such as neem arka, dashaparni arka, tobacco extract,  
seetaphal powder

**CO7:** start a small scale nursery..

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<b>Semester V USACHO5P1 PRACTICAL</b>		<b>L 60</b>	<b>Cr. 2</b>
<b>1.</b>	Study of garden implements and their use. for different purposes. <ul style="list-style-type: none"> <li>● Implements for digging and soil preparation</li> <li>● Implements for weeding</li> <li>● Implements for pruning</li> <li>● Implements for budding</li> <li>● Implements for watering</li> <li>● Implements for Spraying</li> <li>● Implements for harvesting</li> </ul>		
<b>2.</b>	To observe different types of pots and potting medium (Clay, Cement, Porcelain, Plastic, Special type of pots)		
<b>3.</b>	To study Potting and repotting of plants.		
<b>4.</b>	Propagation practices by seed		
<b>5.</b>	Propagation practices by vegetative propagation- Tuber, Rhizome and Offset		
<b>6.</b>	Propagation practices by vegetative propagation- Sucker and Corms, Runners		
<b>7.</b>	Propagation practices by cutting- Stem, root and leaf cutting.		
<b>8.</b>	Propagation practices by layering- Simple, compound and air layering.		
<b>9.</b>	Propagation practices by budding- T budding.		
<b>10.</b>	Propagation practices by grafting- Whip / Whip and tongue grafting.		
<b>11.</b>	Determination of Soil pH.		
<b>12.</b>	Study of Use of soil testing Kit.		
<b>13.</b>	Determination of pH of water, liquid fertilizers .		
<b>14.</b>	Identification of : Fertilizers – Identification by physical and chemical methods –Urea , Ammonium Sulphate , Potassium Sulphate, Super		

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	Phosphate .		
15.	Identification of plants as green manure – <i>Glyricidia</i> , <i>Crotolaria</i> , <i>Leucaena</i> .		
16.	Identification of Biofertilizers (material as slides) VAM, Nostoc, Rhizobium .		
17.	<b>Identification of plant diseases:</b> <ul style="list-style-type: none"> <li>● Fungal – Powdery mildew, Rust, Wilt, Blight, Smut</li> <li>● Bacterial – Canker ,Wilt</li> <li>● Viral – Leaf curl, yellow vein Mosaic</li> </ul>		
18.	<b>Identification of insects and pests:</b> <ul style="list-style-type: none"> <li>● Insects – Sucking, Biting, Chewing, Borers &amp; Ants .</li> <li>● Non Insects pests- Nematodes, Rodents.</li> </ul>		
19.	<b>Preparation of natural insecticides</b> – Neem arka		
20.	<b>Preparation of natural insecticides</b> – Dashparni arka		
21.	<b>Preparation of natural insecticides-</b> Tobacco extracts		
22.	<b>Preparation of natural insecticides-</b> Seetaphal powder		
23.	<b>Project</b> – Each student should individually present a project related to any topic related to Horticulture. It should be duly certified and presented at the time of practical examination. Project presentation college level is compulsory.		

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**T.Y.B.Sc. Applied component  
(Horticulture and gardening)**

**Duration- 4 hrs**

**Maximum marks 60**

**Note- Show all the preparations to the examiner.**

- |       |  |    |
|-------|--|----|
| Q.1   | Demonstrate the propagation techniques ----- and ----- using specimen A and B.       | 10 |
| Q.2   | Identify the given fertilizers C and D with the help of physical and chemical tests. | 10 |
| Q.3   | Estimate the pH of given sample E.   | 05 |
| or    |  |    |
|       | Identify and comment on the preparation and use of the given natural insecticide E.  |    |
| Q.4 a | Identify and comment on garden implements F, G, H.                                   | 09 |
| b     | Identify and comment on the specimens I, J, K.                                       | 06 |
| Q.5   | Project  | 20 |

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**Key:-**

**A and B-**

Vegetative propagation- runner, suckers, bulb, tuber, rhizome

Cutting- stem, leaf cutting

Layering- air layering

Grafting - Whip/ whip and tongue

Budding- T budding

**C and D-**

Urea

Super Phosphate

Ammonium Sulphate

Potassium Sulphate

**E-**

Natural insecticides- Neem, Tobacco and Dashparni Arka

**F-**

Biofertilizers- Nostoc, Rhizobium

Green manure- *Crotolaria*, *Leucaena*, *Glyricidia*

**G-**

Plant pathology- Citrus canker/ papaya leaf curl/ Fusarium wilt of banana/Yellow vein mosaic in Lady finger/ White rust/ Colocasia blight

**H- Insects**

Rhinoceros beetle, Mango stem borer, Grasshopper, Aphids, weevil

**I, J, K- Garden implements**

Spade, Shovel, Pickaxe, Garden shear, Secateur, Hand fork, garden rake, Watering can, Sprayer, Harvester, Tree Pruner, Scythe.

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**Evaluation pattern:**

**Continuous internal evaluation: 10 marks**

Each practical will have 05 marks as continuous internal evaluation. the distribution of 05 marks is as follows:

01 mark: attendance, 02 marks: methodology, 02 marks: analysis and result

The total marks of all practicals will be converted to 05 at the end of semester.

Journal: 05 marks

**Internal Evaluation Test: 10 marks per paper**

**Practical Paper- Applied component (Horticulture and gardening) I:**

<b>Question No</b>	<b>Unit</b>	<b>Marks</b>
<b>1</b>	Propagation techniques	10
<b>2</b>	Physical and chemical tests	10
<b>3</b>	pH of soil / natural insecticide	05
<b>4</b>	Identify and describe	09+06=15
<b>5</b>	Project	20

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<b>Name of the Course</b>	Botany I- Plant Diversity III
<b>Course Code</b>	USBOT601
<b>Class</b>	T. Y. B. Sc.
<b>Semester</b>	06
<b>No of Credits</b>	2.5
<b>Nature</b>	Theory
<b>Type</b>	Core

**Nomenclature: PLANT DIVERSITY – III**

**Course Outcomes:**

**Students will be able to**

**CO1:** Identify and describe the life cycles of prescribed Bryophytes.

**CO2:** Classify the prescribed classes of Pteridophytes and identify as well as describe the life cycles of one example from each class.

