



**Anekant Education Society's  
Tuljaram Chaturchand College of Arts, Science  
and Commerce, Baramati.  
(Autonomous)**

**Four B. Sc. Degree Program in Botany  
(Faculty of Science and Technology)**

**CBCS Syllabus**

**S. Y. B. Sc. (Botany) Semester -IV**

## Program Outcomes for B.Sc.

- PO.1 Comprehensive Knowledge and Understanding:** Graduates will possess a profound understanding of their field of study, including foundational theories, principles, methodologies, and key concepts, within a broader multidisciplinary context.
- PO2. Practical, Professional, and Procedural Knowledge:** Graduates will acquire practical skills and expertise essential for professional tasks within their field. This includes knowledge of industry standards, best practices, regulations, and ethical considerations, with the ability to apply this knowledge effectively in real-world scenarios.
- PO3. Entrepreneurial Mindset and Knowledge:** Graduates will cultivate an entrepreneurial mindset, identifying opportunities, fostering innovation, and understanding business principles, market dynamics, and risk management strategies.
- PO4. Specialized Skills and Competencies:** Graduates will demonstrate proficiency in technical skills, analytical abilities, problem-solving, effective communication, and leadership, relevant to their field of study. They will also adapt and innovate in response to changing circumstances.
- PO5. Capacity for Application, Problem-Solving, and Analytical Reasoning:** Graduates will possess the capacity to apply learned concepts in practical settings, solve complex problems, and analyze data effectively. This requires critical thinking, creativity, adaptability, and a readiness to learn and take calculated risks.
- PO6. Communication Skills and Collaboration:** Graduates will effectively communicate complex information, both orally and in writing, using appropriate media and language. They will also collaborate effectively in diverse teams, demonstrating leadership qualities and facilitating cooperative efforts toward common goals.
- PO7. Research-related Skills:** Graduates will demonstrate observational and inquiry skills, formulate research questions, and utilize appropriate methodologies for data collection and analysis. They will also adhere to research ethics and effectively report research findings.
- PO8. Learning How to Learn Skills:** Graduates will acquire new knowledge and skills through self-directed learning, adapt to changing demands, and set and achieve goals independently.
- PO9. Digital and Technological Skills:** Graduates will demonstrate proficiency in using ICT, accessing information sources, and analyzing data using appropriate software.
- PO10. Multicultural Competence, Inclusive Spirit, and Empathy:** Graduates will engage effectively in multicultural settings, respecting diverse perspectives, leading diverse teams, and demonstrating empathy and understanding of others' perspectives and emotions.
- PO11. Value Inculcation and Environmental Awareness:** Graduates will embrace ethical and moral values, practice responsible citizenship, recognize and address ethical issues, and take appropriate actions to promote sustainability and environmental conservation.
- PO12. Autonomy, Responsibility, and Accountability:** Graduates will apply knowledge and skills independently, manage projects effectively, and demonstrate responsibility and accountability in work and learning contexts.
- PO13. Community Engagement and Service:** Graduates will actively participate in community-engaged services and activities, promoting societal well-being.

**Anekant Education of Society's  
Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati  
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**SYLLABUS (CBCS) FOR S. Y. B. Sc. BOTANY (w.e. from June, 2024)**

Sem.	Course Type	Course Code	Course Title	Theory/ Practical	Credits	
<b>III</b>	Major Mandatory	BOT-201-MJM	Taxonomy of Angiosperms	Theory	02	
	Major Mandatory	BOT-202-MJM	Plant Physiology - I	Theory	02	
	Major Mandatory	BOT-203-MJM	Plant Biotechnology - I	Theory	02	
	Major Mandatory	BOT-204-MJM	Practical - I	Practical	02	
	Minor	BOT-241-MN	Floriculture - I	Theory	02	
	Minor	BOT-242-MN	Floriculture - I	Practical	02	
	Open Elective (OE)	BOT-216-OE	Bio-fertilizers	Theory	02	
	Vocational Skill Course (VSC)	BOT-221-VSC	Herbal Cosmetics	Theory	02	
	Ability Enhancement Course (AEC)	MAR-231-AEC HIN-231-AEC SAN-231-AEC	-	Theory	02	
	Co-curricular Course (CC)	YOG/PES/CUL/N SS/NCC-239-CC	To be selected from the Basket	Theory	02	
	Field Project (FP)	BOT-235-FP	-	Practical	02	
	Generic IKS Course (IKS)	GEN-245-IKS	-	Theory	02	
	<b>Total Credits Semester - III</b>					<b>24</b>
<b>IV</b>	Major Mandatory	BOT-251-MJM	Plant Anatomy	Theory	02	
	Major Mandatory	BOT-252-MJM	Plant Embryology	Theory	02	
	Major Mandatory	BOT-253-MJM	Plant Ecology	Theory	02	
	Major Mandatory	BOT-254-MJM	Practical - II	Practical	02	
	Minor	BOT-261-MN	Horticulture	Theory	02	
	Minor	BOT-262-MN	Horticulture	Practical	02	
	Open Elective (OE)	BOT-266-OE	Bio fertilizer	Practical	02	
	Skill Enhancement Course (VSC)	BOT-276-VSC	Herbal Cosmetics	Practical	02	
	Ability Enhancement Course (AEC)	MAR-281-AEC HIN-281-AEC SAN-281-AEC	-	Theory	02	
	Co-curricular Course (CC)	YOG/PES/CUL/N SS/NCC-289-CC	To be selected from the Basket	Theory	02	
	Community Engagement Project (CEP)	BOT-285-CEP	-	Practical	02	
	<b>Total Credits Semester - IV</b>					<b>22</b>
	<b>Cumulative Credits Semester III + Semester IV</b>					<b>46</b>

**Name of the Programme : B. Sc. Botany**  
**Programme Code : USBT**  
**Class : S.Y. B. Sc.**  
**Semester : IV**  
**Course Type : Major Mandatory (Theory)**  
**Course Code : BOT-251-MJM**  
**Course Title : Plant Anatomy**  
**No. of Credits : 02**  
**No. of Teaching Hours : 30**

#### **A) Learning Objectives:**

1. To introduce students with internal structure of plant and its organs.
2. To study importance and scope of plant anatomy.
3. To study different tissues present in plant.
4. To study tissue systems in plant.
5. To study normal secondary growth in plants.
6. To give knowledge of importance of cambium in secondary growth.
7. To study abnormal secondary growth and its causes.

#### **B) Course Outcome:**

**By the end of the course, students will be able to:**

- CO1. Describe internal structure of plant and its organs.
- CO2. Get knowledge of importance and scope of plant anatomy.
- CO3. Get knowledge of different tissues present in plant.
- CO4. Get knowledge of tissue systems in plants.
- CO5. Get knowledge of normal secondary growth in plants.
- CO6. Get knowledge of importance of cambium in secondary growth.
- CO7. Get knowledge of abnormal secondary growth and its causes.