**CO3:** Study evolutionary aspects and economic utilization of Bryophytes and Pteridophytes.

**CO4:** Identify, describe and study in detail the life cycles prescribed gymnosperms.

**CO5:** Describe the economic importance of gymnosperms.

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**Curriculum: PLANT DIVERSITY – III**

Unit	Title	Learning Points	No of Lectures
1	<b>Bryophyta</b>	Classification, general characters and Life cycle of <i>Marchantia</i> Classification, general characters and Life cycle of <i>Pellia</i> Classification, general characters and Life cycle of <i>Sphagnum</i>	15
2	<b>Pteridophyta</b>	Lepidophyta – Classification, general characters; Life cycle of <i>Lycopodium</i> Calamophyta – Classification, general characters; Life cycle of <i>Equisetum</i> Pterophyta - Classification, general characters; Life cycle of <i>Adiantum</i> and <i>Marselia</i>	15
3	<b>Bryophytes and Pteridophytes: Applied aspects</b>	<ul style="list-style-type: none"> <li>● Ecology of Bryophytes.</li> <li>● Economic importance of Bryophytes.</li> <li>● Bryophytes as Indicators.</li> <li>● Evolution of Sporophyte and Gametophyte in Bryophytes.</li> <li>● Economic importance of Pteridophytes</li> <li>● Diversity and distribution of Indian Pteridophytes</li> <li>● Types of Sori and Evolution of Sori in Pteridophytes.</li> </ul>	15
4	<b>Gymnosperms</b>	<ul style="list-style-type: none"> <li>● Classification, general characters and Life cycle of <i>Thuja</i></li> <li>● Classification, general characters and Life cycle of <i>Gnetum</i></li> <li>● Classification, general characters and Life cycle of <i>Ephedra</i>.</li> <li>● Economic importance of Gymnosperms</li> </ul>	

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**Learning Resources recommended:**

- Botany for Degree Students: Bryophyta, B.R. Vashishta , 2010.
- Botany for Degree Students: Pteridophyta, B.R. Vashishta ,2010.
- Botany for Degree Students: Gymnosperms,Vashishta , 2010.
- College Botany Volume I and II Gangulee, Das and Dutta , Central Education enterprises, Latest edition.
- Cryptogamic Botany Volume I and II , G M Smith Mc-Graw Hill Publications.

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**Evaluation Pattern**

**Internal Evaluation: Theory course - 40 Marks**

<b>Method</b>	<b>Marks</b>
<b>Internal Evaluation Test</b>	<b>20</b>
<b>Assignment</b>	<b>20</b>

**Semester End Evaluation (Paper Pattern)- 60 Marks**

<b>Question No</b>	<b>Unit</b>	<b>Marks</b>
<b>1 A</b>	<b>All Units 6 MCQ</b>	<b>6</b>
<b>B</b>	<b>Answer in one or two sentences (Based on all units)any three</b>	<b>6</b>
<b>2</b>	<b>Long answer questions from Unit 1</b>	<b>12</b>
<b>3</b>	<b>Long answer questions from Unit 2</b>	<b>12</b>
<b>4</b>	<b>Long answer questions from Unit 3</b>	<b>12</b>
<b>5</b>	<b>Long answer questions from Unit 4</b>	<b>12</b>

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<b>Name of the Course</b>	Botany II- Plant Diversity IV
<b>Course Code</b>	USBOT602
<b>Class</b>	T. Y. B. Sc.
<b>Semester</b>	06
<b>No of Credits</b>	2.5
<b>Nature</b>	Theory
<b>Type</b>	Core

**Nomenclature: PLANT DIVERSITY – IV**

**Course Outcomes:**

**Students will be able to**

- CO1:** Learn the contributions of botanical gardens and BSI to angiosperm study.
- CO2:** Describe the vegetative and reproductive structures of the members of prescribed families.
- CO3:** Gain exposure to a phylogenetic system of classification.
- CO4:** Gain insight into the anatomical adaptations in different plant groups.
- CO5:** Understand the development of male and female gametophytes, embryonic structure and development in plants.
- CO6:** Understand the different aspects and importance of biodiversity and utilize it for conservation of species.

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**Curriculum: PLANT DIVERSITY – IV**

<b>Unit</b>	<b>Title</b>	<b>Learning Points</b>	<b>No of Lectures</b>
<b>1</b>	<b>Angiosperms II</b>	<p><b>Major Botanic gardens of India</b>– Indian Botanical Garden, Howrah; National Botanical Garden (NBRI) Lucknow; Lloyd Botanical Garden, Darjeeling; Lalbaugh Botanical Garden, Bangaluru.</p> <p>Botanical survey of India and regional branches of BSI. Bentham and Hooker’s system of classification for flowering plants up to family with respect to the following prescribed families and economic importance, medicinal importance and fruit morphology for members of the families</p> <ul style="list-style-type: none"> <li>● Rhamnaceae</li> <li>● Combretaceae</li> <li>● Asclepiadaceae</li> <li>● Labiatae</li> <li>● Euphorbiaceae</li> <li>● Cannaceae</li> </ul> <p>Hutchinson's System of Classification : Brief Introduction, Outline, Merits and Demerits .</p>	<b>08</b>
<b>2</b>	<b>Anatomy II</b>	<p>Ecological anatomy</p> <p>Hydrophytes – submerged, floating, rooted</p> <p>Hygrophytes -</p> <p>Mesophytes</p> <p>Sciophytes</p> <p>Halophytes</p> <p>Epiphytes</p> <p>Xerophytes</p>	<b>10</b>
<b>3</b>	<b>Embryology</b>	<p><b>Microsporogenesis -</b></p> <p><b>Megasporogenesis-</b> Development of monosporic type, examples of all embryo sacs</p> <p>Types of ovules</p> <p>Double fertilization</p> <p>Development of embryo–Capsella</p>	<b>10</b>
<b>4</b>	<b>Plant Geography</b>	<p><b>Phytogeographical regions of India.</b></p> <p><b>Biodiversity:</b></p> <p>Definition, diversity of flora found in various forest types of</p>	<b>10</b>

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	<b>and Biodiversity</b>	India Levels of biodiversity Importance and status of biodiversity Loss of biodiversity Conservation of biodiversity Genetic diversity- Molecular characteristics	
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**Learning Resources recommended:**

- An introduction to Embryology of Angiosperms - P Maheshwari, McGraw Hill Publications, 2020.
- The Embryology of Angiosperms - Bhojwani S.S. and Bhatnagar S.P., Vikas Publication House Pvt. Ltd., New Delhi., 2011.
- Economic Botany - B. P. Pandey Seventh Edition; S. Chand and Company, 1999.
- Ecology and Environment - P.D. Sharma, Rastogi publications, India, 2018.
- Physiological Plant Anatomy -Haberlandt, Mac Millan Publi., 2003.
- Taxonomy of Vascular Plants -Lawrence George, H M, Oxford and IBH Publ, 2010.
- Cryptogamic Botany Vol I and II - G M Smith, Mcgraw Hill Publi., 1995.