**Unit - I (10L)**

**1. Plant Anatomy introduction (2L)**

Definition, scope of plant anatomy and types of tissues.

**2. Epidermal tissue system (4L)**

Structure and function of epidermal tissue system, uniseriate and multiseriate epidermis, stomata: structure, types and functions, epidermal outgrowth: glandular and non-glandular trichomes.

**3. Mechanical tissue system (4L)**

Principles involved in distribution of mechanical tissues - inflexibility, incompressibility, inextensibility and shearing stress, tissues providing mechanical support, their distribution in leaf, stem and root of dicots and monocots.

**Unit - II (8L)**

**1. Vascular tissue system (4L)**

Structure and function of xylem, phloem and cambium, Types of vascular bundles.

**2. Meristematic tissue system (4L)**

Structure and function of meristematic tissue system, Types of meristems.

**Unit - III (12L)**

**1. Normal secondary growth (6L)**

Introduction, cambium and its role in secondary growth, process of secondary growth in stems of *Helianthus annuus*, extrastelar and intrastelar secondary growth, annual rings, periderm, bark, tylosis and lenticels.

**2. Anomalous secondary growth (6L)**

Introduction, causes or reasons of anomalous secondary growth, anomalous secondary growth in dicot stem (*Bignonia*), dicot root (*Raphanus*) and monocot stem (*Dracaena*).

**References**

1. P. J. Chandurkar, Plant Anatomy, 1971, Oxford and IBH publication Co. New Delhi
2. B. P. Pandey, Plant Anatomy, 1987, S. Chand and Co. Ltd, New Delhi
3. Eams and Mc Daniel, An Introduction to Plant Anatomy, 1990, McGraw –Hill Book Co. Ltd and Kogakusha Co, Tokyo, Japan
4. Adriance S Foster, Practical Plant Anatomy, 2000, D Van Nostrand Co. INC, Newyork
5. Esau, Plant Anatomy, 2000, Wiley Toppan Co. California, USA
6. Pijush Roy, Plant Anatomy, 2004, New Central Book Agency Ltd, Kolkata

**Mapping of Program Outcomes with Course Outcomes**

**Weightage:** 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

Course Outcomes	Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO 8	PO9	PO10	PO11	PO12	PO13
CO 1	3	3								3			
CO 2	3		3			2							2
CO 3	2	3					3	3	2				
CO 4	2	2					3	3	2				
CO 5	3			2			2	2	3				
CO 6	2						2					3	
CO 7	3	2		3	2		2	2	3		2		

**Justification for the mapping**

**PO1. Comprehensive Knowledge and Understanding**

- CO1. Describe internal structure of plant and its organs.
- CO2. Get knowledge of importance and scope of plant anatomy.
- CO3. Get knowledge of different tissues present in plant.
- CO4. Get knowledge of tissue systems in plants.

- CO5. Get knowledge of normal secondary growth in plants.
- CO6. Get knowledge of importance of cambium in secondary growth.
- CO7. Get knowledge of abnormal secondary growth and its causes.

**PO2. Practical, Professional, and Procedural Knowledge**

- CO1. Describe internal structure of plant and its organs.
- CO3. Get knowledge of different tissues present in plant.
- CO4. Get knowledge of tissue systems in plants.
- CO7. Get knowledge of abnormal secondary growth and its causes.

**PO3. Entrepreneurial Mindset and Knowledge**

- CO2. Get knowledge of importance and scope of plant anatomy.

**PO4. Specialized Skills and Competencies**

- CO5. Get knowledge of normal secondary growth in plants.
- CO7. Get knowledge of abnormal secondary growth and its causes.

**PO5. Capacity for Application, Problem-Solving, and Analytical Reasoning**

- CO7. Get knowledge of abnormal secondary growth and its causes.

**PO6. Communication Skills and Collaboration**

- CO2. Get knowledge of importance and scope of plant anatomy.

**PO7. Research-related Skills**

- CO3. Get knowledge of different tissues present in plant.
- CO4. Get knowledge of tissue systems in plants.
- CO5. Get knowledge of normal secondary growth in plants.
- CO6. Get knowledge of importance of cambium in secondary growth.
- CO7. Get knowledge of abnormal secondary growth and its causes.

**PO8. Learning How to Learn Skills**

- CO3. Get knowledge of different tissues present in plant.
- CO4. Get knowledge of tissue systems in plants.
- CO5. Get knowledge of normal secondary growth in plants.
- CO7. Get knowledge of abnormal secondary growth and its causes.

**PO9. Digital and Technological Skills**

- CO3. Get knowledge of different tissues present in plant.
- CO4. Get knowledge of tissue systems in plants.
- CO5. Get knowledge of normal secondary growth in plants.
- CO7. Get knowledge of abnormal secondary growth and its causes.

**PO10 Multicultural Competence, Inclusive Spirit, and Empathy**

- CO1. Describe internal structure of plant and its organs.

**PO11. Value Inculcation and Environmental Awareness**

- CO7. Get knowledge of abnormal secondary growth and its causes.

**PO12 Autonomy, Responsibility, and Accountability**

- CO6. Get knowledge of importance of cambium in secondary growth.

**PO13. Community Engagement and Service**

- CO2. Get knowledge of importance and scope of plant anatomy.

<b>Name of the Programme</b>	<b>: B. Sc. Botany</b>
<b>Programme Code</b>	<b>: USBT</b>
<b>Class</b>	<b>: S.Y. B. Sc.</b>
<b>Semester</b>	<b>: IV</b>
<b>Course Type</b>	<b>: Major Mandatory (Theory)</b>
<b>Course Code</b>	<b>: BOT-252-MJM</b>
<b>Course Title</b>	<b>: Plant Embryology</b>
<b>No. of Credits</b>	<b>: 02</b>
<b>No. of Teaching Hours</b>	<b>: 30</b>

### **A) Learning Objectives:**

1. To introduce students with importance and scope of plant embryology.
2. To study structure of microsporangium and male gametophyte.
3. To study developmental aspects of male gametophyte.
4. To study developmental aspects of female gametophyte.
5. Acquaint students with fertilization process in plant.
6. To study development of embryo in plant.
7. To study structure of monocot and dicot embryo in plant.

### **B) Course Outcome:**

**By the end of the course, students will be able to:**

- CO1.** Students get knowledge of importance and scope of plant embryology.  
**CO2.** Students learnt structure of microsporangium and male gametophyte.  
**CO3.** Students learnt developmental aspects of male gametophyte.  
**CO4.** Students learnt developmental aspects of female gametophyte.  
**CO5.** Students get knowledge of fertilization in plant.  
**CO6.** Students learnt development of embryo in plant.  
**CO7.** Students get knowledge of monocot and dicot embryo in plant.

#### **Unit - I (10L)**

- 1. Plant Embryology introduction (2L)**  
Definition and scope of plant embryology.
- 2. Microsporangium and male gametophyte (8L)**
  - a. Microsporangium: structure of tetrasporangiate anther, types of tapetum, sporogenous tissue.
  - b. Microsporogenesis: process and its types, types of microspore tetrad.
  - c. Male gametophyte: structure and development of male gametophyte.

#### **Unit - II (8L)**

- 1. Megasporangium and female gametophyte:**
  - a) Megasporangium: structure, types of ovules - anatropous, orthotropous, amphitropous, campylotropous, circinotropous.
  - b) Megasporeogenesis: process and its types, types of megaspore tetrads.
  - c) Female gametophyte: structure of typical embryo sac, types of embryo sacs with examples - monosporic, bisporic and tetrasporic.

#### **Unit - III (12L)**

- 1. Fertilization: (6L)**  
Mechanism of pollination - entomophily, anemophily, hydrophily, zoophily, germination of pollen grain, double fertilization (syngamy and triple fusion) and its significance.

## 2. Endosperm and embryo

(6L)

- a) Endosperm: Types - nuclear, helobial and cellular.
- b) Embryogeny: structure of dicot and monocot embryo and seed formation

### References

1. Pandey S N and Chadha A, 2005, Plant Anatomy and Embryology, Vikas Publishing House, Pvt, Ltd, New Delhi
2. Bhojwani S S and Bhatnagar S P, 2010, An Embryology of Angiosperms, S. Chand and Co. Ltd, New Delhi
3. Maheshwari P, 2005, An introduction to Embryology of Angiosperm, S. Chand and Co. Ltd, New Delhi
4. Pandey B P, 1987, Plant Anatomy, S. Chand and Co. Ltd, New Delhi

### Mapping of Program Outcomes with Course Outcomes

**Weightage:** 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

Course Outcomes	Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO 8	PO9	PO10	PO11	PO12	PO13
CO 1	3	1	3							3	3	3	3
CO 2	2	2		3		3	3	3	3				
CO 3	2	3		3	3	3	3	3	3				
CO 4	2	2		2	2	2	2	2	2				
CO 5	3	2	2										
CO 6	2	1		2	2	2	2	2	2				
CO 7	2	3											

#### Justification for the mapping

#### **PO1. Comprehensive Knowledge and Understanding**

- CO1. Students get knowledge of importance and scope of plant embryology.
- CO2. Students learnt structure of microsporangium and male gametophyte.
- CO3. Students learnt developmental aspects of male gametophyte.
- CO4. Students learnt developmental aspects of female gametophyte.
- CO5. Students get knowledge of fertilization in plant.
- CO6. Students learnt development of embryo in plant.
- CO7. Students get knowledge of monocot and dicot embryo in plant.

#### **PO2. Practical, Professional, and Procedural Knowledge**

- CO1. Students get knowledge of importance and scope of plant embryology.
- CO2. Students learnt structure of microsporangium and male gametophyte.
- CO3. Students learnt developmental aspects of male gametophyte.
- CO4. Students learnt developmental aspects of female gametophyte.
- CO5. Students get knowledge of fertilization in plant.
- CO7. Students get knowledge of monocot and dicot embryo in plant.

#### **PO3. Entrepreneurial Mindset and Knowledge**

- CO1. Students get knowledge of importance and scope of plant embryology.
- CO5. Students get knowledge of fertilization in plant.



**PO4. Specialized Skills and Competencies**

CO2. Students learnt structure of microsporangium and male gametophyte.

CO3. Students learnt developmental aspects of male gametophyte.

CO4. Students learnt developmental aspects of female gametophyte.

CO6. Students learnt development of embryo in plant.

**PO5. Capacity for Application, Problem-Solving, and Analytical Reasoning**

CO3. Students learnt developmental aspects of male gametophyte.

CO4. Students learnt developmental aspects of female gametophyte.

CO6. Students learnt development of embryo in plant.

**PO6. Communication Skills and Collaboration**

CO2. Students learnt structure of microsporangium and male gametophyte.

CO3. Students learnt developmental aspects of male gametophyte.

CO4. Students learnt developmental aspects of female gametophyte.

CO6. Students learnt development of embryo in plant.

**PO7. Research-related Skills**

CO2. Students learnt structure of microsporangium and male gametophyte.

CO3. Students learnt developmental aspects of male gametophyte.

CO4. Students learnt developmental aspects of female gametophyte.

CO6. Students learnt development of embryo in plant.

**PO8. Learning How to Learn Skills**

CO2. Students learnt structure of microsporangium and male gametophyte.

CO3. Students learnt developmental aspects of male gametophyte.

CO4. Students learnt developmental aspects of female gametophyte.

CO6. Students learnt development of embryo in plant.

**PO9. Digital and Technological Skills**

CO2. Students learnt structure of microsporangium and male gametophyte.

CO3. Students learnt developmental aspects of male gametophyte.

CO4. Students learnt developmental aspects of female gametophyte.

CO6. Students learnt development of embryo in plant.

**PO10 Multicultural Competence, Inclusive Spirit, and Empathy**

CO1. Students get knowledge of importance and scope of plant embryology.

**PO11. Value Inculcation and Environmental Awareness**

CO1. Students get knowledge of importance and scope of plant embryology.

**PO12 Autonomy, Responsibility, and Accountability**

CO1. Students get knowledge of importance and scope of plant embryology.

**PO13. Community Engagement and Service**

CO1. Students get knowledge of importance and scope of plant embryology.

<b>Name of the Programme</b>	<b>: B.Sc. Botany</b>
<b>Program Code</b>	<b>: USBT</b>
<b>Class</b>	<b>: S. Y. B. Sc.</b>
<b>Semester</b>	<b>: IV</b>
<b>Course Type</b>	<b>: Major Mandatory (Theory)</b>
<b>Course Code</b>	<b>: BOT-253-MJM</b>
<b>Course Title</b>	<b>: Plant Ecology</b>
<b>No. of Credits</b>	<b>: 02</b>
<b>No. of Teaching Hours</b>	<b>: 30</b>

### A) Course Objective:

1. To understand the concepts of plant ecology.
2. To impart ecosystem dynamics.
3. To study plant-environment interactions.
4. To explore plant communities and biodiversity.
5. To knowledge about ecological adaptations and ecological successions.
6. To understand human impact on plant ecology.
7. To promote environmental awareness and conservation ethics.

### B) Course Outcome:

**By the end of the course, students will be able to:**

- CO1. Understanding of basic ecological principles, including ecosystem structure, function and energy flow.
- CO2. Assess the structure, composition, and dynamics of plant communities.
- CO3. Demonstrate the ability to identify factors that influence plant diversity and distribution within various ecosystems.
- CO4. Understand the role of plants in ecosystem processes such as primary production and nutrient cycling.
- CO5. Gain insight into key ecological processes, including plant population regulation, competition, herbivory, and mutualism.
- CO6. Critically evaluate the impact of human activities on plant communities and ecosystems.
- CO7. Demonstrate the ability to apply ecological concepts to real-world environmental problems, such as conservation of endangered species, habitat restoration, and sustainable land use practices.