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**Evaluation Pattern**

**Internal Evaluation: Theory course - 40 Marks**

<b>Method</b>	<b>Marks</b>
<b>Internal Evaluation Test</b>	<b>20</b>
<b>Assignment</b>	<b>20</b>

**Semester End Evaluation (Paper Pattern)- 60 Marks**

<b>Question No</b>	<b>Unit</b>	<b>Marks</b>
<b>1 A</b>	<b>All Units 6 MCQ</b>	<b>6</b>
<b>B</b>	<b>Answer in one or two sentences (Based on all units)any three</b>	<b>6</b>
<b>2</b>	<b>Long answer questions from Unit 1</b>	<b>12</b>
<b>3</b>	<b>Long answer questions from Unit 2</b>	<b>12</b>
<b>4</b>	<b>Long answer questions from Unit 3</b>	<b>12</b>
<b>5</b>	<b>Long answer questions from Unit 4</b>	<b>12</b>

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<b>Name of the Course</b>	Botany III-Form And Function IV
<b>Course Code</b>	USBOT603
<b>Class</b>	T. Y. B. Sc.
<b>Semester</b>	06
<b>No of Credits</b>	2.5
<b>Nature</b>	Theory
<b>Type</b>	Core

**Nomenclature: FORMS AND FUNCTION – III**

**Course Outcomes:**

**Students will be able to**

- CO1:** Study various plant biomolecular structures and appreciate the structures, role, functions and applications of enzymes.
- CO2:** Gain knowledge about Nitrogen and plant hormone metabolism with applications of the same in agriculture and horticulture.
- CO3:** Understand principles of genetic mapping, mutations and solve problems based on them, gain knowledge of various metabolic disorders and their implications.
- CO4:** Generate and test hypotheses, make observations, collect data, analyze and interpret results, derive conclusions.
- CO5:** Evaluate test hypotheses significance within a broad scientific context, using suitable statistical techniques.

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**FORMS AND FUNCTION – III**

<b>Unit</b>	<b>Title</b>	<b>Learning Points</b>	<b>No of Lectures</b>
<b>1</b>	<b>Plant Biochemistry</b>	<b>Structure of biomolecules:</b> Carbohydrates (sugars, starch, cellulose, pectin), lipids (fatty acids and glycerol), proteins (amino acids) <b>Enzymes:</b> Nomenclature, classification, mode of action, Enzyme kinetics, Michaelis-Menten equation, competitive, noncompetitive and un-competitive inhibitors.	<b>10</b>
<b>2</b>	<b>Plant Physiology II</b>	<b>Nitrogen Metabolism:</b> Nitrogen cycle, root nodule formation, and leghaemoglobin, nitrogenase activity, assimilation of nitrates, (NR, NiR activity), assimilation of ammonia, (amination and transamination reactions), nitrogen assimilation and carbohydrate utilization. Physiological effects and commercial applications of Auxins, Gibberellins, Cytokinins and Abscisic acid	<b>10</b>
<b>3</b>	<b>Genetics</b>	<b>Genetic mapping in eukaryotes:</b> discovery of genetic linkage, gene recombination, construction of genetic maps, three-point crosses and mapping chromosomes, problems based on the same. <b>Gene mutations:</b> definition, types of mutations, causes of mutations, induced mutations, the Ames' test <b>Metabolic disorders</b> – enzymatic and non-enzymatic: Gene control of enzyme structure Garrod's hypothesis of inborn errors of metabolism, Phenyl ketone urea.	<b>10</b>
<b>4</b>	<b>Biostatistics</b>	Test of significance student's t-test – Paired and Unpaired. Regression. ANOVA (one way).	<b>08</b>

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**Learning Resources recommended:**

- Introduction to Biostatistics - P K Banerjee, Chand Publication, Dec 2007.
- Fundamentals of Biostatistics - Rastogi, Ane Books Pvt. Ltd, 2009.
- Plant Physiology - Salisbury and Ross, CBS Publishers, 2005.
- Plant Physiology - Taiz and Zeiger Sinauer Associates, Inc. Publishers, 2002.
- Lehninger, Principles of biochemistry - David N Nelson and Michael Cox, 2010

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**Evaluation Pattern**

**Internal Evaluation: Theory course - 40 Marks**

<b>Method</b>	<b>Marks</b>
<b>Internal Evaluation Test</b>	<b>20</b>
<b>Assignment</b>	<b>20</b>

**Semester End Evaluation (Paper Pattern)- 60 Marks**

<b>Question No</b>	<b>Unit</b>	<b>Marks</b>
<b>1 A</b>	<b>All Units 6 MCQ</b>	<b>6</b>
<b>B</b>	<b>Answer in one or two sentences(Based on all units)any three</b>	<b>6</b>
<b>2</b>	<b>Long answer questions from Unit 1</b>	<b>12</b>
<b>3</b>	<b>Long answer questions from Unit 2</b>	<b>12</b>
<b>4</b>	<b>Long answer questions from Unit 3</b>	<b>12</b>
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<b>Name of the Course</b>	Botany IV-Current Trends In Plant Sciences II
<b>Course Code</b>	USBOT604
<b>Class</b>	T. Y. B. Sc.
<b>Semester</b>	06
<b>No of Credits</b>	2.5
<b>Nature</b>	Theory
<b>Type</b>	Core

**Nomenclature: Current Trends in Plant Sciences – II**

**Course Outcomes:**

**Students will be able to**

**CO1:** Gain insight into recent molecular biology techniques for DNA analysis and amplification and Barcoding techniques and applications therein.

**CO2:** Understand and apply tools of Bioinformatics for data retrieval and phylogenetic analysis.

**CO3:** Learn about the plant sources of fats and oils and methods of extractions.

**CO4:** Deal with entrepreneurship in the field of science .

**CO5:** Gain knowledge and proficiency in preservation of plants and explore the possibility of entrepreneurship in the field.

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### Current Trends in Plant Science – II

Unit	Title	Learning Points	No of Lectures
1	<b>Plant Biotechnology II</b>	<b>DNA sequence analysis</b> – Maxam – Gilbert Method and Sanger’s method, Pyro Sequencing. Polymerase Chain Reaction (PCR). <b>DNA barcoding:</b> Basic features, nuclear genome sequence, chloroplast genome sequence, rbcL gene sequence, mat K gene sequence, present status of barcoding in plants.	<b>08</b>
2	<b>Bioinformatics</b>	Organization of biological data, databases Exploration of databases, retrieval of desired data, BLAST. Protein structure analysis and application Multiple sequence analysis and phylogenetic analysis.	<b>10</b>
3	<b>Economic Botany</b>	<b>Essential Oils:</b> Extraction, Perfumes, Perfume Oils, Oil of Rose, Sandalwood Oil, Patchouli, <i>Michelia champaca</i> , Grass Oils: Citronella, Vetiver. <b>Fatty oils:</b> Drying oil (Linseed and Soyabean oil), Semi Drying oils (Cotton seed, Sesame oil) and Non-Drying oils (Olive oil and Peanut oil) <b>Vegetable Fats:</b> Coconut and Palm oil	<b>10</b>
4	<b>Post Harvest Technology</b>	Storage of Plant Produce – Preservation of Fruits and Vegetables Drying (Dehydration) – Natural conditions – Sun drying, Artificial Drying – Hot Air Drying, Vacuum Drying, Osmotically Dried Fruits, Crystallized or Candied Fruits, Fruit Leather, Freeze Drying Freezing - Cold Air Blast System, Liquid Immersion method, Plate Freezers, Cryogenic Freezing, Dehydro-Freezing, Freeze Drying Canning Pickling - in brine, in vinegar, Indian Pickles. Sugar Concentrates - Jams, Jellies, Fruit juices. Food Preservatives. Use of Antioxidants in Preservation.	<b>10</b>

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**Learning Resources recommended:**

- Post-Harvest Technology -Verma and Joshi, Indus Publication,2012.
- Bioinformatics - Sunder Rajan,Himalaya publication,2014.
- Instant Notes on Bioinformatics by Westhead ,Taylor Francis Publications,2002.
- Bioinformatics -Ignasimuthu,Alpha Science International.2005.
- Comprehensive Biotechnology - K. Ramawat,S Chand publication 2004.
- Economic Botany - A F Hill, Tata Mcgraw Hill Publishing Co. Ltd.April 1986.

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**Evaluation Pattern**

**Internal Evaluation: Theory course - 40 Marks**

Method	Marks
Internal Evaluation Test	20
Assignment	20

**Semester End Evaluation (Paper Pattern)- 60 Marks**

Question No	Unit	Marks
1 A	All Units 6 MCQ	6
B	Answer in one or two sentences((Based on all units)any three	6
2	Long answer questions from Unit 1	12
3	Long answer questions from Unit 2	12
4	Long answer questions from Unit 3	12
5	Long answer questions from Unit 4	12

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<b>Name of the Course</b>	Botany Practical
<b>Course Code</b>	USBOTP07
<b>Class</b>	T. Y. B. Sc.
<b>Semester</b>	06
<b>No of Credits</b>	6
<b>Nature</b>	Theory
<b>Type</b>	Core

**Course outcomes:**

**Students will be able to**

**CO1:** Learn and differentiate between pteridophytes, gymnosperms and angiosperms.

**CO2:** Identify and classify prescribed pteridophytes and gymnosperms.

**CO3:** Get knowledge and identify the members of prescribed angiosperm families.

**CO4:** Understand the economic importance of pteridophytes, gymnosperms and angiosperms.

**CO5:** Observe and distinguish between the primary structure of dicot and monocot stem and root.

**CO6:** Separate the components of a mixture using paper chromatography technique.

**CO7:** Detect the presence of tannins in plant samples.

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<b>Semester VI USBOTP07</b>		<b>L.</b>	<b>Cr.</b>
		<b>60</b>	<b>3</b>
<b>Sr. No.</b>	<b>PRACTICAL Paper I – PLANT DIVERSITY III</b>		
<b>Bryophyta</b>			
1.	Study of stages in the life cycle of the following bryophytes from fresh /preserved material and permanent slides <ul style="list-style-type: none"> <li>● <i>Marchantia</i></li> <li>● <i>Pellia</i></li> <li>● <i>Sphagnum</i></li> </ul>		
<b>Pteridophyta</b>			
2.	Study of stages in the life cycles of the following pteridophytes from fresh / preserved material and permanent slides <ul style="list-style-type: none"> <li>● <i>Lycopodium</i></li> <li>● <i>Equisetum</i></li> <li>● <i>Adiantum</i></li> <li>● <i>Marselia</i></li> </ul>		
<b>Bryophytes and Pteridophytes: Applied aspects</b>			
3.	<ul style="list-style-type: none"> <li>● Economic importance of bryophytes.</li> </ul>		
4.	<ul style="list-style-type: none"> <li>● Economic importance of pteridophytes.</li> </ul>		
5.	<ul style="list-style-type: none"> <li>● Types of sporophytes in bryophytes (from permanent slides).</li> </ul>		
6.	<ul style="list-style-type: none"> <li>● Types of sori and soral arrangement in pteridophytes.</li> </ul>		
<b>Gymnosperms</b>			
7.	Study of stages in the life cycles of the following gymnosperms from fresh / preserved material and permanent slides <ul style="list-style-type: none"> <li>● <i>Thuja</i></li> <li>● <i>Gnetum</i></li> <li>● <i>Ephedra</i></li> </ul>		