**Credit-I** **(15L)**

**1. Introduction of plant ecology** **02L**

Introduction, concept, definition, autecology and synecology, applications of plant ecology

**2. Ecosystem ecology** **06L**

Introduction, ecological organization, concept of population, community, ecosystem and biosphere.

**Kinds of ecosystem** – Natural and artificial, terrestrial and aquatic-fresh (lotic/lentic), marine ecosystem.

**Components of ecosystem**– Biotic and Abiotic components.

**Ecosystem dynamics** – food chain, food web and ecological pyramids.

**Biogeochemical cycles** – carbon, nitrogen and phosphorous.

**3. Population and community ecology** **04L**

**Population** – concept, definition, characteristics- size, density, distribution, age structure, reproductive base and ecotypes.

**Community** – concept, definition, characteristics- structure, dominance, diversity, periodicity, stratification, ecotone and edge structure

**4. Biodiversity and its conservation** **03L**

Concept and definition of biodiversity. Methods of biodiversity conservation : *Ex-situ* and *In-situ*. Social approaches in biodiversity conservation- sacred groves, Chipko movement

**Credit-II** **15L**

**1. Ecological adaptations** **03L**

Adaptive features of plants - external and internal features.

Classification of plants and their characteristics–hydrophytes, mesophytes and xerophytes.

**2. Ecological succession** **04L**

Introduction, concept, definition, Principles, types– primary and secondary.

Hydrosere, xerosere and climax community.

**3. Man and Environment** **04L**

Environmental toxicology – Eutrophication, bioaccumulation and biomagnifications

Environmental Crisis - Desertification, Ozone depletion and Global warming

**4. Environmental Impact Assessment and Environmental audit** **04L**

EIA-concept, definition, objectives, methodology and applications

Environmental Audit- concept, definition, need, methodology and certification

**References:**

1. M. Anji Reddy Textbook of Remote sensing and GIS (Third edition, 2006) by BS Publication, Hyderabad.
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3. John R. Jensen Remote sensing of the environment (2000), Dorling Kindersley India Pvt. Ltd,
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5. Larry W. Canter, "Environment Impact Assessment", McGraw-Hill Book Company, New York
6. G. J. Rau and C. D. Weeten, "Environmental Impact Analysis Handbook, Mc Graw Hill, 1980.
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9. Kendeigh S. C. 1980. Ecology with Special Reference to Animals and Man. Prentice Hall of India Pvt. Ltd., New Delhi.
10. Kumar.H.D.1996. Modern Concepts of Ecology (3rd edition). Vikas Publishing House Pvt., Ltd. Delhi.
11. Kumar H. D. 1997. General Ecology. Vikas Publishing Pvt. Ltd., Delhi.
12. Kermond F.J. 1996. Concepts of Ecology. Prentice Hall of India Pvt. Ltd., New Delhi.
13. Smith. L. R. 1996. Ecology and Field Biology (5th edition). Harper Collns College Publishers, USA.
14. Weaver. J. E. and Clements. S.E. 1966. Plant Ecology. Tata McGraw Publishing Co. Ltd. Bombay.
15. Smith L. R. and Mith T. M. 1998. Elements of Ecology. (4th edition). An Imprint of Addison Wesley, Long manink., California.

### Mapping of Program out comes with Course Outcomes

**Class:** S. Y. B. Sc. (Sem. IV)

**Subject:** Botany

**Course:** Plant Ecology

**Course Code:** BOT-253-MJM

**Weightage:** 1= weak or low relation, 2=moderate or partial relation, 3=strong or direct relation

Course Outcomes	Programme Outcomes(POs)												
	PO 1	PO 2	PO3	PO4	PO5	PO 6	PO7	PO 8	PO 9	PO 10	PO11	PO 12	PO 13
CO1	3		1				1		1	1	2		1
CO2		2		2	2	1		1				1	
CO3	3						1				2		
CO4		2	1	2	3	1		1	1	1			1
CO5	3			2							2	1	
CO6		2				2			1	1			
CO7			1					1				2	3

### Justification for the mapping

#### **PO.1 Comprehensive Knowledge and Understanding:**

- CO1. Understanding of basic ecological principles, including ecosystem structure, function and energy flow.
- CO3. Demonstrate the ability to identify factors that influence plant diversity and distribution within various ecosystems.
- CO5. Gain insight into key ecological processes, including plant population regulation, competition, herbivory, and mutualism.

#### **PO2. Practical, Professional, and Procedural Knowledge:**

- CO2. Assess the structure, composition, and dynamics of plant communities.
- CO4. Understand the role of plants in ecosystem processes such as primary production and nutrient cycling.
- CO6. Critically evaluate the impact of human activities on plant communities and ecosystems.

#### **PO3. Entrepreneurial Mindset and Knowledge:**

- CO1. Understanding of basic ecological principles, including ecosystem structure, function and energy flow.
- CO4. Understand the role of plants in ecosystem processes such as primary production and nutrient cycling.
- CO7. Demonstrate the ability to apply ecological concepts to real-world environmental problems, such as conservation of endangered species, habitat restoration, and sustainable land use practices.

#### **PO4. Specialized Skills and Competencies:**

- CO2. Assess the structure, composition, and dynamics of plant communities.
- CO4. Understand the role of plants in ecosystem processes such as primary production and nutrient cycling.
- CO5. Gain insight into key ecological processes, including plant population regulation, competition, herbivory, and mutualism.

#### **PO5.Capacity for Application, Problem-Solving, and Analytical Reasoning:**

- CO2. Assess the structure, composition, and dynamics of plant communities.
- CO4. Understand the role of plants in ecosystem processes such as primary production and nutrient cycling.

#### **PO6. Communication Skills and Collaboration:**

- CO2. Assess the structure, composition, and dynamics of plant communities.

CO4. Understand the role of plants in ecosystem processes such as primary production and nutrient cycling.

CO6. Critically evaluate the impact of human activities on plant communities and ecosystems.

**PO7. Research-related Skills:**

CO1. Understanding of basic ecological principles, including ecosystem structure, function and energy flow.

CO3. Demonstrate the ability to identify factors that influence plant diversity and distribution within various ecosystems.

**PO8. Learning How to Learn Skills:**

CO2. Assess the structure, composition, and dynamics of plant communities.

CO4. Understand the role of plants in ecosystem processes such as primary production and nutrient cycling.

CO7. Demonstrate the ability to apply ecological concepts to real-world environmental problems, such as conservation of endangered species, habitat restoration, and sustainable land use practices.

**PO9. Digital and Technological Skills:**

CO1. Understanding of basic ecological principles, including ecosystem structure, function and energy flow.