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8.	Economic importance of gymnosperms		
<b>PRACTICAL Paper II – PLANT DIVERSITY IV</b>			1.5
<b>Angiosperms II</b>			
1.	Study of one plant from each of the following angiosperm families as per Bentham and Hooker's system of classification. <ul style="list-style-type: none"> <li>● Rhamnaceae</li> <li>● Combretaceae</li> <li>● Asclepiadaceae</li> <li>● Labiatae</li> <li>● Euphorbiaceae</li> <li>● Cannaceae</li> </ul>		
2.	Morphological peculiarities and economic importance of the members of the above-mentioned angiosperm families.		
<b>Anatomy II</b>			
4.	<b>Study of Ecological Anatomy of some plants showing adaptations:-</b> <ul style="list-style-type: none"> <li>● Hydrophytes: <i>Hydrilla</i> stem, <i>Nymphaea</i> petiole, <i>Eichhornia</i> offset</li> <li>● Epiphytes: <i>Orchid</i> root</li> <li>● Sciophytes: <i>Peperomia</i> leaf</li> <li>● Xerophytes: <i>Nerium</i> leaf, <i>Opuntia</i> phylloclade</li> <li>● Halophytes: <i>Avicennia</i> leaf and pneumatophore, <i>Sesuvium / Sueda</i> leaf</li> <li>● Mesophytes: <i>Vinca</i> leaf</li> </ul>		
<b>Embryology</b>			
5.	Study of various stages of Microsporogenesis, Megasporogenesis and Embryo Development with the help of permanent slides/photomicrographs.		
6.	Mounting of Monocot (Maize) and Dicot (Castor and Gram)embryo.		
7.	In vivo growth of pollen tube in <i>Portulaca/Vinca</i> .		
<b>Plant Geography</b>			
8.	Study of phytogeographic regions of India.		
9.	Preparation of vegetation map using Garmin's GPS Instrument.		

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10.	Problems based on Simpson's diversity Index.		
11.	Effect of varying concentration of sucrose on in-vitro pollen germination.		

<b>Name of the Course</b>	Botany Practical
<b>Course Code</b>	USBOTP08
<b>Class</b>	T. Y. B. Sc.
<b>Semester</b>	06
<b>No of Credits</b>	6
<b>Nature</b>	Theory
<b>Type</b>	Core

**Course outcomes :**

**Student will be able to:-**

**CO1 :**Estimate proteins by Biuret method

**CO2:** Understand the effect of GA on seed germination

**CO3:** Get knowledge about the estimation of reducing sugar by DNSA method.

**CO4:** Solve the problems based on three-point crosses.

**CO5:** Identify the types of mutation in prescribed DNA sequences.

**CO6:** Differentiate various stages in mitosis using pre-treated root tips of *Allium*.

**CO7:** Perform prescribed biostatistics experiments by solving problems.

**CO8:** Learn DNA sequencing by Sanger's method and Pyrosequencing method.

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	<b>VI USBOTP08</b>		
	<b>PRACTICAL - Paper III FORM AND FUNCTION III</b>		1.5
<b>Plant Biochemistry</b>			
1	Estimation of proteins by Biuret method.		
2	Study of effect of temperature on the activity of enzyme amylase.		
3	Study of the effect of pH on the activity of enzyme amylase.		
4	Study of effect of substrate variation on the activity of enzyme amylase.		
<b>Plant Physiology II</b>			
5	Estimation of alpha-amino nitrogen.		
6	Study of effect of GA on seed germination.		
7	Estimation of reducing sugars by DNSA method.		
<b>Genetics</b>			
8	Problems based on three-point crosses, construction of chromosome maps.		
9	Identification of types of mutations from given DNA sequences.		
10	Study of mitosis using pre-treated root tips of <i>Allium</i> .		

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<b>Biostatistics</b>			
11	t-test (paired and unpaired).		
12	Problems based on regression analysis.		
13	ANOVA (One Way)		
	<b>PAPER IV CURRENT TRENDS IN PLANT SCIENCES II</b>		1.5
<b>Plant Biotechnology II</b>			
1	DNA sequencing by Sanger's method and Pyro Sequencing method.		
2	DNA barcoding of plant material by using suitable data.		
<b>Bioinformatics</b>			
3	BLAST: nBLAST, pBLAST		
4	Multiple sequence alignment		
5	Phylogenetic analysis		
6	RASMOL/SPDBV		
<b>Economic Botany</b>			
7	Demonstration: Extraction of essential oil using Clevenger's apparatus.		
8	Thin layer chromatography of essential oil of Patchouli and Citronella.		
9	Saponification value of Palm oil.		
<b>Post-Harvest Technology</b>			
10	Preparation of <ul style="list-style-type: none"> <li>● Squash</li> <li>● Jam</li> <li>● Jelly</li> <li>● Pickle</li> </ul>		

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**UNIVERSITY OF MUMBAI  
T.Y.B.SC. BOTANY SEMESTER VI  
(USBOP8)  
Plant Diversity III (USBOP601)  
Practical Paper – I**

**Duration: 9:00 am to 11 am**

**Max. Marks:30**

- Q.1 Identify, classify and describe specimen 'A' and 'B'. Sketch neat and labeled diagrams of morphological/microscopical structures seen in the specimens. 08
- Q. 2 Identify, classify and describe specimen 'C' and 'D'. Sketch neat and labeled diagrams of morphological/microscopical structures seen in the specimens. 08
- Q.3 Identify, classify and describe specimen 'E'. Sketch neat and labeled diagrams of morphological/microscopical structures seen in the specimens. 04
- Q.4 Identify and describe slides/specimen 'F', 'G' 'H', 'I' & 'J'. 10

**KEY**

A & B– Bryophytes: *Marchantia*, *Pellia* & *Sphagnum*

C & D– Pteridophytes: *Lycopodium*, *Equisetum*, *Adiantum* & *Marsilea*

E– Gymnosperm: *Thuja*, *Gnetum* & *Ephedra*

F, G, H, I & J– Economic importance of Bryophytes, Economic importance of Pteridophytes

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Types of sporophytes in bryophytes, Types of sori in pteridophytes, Soral arrangement in pteridophytes, Economic importance of gymnosperms. (In random order)

### **Evaluation Pattern**

#### **Internal Evaluation: Practical course**

**Total marks 40**

**Continuous internal evaluation: 10 marks per paper**

Each practical will have 10 marks as continuous internal evaluation. the distribution of 10 marks is as follows:

02 marks : attendance

06 marks: methodology

02 marks: analysis and result

The total marks of all practicals will be converted to 10 at the end of semester.