CO4. Understand the role of plants in ecosystem processes such as primary production and nutrient cycling.

CO6. Critically evaluate the impact of human activities on plant communities and ecosystems.

**PO10. Multicultural Competence, Inclusive Spirit, and Empathy**

CO1. Understanding of basic ecological principles, including ecosystem structure, function and energy flow.

CO4. Understand the role of plants in ecosystem processes such as primary production and nutrient cycling.

CO6. Critically evaluate the impact of human activities on plant communities and ecosystems.

**PO11. Value Inculcation and Environmental Awareness:**

CO1. Understanding of basic ecological principles, including ecosystem structure, function and energy flow.

CO3. Demonstrate the ability to identify factors that influence plant diversity and distribution within various ecosystems.

CO5. Gain insight into key ecological processes, including plant population regulation, competition, herbivory, and mutualism.

**PO12. Autonomy, Responsibility, and Accountability:**

CO2. Assess the structure, composition, and dynamics of plant communities.

CO5. Gain insight into key ecological processes, including plant population regulation, competition, herbivory, and mutualism.

CO7. Demonstrate the ability to apply ecological concepts to real-world environmental problems, such as conservation of endangered species, habitat restoration, and sustainable land use practices.

**PO13. Community Engagement and Service:**

CO1. Understanding of basic ecological principles, including ecosystem structure, function and energy flow.

CO4. Understand the role of plants in ecosystem processes such as primary production and nutrient cycling.

CO7. Demonstrate the ability to apply ecological concepts to real-world environmental problems, such as conservation of endangered species, habitat restoration, and sustainable land use practices.

**Name of the Programme** : B. Sc. Botany  
**Programme Code** : USBT  
**Class** : S.Y. B. Sc.  
**Semester** : IV  
**Course Type** : Major Mandatory (Practical)  
**Course Code** : BOT-254-MJM  
**Course Title** : Practical - II  
**No. of Credits** : 02  
**No. of Teaching Hours** : 60

#### **A) Learning Objectives:**

1. To study internal morphology of plant.
2. To study different tissue systems in plant.
3. To study normal and abnormal secondary growth in plant.
4. To study types of vegetation.
5. To study ecological adaptations in plants.
6. To make students expertise in sectioning and staining technique.
7. Acquaint students with GPS technology.

#### **B) Course Outcome:**

**By the end of the course, students will be able to:**

- CO1. Know internal morphology of plant.
- CO2. Students get knowledge of different tissue systems in plant.
- CO3. Students learnt normal and abnormal secondary growth in plant.
- CO4. Students learnt types of vegetation.
- CO5. Students get knowledge of ecological adaptations in plants.
- CO6. Students are expertise in sectioning and staining technique
- CO7. Students get expertise in GPS technology.

#### **Practicals**

- 1) Study of epidermal tissue system - non-glandular and glandular trichomes, multilayered epidermis, typical stomata (dicot and monocot). (01 P)
- 2) Study of mechanical tissues and their distribution in root, stem and leaves. (01 P)
- 3) Study of Meristems in plant. (01P)
- 4) Study of vascular bundles in plant. (01P)
- 5) Study of normal secondary growth in dicot stem – *Annona /Moringa*. (Double stained temporary preparation). (01 P)
- 6) Study of anomalous secondary growth in *Bignonia* and *Dracaena* stem. (Double stained temporary preparation). (01 P)
- 7) Study of tetrasporangiate anther and types of ovules. (01 P)
- 8) Study of dicot and monocot embryo. (01 P)
- 9) Vegetation study by list count quadrat method. (01 P)
- 10) Study of Hydrophytes. (01 P)
- 11) Study of Xerophytes. (01 P)
- 12) Study of Ecological instruments. (01 P)
- 13) Determination of organic carbon in soil by titration method. (01 P)
- 14) Interpretation of data using satellite imageries. (01 P)
- 15) Visit to any aquatic / terrestrial ecosystem. (01P)

## Mapping of Program Outcomes with Course Outcomes

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

Course Outcomes	Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO 8	PO9	PO10	PO11	PO12	PO13
CO 1	3				3								
CO 2	2				2								
CO 3	3				3								
CO 4	3												
CO 5	2												
CO 6	2	3	2	2			3	3	3				
CO 7	2	3	2	2		3	2	2	2		3		3

### Justification for the mapping

#### **PO1. Comprehensive Knowledge and Understanding**

CO1. Know internal morphology of plant

CO2. Students get knowledge of different tissue systems in plant.

CO3. Students learnt normal and abnormal secondary growth in plant.

CO4. Students learnt types of vegetation.

CO5. Students get knowledge of ecological adaptations in plants.

CO6. Students are expertise in sectioning and staining technique

CO7. Students get expertise in GPS technology.

#### **PO2. Practical, Professional, and Procedural Knowledge**

CO6. Students are expertise in sectioning and staining technique

CO7. Students get expertise in GPS technology.

#### **PO3. Entrepreneurial Mindset and Knowledge**

CO6. Students are expertise in sectioning and staining technique

CO7. Students get expertise in GPS technology.

#### **PO4. Specialized Skills and Competencies**

CO6. Students are expertise in sectioning and staining technique

CO7. Students get expertise in GPS technology.

#### **PO5. Capacity for Application, Problem-Solving, and Analytical Reasoning**

CO1. Know internal morphology of plant.

CO2. Students get knowledge of different tissue systems in plant.

CO3. Students learnt normal and abnormal secondary growth in plant.

#### **PO6. Communication Skills and Collaboration**

CO7. Students get expertise in GPS technology.

#### **PO7. Research-related Skills**

CO6. Students are expertise in sectioning and staining technique

CO7. Students get expertise in GPS technology.

#### **PO8. Learning How to Learn Skills**

CO6. Students are expertise in sectioning and staining technique

CO7. Students get expertise in GPS technology.

#### **PO9. Digital and Technological Skills**

CO6. Students are expertise in sectioning and staining technique

<b>Name of the Programme</b>	<b>: B.Sc. Botany</b>
<b>Program Code</b>	<b>: USBT</b>
<b>Class</b>	<b>: S.Y.B.Sc.</b>
<b>Semester</b>	<b>: IV</b>
<b>Course Type</b>	<b>: Minor (Theory)</b>
<b>Course Code</b>	<b>: BOT-261-MN</b>
<b>Course Title</b>	<b>: Horticulture</b>
<b>No. of Credits</b>	<b>: 02</b>
<b>No. of Teaching Hours</b>	<b>: 30</b>

### **A) Learning Objectives:**

1. To Understanding the Fundamentals of Horticulture.
2. To know soil and climatic conditions necessary for the optimal growth of different horticultural plants.
3. To understand techniques for raising and managing a nursery
4. To know the plant Propagation Techniques.
5. To understand the nutritional requirements of horticultural plants and the role of fertilizers.
6. To gain knowledge on the cultivation techniques of major fruit trees
7. To explore indoor gardening practices.