**Internal Evaluation Test: 10 marks per paper**

#### **Semester End Evaluation (Practical exam Pattern)**

**Practical Paper I:30 marks**

**Practical Paper II: 30 marks**

**Practical Paper III:30 marks**

**Practical Paper IV: 30 marks**

#### **Practical Paper I:**

<b>Question No</b>	<b>Unit</b>	<b>Marks</b>
<b>1</b>	<b>Based on bryophytes</b>	<b>08</b>

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<b>2</b>	<b>Based on Practical pteridophytes</b>	<b>08</b>
<b>3</b>	<b>Based on gymnosperms</b>	<b>04</b>
<b>4</b>	<b>Identify and describe from bryophytes , pteridophytes and gymnosperms (5 specimens)</b>	<b>10</b>

**T.Y.B.SC. BOTANY SEMESTER VI  
(USBOP8)  
Practical Paper – II**

**Duration: 9:00 am to 01:00 pm**

**Max. Marks:30**

- Q. 1 Classify specimen 'A' up to its family giving reasons. Give floral formula.  
Sketch neat and labeled diagrams of L.S. of flower and T.S. ovary.  
07
- Q. 2 Make a stained preparation of specimen 'C' and comment on its ecological anatomy. 08
- Q.3.A Calculate Simpson's Diversity Index from the given data 'D'. 06  
OR  
Mark the Phytogeographic region 'E' in the map of India and Comment on the same. 06
- Q.4 Identify and describe slides/specimens 'F', 'G' & 'H'. 09

**KEY**

A– Families of T.Y.B.Sc Sem – VI only

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B– Plants from F.Y., S.Y. & T.Y. B. Sc.(Sem – V Families to be included).

C– Ecological anatomy.

F, G & H– Economic importance of specimen from prescribed families

(Sem VI only), Morphological peculiarities of prescribed families (Sem – VI only),

Embryology. (In random order)

### **Evaluation Pattern**

#### **Internal Evaluation: Practical course**

##### **Continuous internal evaluation: 10 marks**

Each practical will have 05 marks as continuous internal evaluation. the distribution of 05 marks is as follows:

01 mark: attendance, 02 marks: methodology, 02 marks: analysis and result

The total marks of all practicals will be converted to 05 at the end of semester.

field report 05 marks

##### **Internal Evaluation Test: 10 marks per paper**

#### **Semester End Evaluation (Practical exam Pattern)**

**Practical Paper I:30 marks**

**Practical Paper II: 30 marks**

**Practical Paper III:30 marks**

**Practical Paper IV: 30 marks**

#### **Practical Paper II:**

<b>Question No</b>	<b>Unit</b>	<b>Marks</b>
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<b>1</b>	<b>Practical on families</b>	<b>07</b>
<b>2</b>	<b>Practical on ecological anatomy</b>	<b>08</b>
<b>3</b>	<b>Practical on Simpson's Diversity Index / Phytogeographic region</b>	<b>06</b>
<b>4</b>	<b>Identify and describe</b>	<b>09</b>

**UNIVERSITY OF MUMBAI  
T.Y.B.Sc. BOTANY SEMESTER VI (USBOP9)  
FORM AND FUNCTION III (USBOP603)  
PRACTICAL III**

**Duration: 9:00 am to 11am**

**Max. Marks:30**

- Q.1 Perform the experiment 'A' allotted to you. 07
- Q.2 Perform the experiment 'B' allotted to you. 07
- Q.3 Make a squash preparation to show the stage of mitosis from the pre-treated root tips 'C'. 04
- Q.4 Construct a chromosome map from the given data 'D' / Identify the type of mutation and comment on them (any two types of mutations) 06
- Q.5 From the given data/ material 'E' determine test of significance using students t-test/ Regression Analysis /ANOVA 06

**KEY**

A– Plant Biochemistry Experiment.

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B– Plant Physiology Experiment.

### **Evaluation Pattern**

#### **Internal Evaluation: Practical course**

##### **Continuous internal evaluation: 10 marks**

Each practical will have 05 marks as continuous internal evaluation. the distribution of 05 marks is as follows:

01 mark: attendance, 02 marks: methodology, 02 marks: analysis and result

The total marks of all practicals will be converted to 05 at the end of semester.

For the remaining 05 marks the distribution is as follows:

Journal 05 marks

##### **Internal Evaluation Test: 10 marks**

#### **Semester End Evaluation (Practical exam Pattern)**

**Practical Paper I :30 marks**

**Practical Paper II : 30 marks**

**Practical Paper III :30 marks**

**Practical Paper IV : 30 marks**

#### **Practical Paper III:**

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Question No	Unit	Marks
1	Practical on biochemistry experiment	07
2	Practical on physiology experiment	07
3	Practical on squash preparation	04
4	Practical on chromosome map / mutation	06
5	Statistics	06

**T.Y.B.Sc. BOTANY SEMESTER VI (USBOP9)  
CURRENT TRENDS IN PLANT SCIENCE II (USBOP604)  
PRACTICAL IV**

**Duration: 9:00 am to 11 am**

**Max. Marks:30**

Q.1 Perform the DNA barcoding of plant material using given data 'A'. 07

OR

Perform DNA sequencing by Sanger's method of the given sequence 'A'. 07

Q.2 Perform the experiment 'B' allotted to you. 07

Q.3 Perform the given analysis of data 'C' using a computer(Bioinformatics). 07

Q.4 Prepare the squash/jam/jelly/pickle from the given material 'D'. 09

**KEY**

B– TLC of Patchouli or Citronella / Saponification value

C– BLAST / Multiple Sequence Alignment (MSA) / Phylogenetic Analysis / RASMOL / SPDBV

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**Evaluation Pattern**

**Continuous internal evaluation: 10 marks**

Each practical will have 05 marks as continuous internal evaluation. the distribution of 05 marks is as follows:

01 mark: attendance, 02 marks: methodology, 02 marks: analysis and result

The total marks of all practicals will be converted to 05 at the end of semester.

For the remaining 05 marks the distribution is as follows:

Viva 05 marks

**Internal Evaluation Test: 10 marks per paper**

**Semester End Evaluation (Practical exam Pattern)**

**Practical Paper I :30 marks**

**Practical Paper II : 30 marks**

**Practical Paper III :30 marks**

**Practical Paper IV : 30 marks**

**Practical Paper IV:**

Question No	Unit	Marks
1	Practical on DNA barcoding / Biotechnology	07

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<b>2</b>	<b>Practical on TLC / Saponification</b>	<b>07</b>
<b>3</b>	<b>Practical on bioinformatics</b>	<b>07</b>
<b>4</b>	<b>Prepare the squash/jam/jelly/pickle</b>	<b>09</b>

### **Horticulture and gardening**

<b>Name of the Course</b>	Horticulture and gardening
<b>Course Code</b>	USACHO601
<b>Class</b>	T. Y. B. Sc.
<b>Semester</b>	06
<b>No of Credits</b>	2
<b>Nature</b>	Theory
<b>Type</b>	Core

### **Nomenclature: HORTICULTURE AND GARDENING –II**

#### **Course Outcomes:**

#### **Students will be able to**

**CO1:** Understand important garden features and three important gardens of India.

**CO2:** Learn greenhouse technology of plants , floriculture, its scope and importance.

**CO3:** Understand the commercial production in relation to propagation, post plantation care, harvesting, post harvest management and varieties of prescribed crops.

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**CO4:** Learn fruit and vegetable preservation technology ,horticulture business, management and entrepreneurship development.

**CO5:** Enhance the ways of increasing the market value and shelf life of horticultural produce.

**Curriculum : HORTICULTURE AND GARDENING –II**

<b>Unit</b>	<b>Title</b>	<b>Learning Points</b>	<b>No of Lectures</b>
<b>1</b>	<b>LANDSCAPE GARDENING</b>	<p>Principles of landscaping &amp; garden design.</p> <ul style="list-style-type: none"> <li>• Indoor plants &amp; Indoor gardens- Hydroponics, Terrarium/ Bottle garden,Dish garden.</li> <li>• Important garden features- Paths &amp; Avenues, Hedges &amp; Edges, Lawn,Flower Beds, Arches &amp; Pergolas, Fencing, Water bodies, Rock garden &amp; Plants suitable for different locations &amp; climates.</li> <li>• Lawn- Purpose of preparation of lawn, Method of preparation of lawn , management of lawn &amp; lawn plants.</li> <li>• Soil manipulation for plantation of desirable varieties.</li> </ul>	<b>15</b>

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		<ul style="list-style-type: none"> <li>• Mughal, Buddist, Botanical garden, Vertical wall garden &amp; Theme park</li> <li>• Important Gardens of India—Shalimar (Srinagar), Vrindavan( Mysore), Veer Jijamata Udyan( Mumbai)</li> </ul>	
<b>2</b>	<b>HORTICULTURE PRODUCE</b>	<p>High –tech Horticultural production- Green house technology- Meaning,types, layout &amp; construction, irrigation systems. Care &amp; attention. Hardening of plants. Space gardens.</p> <ul style="list-style-type: none"> <li>• Floriculture – Scope &amp; importance, soil and climatic requirement and cultivation practices and Economics of greenhouse production of <i>Gerbera</i>,Carnation, Roses, Orchids.</li> </ul> <p>Propagation techniques, packing and marketing, enhancing and delaying the period of bloom by special methods. Floral decoration, Florist shop management.</p>	<b>15</b>
<b>3</b>	<b>COMMERCIAL PRODUCTION</b>	<p>Commercial production of the following – in relation to propagation, post plantation care, harvesting, post harvest management &amp; varieties.</p> <ul style="list-style-type: none"> <li>• Tubers- potato</li> <li>• Vegetables- Tomato</li> <li>• Fruits- Mango, Grapes &amp; Coconut- products like coco peat/ Coir etc.</li> <li>• Spices/condiments- Chilly</li> <li>• Medicinal plants- <i>Aloe vera</i>, <i>Stevia rebaudiana</i> (Madura)</li> <li>• Aromatic plant- <i>Citronella</i>, <i>Patchouli</i></li> </ul>	<b>15</b>
<b>4.</b>	<b>POST HARVEST TECHNOLOGY &amp; ENTREPRENEUR-</b>	<p>Maturity- Factors responsible for maturity &amp; ripening methods used for delaying ripening.</p>	<b>15</b>

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	<b>– SHIP IN HORTICULTURE</b>	<ul style="list-style-type: none"> <li>• Harvest- Time of harvest, harvesting and handling of harvested products</li> <li>• Storage of fresh produce- Types of storage of fruits &amp; vegetables</li> <li>• Fruit &amp; vegetables preservation technology.</li> <li>• Marketing- grading, packing &amp; transportation. Ways of increasing the market value and shelf life of horticultural produce.</li> <li>• Horticultural business, management and Entrepreneurship development</li> </ul> <p>Horticulture as a business definition and nature, organization, planning and operation of Horticulture farm business.</p>	
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**Learning Resources recommended:**

- Basic Horticulture - Jitendra singh (First edition) Kalyani publication,2008.
- Propagation practices - M K Sadhu,New age international,1989.
- Floriculture in India - G S Randhawa and A. Mukhopadhyay ,Allied publishers private limited,2015.
- Indoor gardening - S C Dey,Agrobios (india),2003.
- Plant propagation and nursery management -Dr. Arun kumar singh,Arun kumar,S k Kataria and sons publication,2023.
- Instant horticulture- S N Gupta,Jain Brothers,2023.
- Introductory ornamental horticulture and landscape gardening,Rajneesh Singh,Bijendra Kumar Singh,Bio green Books,2020
- Basics of horticulture - K.V.Peter,New India Publishing Agency (NIPA),2021.

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**Evaluation Pattern**

**Internal Evaluation: Theory course - 40 Marks**

<b>Method</b>	<b>Marks</b>
<b>Internal Evaluation Test</b>	<b>20</b>
<b>Assignment</b>	<b>20</b>

**Semester End Evaluation (Paper Pattern)- 60 Marks**

<b>Question No</b>	<b>Unit</b>	<b>Marks</b>
<b>1 A</b>	All Units 6 MCQ	<b>06</b>
<b>B</b>	Answer in one or two sentences (Based on all units)any three	<b>06</b>
<b>2</b>	Long answer questions from Unit 1	<b>12</b>
<b>3</b>	Long answer questions from Unit 2	<b>12</b>

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<b>4</b>	Long answer questions from Unit 3	<b>12</b>
<b>5</b>	Long answer questions from Unit 4	<b>12</b>

<b>Name of the Course</b>	Horticulture and gardening
<b>Course Code</b>	USACHO6P1
<b>Class</b>	T. Y. B. Sc.
<b>Semester</b>	06
<b>No of Credits</b>	2
<b>Nature</b>	Practical
<b>Type</b>	Core