### **B) Course Outcomes:**

By the end of the course, students will be able to:

**CO1.** Explain the fundamental concepts of horticulture.

**CO2.** Analyze the soil and climatic requirements for the successful growth and development of various horticultural plants.

**CO3.** Demonstrate knowledge and practical skills in the propagation of plants.

**CO4.** Explain and apply the techniques of training and pruning in orchards.

**CO5.** Understand and manage the nutritional requirements of plants to enhance their growth.

**CO6.** Cultivate and manage commercial flowers.

**CO7.** Develop skills in indoor gardening, including the creation and maintenance of Bonsai.

#### **Credit: 1 (15L)**

Horticulture: Definition, Importance and scope.	2L
Classification of horticultural plants: Fruits, vegetables, flowers, spices, plantation crops.	6L
Soil and climatic requirements of horticultural plants.	3L
Establishment and management of Nursery.	4L

#### **Credit: 2 (15L)**

Propagation of plants: Types of propagation, Cutting, Budding, Grafting, Layering, Natural modifications in plants.	5L
Training and pruning in Orchard.	2L
Nutrition of plants.	2L
Cultivation of commercial flowers- rose and jasmines.	2L
Cultivation of important fruit trees- Mango and Banana.	2L
Indoor gardening – Introduction, concept and scope, Bonsai	2L



### Mapping of Program Outcomes with Course Outcomes

**Class:** S. Y. B. Sc. (Sem. IV)

**Subject:** Botany

**Course:** Horticulture Theory

**Course Code:** BOT-261-MN

**Weightage:** 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

Course Outcomes	Programme Outcomes (POs)												
	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9	PO10	PO 11	PO 12	PO 13
CO 1	3			3		2		2		3		3	
CO 2		3	3		2		3		2				1
CO 3	2												
CO 4		2				1		2		2	3		
CO 5			2		3							2	3
CO 6	3	3							2		2		
CO 7				2			2			2			

#### Justification for the mapping

#### **PO.1 Comprehensive Knowledge and Understanding:**

CO1. Explain the fundamental concepts of horticulture.

CO3. Demonstrate knowledge and practical skills in the propagation of plants.

CO6. Cultivate and manage commercial flowers.

#### **PO2. Practical, Professional, and Procedural Knowledge:**

CO2. Analyze the soil and climatic requirements for the successful growth and development of various horticultural plants.

CO4. Explain and apply the techniques of training and pruning in orchards.

CO6. Cultivate and manage commercial flowers.

#### **PO3. Entrepreneurial Mindset and Knowledge:**

CO2. Analyze the soil and climatic requirements for the successful growth and development of various horticultural plants.

CO5. Understand and manage the nutritional requirements of plants to enhance their growth.

#### **PO4. Specialized Skills and Competencies:**

CO1. Explain the fundamental concepts of horticulture.

CO7. Develop skills in indoor gardening, including the creation and maintenance of Bonsai.

#### **PO5. Capacity for Application, Problem-Solving, and Analytical Reasoning:**

CO2. Analyze the soil and climatic requirements for the successful growth and development of various horticultural plants.

CO5. Understand and manage the nutritional requirements of plants to enhance their growth.

#### **PO6. Communication Skills and Collaboration:**

CO1. Explain the fundamental concepts of horticulture.

CO4. Explain and apply the techniques of training and pruning in orchards.

#### **PO7. Research-related Skills:**

CO2. Analyze the soil and climatic requirements for the successful growth and development of various horticultural plants.

CO7. Develop skills in indoor gardening, including the creation and maintenance of Bonsai.

#### **PO8. Learning How to Learn Skills:**

CO1. Explain the fundamental concepts of horticulture.

CO4. Explain and apply the techniques of training and pruning in orchards.

**PO9. Digital and Technological Skills:**

CO2. Analyze the soil and climatic requirements for the successful growth and development of various horticultural plants.

CO6. Cultivate and manage commercial flowers.

CO7. Develop skills in indoor gardening, including the creation and maintenance of Bonsai.

**PO10. Multicultural Competence, Inclusive Spirit, and Empathy**

CO1. Explain the fundamental concepts of horticulture.

CO4. Explain and apply the techniques of training and pruning in orchards.

CO7. Develop skills in indoor gardening, including the creation and maintenance of Bonsai.

**PO11. Value Inculcation and Environmental Awareness:**

CO4. Explain and apply the techniques of training and pruning in orchards.

CO6. Cultivate and manage commercial flowers.

**PO12. Autonomy, Responsibility, and Accountability:**

CO1. Explain the fundamental concepts of horticulture.

CO5. Understand and manage the nutritional requirements of plants to enhance their growth.

**PO13. Community Engagement and Service:**

CO2. Analyze the soil and climatic requirements for the successful growth and development of various horticultural plants.

CO5. Understand and manage the nutritional requirements of plants to enhance their growth.

CO6. Cultivate and manage commercial flowers.

<b>Name of the Programme</b>	<b>: B.Sc. Botany</b>
<b>Program Code</b>	<b>: USBT</b>
<b>Class</b>	<b>: S.Y. B.Sc.</b>
<b>Semester</b>	<b>: IV</b>
<b>Course Type</b>	<b>: Minor (Practical)</b>
<b>Course Code</b>	<b>: BOT-262-MN</b>
<b>Course Title</b>	<b>: Horticulture</b>
<b>No. of Credits</b>	<b>: 02</b>
<b>No. of Teaching Hours</b>	<b>: 60</b>

### **A) Learning Objectives:**

1. To introduction to Horticultural Tools and Techniques.
2. To understanding Horticultural Crops
3. To prepare seed bed and nursery bed.
4. To understand propagation methods.
5. To develop students' skills in the training and pruning of fruit plants.
6. To instruct students on the preparation of potting mixtures and the application of fertilizers
7. To provide students practical exposure to horticulture industry.