**Course Outcomes:**

**Students will be able to**

**CO1:** Prepare garden plan .

**CO2:** Identify the plant suitable for garden location.

**CO3:** Understand methods of propagation. make flower arrangements of different types.

**CO4:** Get acquainted with different diseases and pests of horticulture plants .

**CO5:** Able to prepare different natural insecticides.

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<b>Semester V USACHO6P1</b>		<b>L</b>	<b>Cr.</b>
<b>PRACTICAL</b>		<b>30</b>	<b>2</b>
<b>1.</b>	Preparation of garden layout		
<b>2.</b>	List of plants suitable for garden locations- 2-3 plants for each location .		
<b>3.</b>	<b>Identification of important horticultural plants</b> 1. Herbs – foliage any 2 and flowering any 2 2. Shrubs – foliage any 2 flowering any 2 3. Trees – foliage any 2 and flowering any 2 4. Climbers – any 2 5. Lianas – any 2 6. Epiphytes – any 2 7. Creepers –any 2 8. Trailers – any 2 9. Aquatic plants – any 3 ( preferably various habitat) 10. Succulents – any 2 11. Weeds –any 10		
<b>4.</b>	Flower arrangements –Indian (Gajara , veni, garland , bouquet - Baskets , hand,torch type , table floral arrangement), Japanese and western all type		
<b>5.</b>	Soil pH, Use of soil testing Kit, electrical conductivity, pH of water, liquid fertilizers .		
<b>6.</b>	Method of preparing bonsai, Bottle Garden / Terrarium, Hanging baskets ,Dish garden .		

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<b>7.</b>	<b>Diseases and pests</b> <ul style="list-style-type: none"> <li>● Fungal – Powdery mildew ,Rust ,Wilt, Blight, Smut,</li> <li>● Bacterial – Canker ,Wilt</li> <li>● Viral – Leaf curl ,yellow vein Mosaic</li> <li>● Insects – Sucking, Biting, Chewing, Borers &amp; Ants .</li> <li>● Non Insects pests- Nematodes, Rodents.</li> </ul>		
<b>8.</b>	<b>Preparation of natural insecticides</b> – Neem arka , Dashparni arka, Seetaphal powder, Tobacco extracts .		
<b>9.</b>	<b>Project</b> – Each student should individually present a project related to any topic related to Horticulture .It should be duly certified and presented at the time of practical examination. Project presentation at college level is compulsory.		

**Learning resources recommended :**

- Basic Horticulture - Jitendra singh (First edition), Kalyani publication
- Propagation practices - M K Sadhu,New age international publication,2008.
- Floriculture in India - G S Randhawa and A. Mukhopadhyya ,Allied publishers private limited,2015.
- Textbook of Horticulture - K. Manibhushan Rao , Laxmi Publications Pvt Ltd,2021.
- Horticulture-Principles and Practices - George Acquaah ,Prentice Hall India Learning Private Limited, 2009.
- Instant Horticulture- S.N. Gupta,21st Edition, ,Jain Brothers Publication,2023
- Introduction to Horticulture - Kumar N, CBS Publisher and distributors Pvt.Ltd.2020.

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**Semester VI USACHOP6**

**Duration : 4 Hours**

**Time : 9.30 am to 1.30pm**

**Max Marks: 60**

Q1	Prepare an appropriate garden plan for the given area <b>A</b> . Suggest at least 2 names for each location.	10
Q2	Use the given materials <b>B</b> to make a Bonsai / Bottle Garden / Terrarium / Hanging Basket /Dish Garden.	10
Q3	Use the given material <b>C</b> to create a flower arrangement - Ikebana / Bouquet / Gajara / Veni / Garland / Rangoli / Bio jewellery  OR  Perform Fruit and vegetable carving.	10

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Q4	a) Identify the horticulture plants <b>D, E</b> and <b>F</b> . Comment on their importance.	12
	b) Identify the green house plant <b>G</b> . Comment on its propagation and requirements for growth.	05
Q5	Prepare Jam / Jelly / Pickle / Squash/ Syrup / Sauce / from the given material, using appropriate method and proportion.	08
Field report		05

### **Evaluation Pattern**

#### **Internal Evaluation: Practical course**

**Total marks 40**

#### **Continuous internal evaluation: 10 marks per paper**

Each practical will have 10 marks as continuous internal evaluation. the distribution of 10 marks is as follows:

02 marks : attendance

06 marks: methodology

02 marks: analysis and result

The total marks of all practicals will be converted to 10 at the end of semester.

**Internal Evaluation Test: 10 marks per paper**

#### **Semester End Evaluation (Practical exam Pattern)**

**Practical Paper :60 marks**

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**Practical Paper- Applied component (Horticulture and gardening) II:**

<b>Question No</b>	<b>Unit</b>	<b>Marks</b>
<b>1</b>	Garden plan	<b>10</b>
<b>2</b>	Bottle garden / dish garden	<b>10</b>
<b>3</b>	flower arrangement / fruit carving	<b>10</b>
<b>4</b>	Identify and describe horticultural plants Green house plant	<b>12</b> <b>05</b>
<b>5</b>	Jam/ Pickle/ Jelly/ Squash/ Sauce	<b>08</b>
<b>6</b>	Field report	<b>05</b>

**Scheme of Practical examination:**

1. Two Practical exams for botany at the end of semester consisting of practical I: 30 marks, Practical II-30 marks passing combined out of 60 and Practical III-30 marks, Practical IV-30 marks passing combined out of 60.
2. Two short field excursions for habitat studies are compulsory.
3. Field work of not less than eight hours' duration is equivalent to one period per week for a batch of 15 students.
4. A candidate will be allowed to appear for the practical examinations if he/she submits a certified journal of T.Y.B.Sc. Botany or a certificate from the Head of the department / Institute to the effect that the candidate has completed the practical course of T.Y.B.Sc. Botany as per the minimum requirements.
5. In case of loss of journal, a candidate must produce a certificate from the Head of the department /Institute that the practicals for the academic year were completed by the student. However, such a candidate will be allowed to appear for the practical examination, but the marks allotted for the journal will not be granted.
6. HOD's decision, in consultation with the Principal, shall remain final and abiding to all.

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Date: 16/04/24  
Place: Ratnagiri



Signature

Chairperson and HoD