### **B) Learning Outcomes:**

By the end of the course, students will be able to:

**CO1.** Demonstrate Proficiency in Using Garden Tools.

**CO2.** Understand and Classify Horticultural Crops.

**CO3.** Prepare seed beds and nursery beds

**CO4.** Capable to implement sexual propagation methods in plants.

**CO5.** Able to apply layering techniques for propagation of plants.

**CO6.** Develop the skills in grafting techniques.

**CO7.** Able to observe and evaluate the practices used in commercial nurseries and orchards

### **Practicals**

1. Study of Garden Tools.	1P
2. Study of Horticultural crops.	1P
3. Preparation of seed bed/ nursery bed.	1P
4. Study of sexual methods of propagation.	1P
5. Studies on propagation by Cuttings.	1P
6. Studies on propagation by Layering.	1P
7. Studies on propagation by Grafting.	1P
8. Studies on propagation by Budding.	1P
9. Propagation through specialized Vegetative structures.	1P
10. Layout and planting of orchard.	1P
11. Training and Pruning of fruit plants.	2P
12. Preparation of potting mixture.	1P
13. Fertilizer application in different crops.	1P
14. Visit to commercial nurseries/orchard.	1P

### Mapping of Program Outcomes with Course Outcomes

**Class:** S. Y. B. Sc.(Sem. IV)

**Subject:** Botany

**Course:** Horticulture Practical

**Course Code:** BOT-262-MN

**Weightage:** 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

Course Outcomes	Programme Outcomes (POs)												
	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9	PO10	PO 11	PO 12	PO 13
CO1	2	3	2	3			1			3	2		3
CO2	3							3	2				
CO3		3	2										
CO4				3	3			2					2
CO5	2				3					2	2		
CO6		3		3				2					
CO7		3	3		3	2	2		2		3	2	2

#### Justification for the mapping

**PO.1 Comprehensive Knowledge and Understanding:**

CO1. Demonstrate Proficiency in Using Garden Tools.

CO3. Prepare seed beds and nursery beds.

CO5. Able to apply layering techniques for propagation of plants.

**PO2. Practical, Professional, and Procedural Knowledge:**

CO1. Demonstrate Proficiency in Using Garden Tools.

CO3. Prepare seed beds and nursery beds.

CO6. Develop the skills in grafting techniques.

CO7. Able to observe and evaluate the practices used in commercial nurseries and orchards.

**PO3. Entrepreneurial Mind-set and Knowledge:**

CO1. Demonstrate Proficiency in Using Garden Tools.

CO3. Prepare seed beds and nursery beds.

CO7. Able to observe and evaluate the practices used in commercial nurseries and orchards.

**PO4. Specialized Skills and Competencies:**

CO1. Demonstrate Proficiency in Using Garden Tools.

CO4. Capable to implement sexual propagation methods in plants.

CO6. Develop the skills in grafting techniques.

CO7. Able to observe and evaluate the practices used in commercial nurseries and orchards.

**PO5. Capacity for Application, Problem-Solving, and Analytical Reasoning:**

CO4. Capable to implement sexual propagation methods in plants.

CO5. Able to apply layering techniques for propagation of plants.

CO7. Able to observe and evaluate the practices used in commercial nurseries and orchards.

**PO6. Communication Skills and Collaboration:**

CO7. Able to observe and evaluate the practices used in commercial nurseries and orchards.

**PO7. Research-related Skills:**

CO1. Demonstrate Proficiency in Using Garden Tools.

CO7. Able to observe and evaluate the practices used in commercial nurseries and orchards.

**PO8. Learning How to Learn Skills:**

CO2. Understand and Classify Horticultural Crops.

CO4. Capable to implement sexual propagation methods in plants.

CO6. Develop the skills in grafting techniques.

**PO9. Digital and Technological Skills:**

CO2. Understand and Classify Horticultural Crops.

CO7. Able to observe and evaluate the practices used in commercial nurseries and orchards.

**PO10. Multicultural Competence, Inclusive Spirit, and Empathy**

CO1. Demonstrate Proficiency in Using Garden Tools.

CO5. Able to apply layering techniques for propagation of plants.

**PO11. Value Inculcation and Environmental Awareness:**

CO1. Demonstrate Proficiency in Using Garden Tools.

CO5. Able to apply layering techniques for propagation of plants.

CO7. Able to observe and evaluate the practices used in commercial nurseries and orchards.

**PO12. Autonomy, Responsibility, and Accountability:**

CO7. Able to observe and evaluate the practices used in commercial nurseries and orchards

**PO13. Community Engagement and Service:**

CO1. Demonstrate Proficiency in Using Garden Tools.

CO4. Capable to implement sexual propagation methods in plants.

CO7. Able to observe and evaluate the practices used in commercial nurseries and orchards.

<b>Name of the Programme</b>	<b>: B.Sc. Botany</b>
<b>Program Code</b>	<b>: USBT</b>
<b>Class</b>	<b>: S.Y.B.Sc.</b>
<b>Semester</b>	<b>: IV</b>
<b>Course Type</b>	<b>: Open Elective (OE) - Practical</b>
<b>Course Code</b>	<b>: BOT-266-OE</b>
<b>Course Title</b>	<b>: Bio-fertilizers</b>
<b>No. of Credits</b>	<b>: 02</b>
<b>No. of Teaching Hours</b>	<b>: 60</b>

### **A) Learning Objectives:**

1. **To** introduce students to the concept of bio-fertilizers and their applications in sustainable agriculture.
2. **To** provide knowledge about different types of bacterial, algal and fungal bio-fertilizers and their roles in enhancing soil fertility.
3. **To** explore the role of mycorrhizal fungi in promoting plant growth, particularly seedling development.
4. **To** familiarize students with organic manures, including green manure, FYM (Farm Yard Manure) and their preparation methods.
5. **To** guide students in the preparation of vermicompost, vermiwash, panchgavya and jeevamruta with an emphasis on their effects on seed germination.
6. **To** emphasize the importance of organic farming practices and their environmental and economic benefits.
7. **To** offer experiential learning through visits to bio-fertilizer cultivation units, encouraging students to observe and report on real-world applications.

### **B) Learning Outcomes:**

**By the end of the course, students will be able to:**

CO1:Identify and describe the applications of bio-fertilizers in improving soil health and crop production.

CO2:Distinguish between various types of bacterial, algal and fungal bio-fertilizers and explain their significance in agriculture.

CO3:Analyze the effects of mycorrhizal fungi on plant growth, particularly in seedling development.

CO4:Demonstrate knowledge of organic manures including their preparation and usage for enhancing soil fertility.

CO5:Prepare vermicompost, vermiwash, panchgavya and jeevamruta assess their effects on seed germination.

CO6:Explain the principles of organic farming and its advantages in sustainable agriculture.

CO7:Apply theoretical knowledge by visiting bio-fertilizer units and compiling comprehensive reports on their observations.

**Bio-fertilizers Practicals. (15P)**

- 1) Study of bio-fertilizers and their applications. (1P)
- 2) Study of types of bacterial bio-fertilizers. (1P)
- 3) Study of types of algal bio-fertilizers. (1P)

- 4) Study of types of fungal bio-fertilizers. (1P)
- 5) To study the effect of mycorrhizal fungi on growth of seedlings. (1P)
- 6) Study of types of organic manures and their applications. (1P)
- 7) Study of preparation of green manure and FYM (Farm Yard Manure). (1P)
- 8) Study of preparation of vermicomposting and its applications. (1P)
- 9) Study of significance and uses of organic farming. (1P)
- 10) Study of liquid organic manure, their types and applications. (1P)
- 11) Study of preparation of panchgavya and its effect on seed germination. (1P)
- 12) Study of preparation of jeevamruta and its effect on seed germination. (1P)
- 13) Study of preparation of vermiwash and its applications. (1P)
- 14) Visit to BGA/ *Spirulina*/ *Azolla* cultivation unit and submission of visit report. (1P)
- 15) Visit to KVK Baramati unit and submission of visit report. (1P)

#### Choice Based Credit System Syllabus (NEP Pattern)

#### Mapping of Program Outcomes with Course Outcomes

**Class:** S. Y. B. Sc.(Sem. IV)

**Subject:** Botany

**Course:** Bio-fertilizers

**Course Code:** BOT-266-OE

**Weightage:** 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

Course Outcomes	Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO 1	3		2			1	2	1	1		3		2
CO 2		3		3									
CO 3		3			3			1					
CO 4	3			3					2			2	
CO 5			2				2	2	2			3	
CO 6	3				3	2					3		3
CO 7		3									3		3

#### Justification for the mapping

##### **PO.1 Comprehensive Knowledge and Understanding:**

CO1:Identify and describe the applications of bio-fertilizers in improving soil health and crop production.

CO4:Demonstrate knowledge of organic manures including their preparation and usage for enhancing soil fertility.

CO6:Explain the principles of organic farming and its advantages in sustainable agriculture.

##### **PO2.Practical, Professional, and Procedural Knowledge:**

CO2:Distinguish between various types of bacterial, algal and fungal bio-fertilizers and explain their significance in agriculture.

CO3:Analyze the effects of mycorrhizal fungi on plant growth, particularly in seedling development.

CO7:Apply theoretical knowledge by visiting bio-fertilizer units and compiling comprehensive reports on their observations.

**PO3. Entrepreneurial Mindset and Knowledge:**

CO1:Identify and describe the applications of bio-fertilizers in improving soil health and crop production.

CO5:Prepare vermicompost, vermiwash, panchgavya and jeevamruta assess their effects on seed germination.

**PO4. Specialized Skills and Competencies:**

CO2:Distinguish between various types of bacterial, algal and fungal bio-fertilizers and explain their significance in agriculture.

CO4:Demonstrate knowledge of organic manures including their preparation and usage for enhancing soil fertility.

**PO5.Capacity for Application, Problem-Solving, and Analytical Reasoning:**

CO3:Analyze the effects of mycorrhizal fungi on plant growth, particularly in seedling development.

CO6:Explain the principles of organic farming and its advantages in sustainable agriculture.

**PO6. Communication Skills and Collaboration:**

CO1:Identify and describe the applications of bio-fertilizers in improving soil health and crop production.

CO6:Explain the principles of organic farming and its advantages in sustainable agriculture.

**PO7. Research-related Skills:**

CO1:Identify and describe the applications of bio-fertilizers in improving soil health and crop production.

CO5:Prepare vermicompost, vermiwash, panchgavya and jeevamruta assess their effects on seed germination.

**PO8. Learning How to Learn Skills:**

CO1:Identify and describe the applications of bio-fertilizers in improving soil health and crop production.

CO3:Analyze the effects of mycorrhizal fungi on plant growth, particularly in seedling development.

CO5:Prepare vermicompost, vermiwash, panchgavya and jeevamruta assess their effects on seed germination.

**PO9. Digital and Technological Skills:**

CO1:Identify and describe the applications of bio-fertilizers in improving soil health and crop production.

CO4:Demonstrate knowledge of organic manures including their preparation and usage for enhancing soil fertility.

CO5:Prepare vermicompost, vermiwash, panchgavya and jeevamruta assess their effects on seed germination.

**PO11.Value Inculcation and Environmental Awareness:**

CO1:Identify and describe the applications of bio-fertilizers in improving soil health and crop production.

CO6:Explain the principles of organic farming and its advantages in sustainable agriculture.



CO7:Apply theoretical knowledge by visiting bio-fertilizer units and compiling comprehensive reports on their observations.

**PO12. Autonomy, Responsibility, and Accountability:**

CO4: Demonstrate knowledge of organic manures including their preparation and usage for enhancing soil fertility.

CO5: Prepare vermicompost, vermiwash, panchgavya and jeevamruta assess their effects on seed germination.

**PO13. Community Engagement and Service:**

CO1. Identify and describe the applications of bio-fertilizers in improving soil health and crop production.

CO6. Explain the principles of organic farming and its advantages in sustainable agriculture.

CO7. Apply theoretical knowledge by visiting bio-fertilizer units and compiling comprehensive reports on their observations.

**Name of the Programme** : B. Sc. Botany  
**Programme Code** : USBT  
**Class** : S.Y. B. Sc.  
**Semester** : IV  
**Course Type** : Vocational skill course (Practical)  
**Course Code** : BOT-276-VSC  
**Course Title** : Herbal cosmetics  
**No. of Credits** : 02  
**No. of Teaching Hours** : 60

#### **A) Learning Objectives:**

8. To understand the Basics of Herbal Ingredients.
9. To study Formulation of Herbal Skin Care Products.
10. To learn various Extraction Techniques of crude drugs.
11. To study how to Assess Quality and Stability of Herbal Products.
12. To Evaluate the Efficacy of Herbal Cosmetics
13. To Develop Sustainable and Ethical Practices
14. To develop Eco-friendly and Sustainable herbal Products

#### **B) Course Outcome:**

By the end of the course, students will be able to:

- CO1.** Identify and describe various herbal ingredients commonly used in cosmetics, including their sources, properties, and benefits.
- CO2.** Gain hands-on experience in formulating basic herbal skincare products like creams, lotions, and face packs, understanding the role of each ingredient.
- CO3.** Demonstrate proficiency in different extraction techniques for active herbal ingredients, such as maceration, infusion, and distillation.
- CO4.** Develop the ability to assess the quality and stability of herbal cosmetics, including understanding factors that affect product shelf life.
- CO5.** Evaluate the efficacy of herbal cosmetics through practical testing methods, including user trials and laboratory analysis.
- CO6.** Understand and implement sustainable and ethical practices in sourcing, formulating, and packaging herbal cosmetics, promoting environmental and social responsibility.
- CO7.** Apply principles of sustainability in sourcing, formulating, and packaging herbal cosmetics, focusing on reducing environmental impact and promoting ethical practices.

#### **Practicals**

- |  |    |
|--|----|
| 1. Demonstration of various instruments used in herbal cosmetics industry.     | 2P |
| 2. Introduction to plants used in preparation of herbal cosmetics.             | 1P |
| 3. Study of extraction of essential oils.                                      | 1P |
| 4. Preparation of moisturizing cream using herbal extracts.                    | 1P |
| 5. Preparation of Ubtan using herbal ingredients.                              | 1P |
| 6. Preparation of herbal face mask.  | 1P |
| 7. Study of methods of qualitative analysis of herbal cosmetic products.       | 2P |
| 8. Preparation of <i>Hibiscus</i> and Curry leaves Hair oil.                   | 1P |
| 9. Preparation of soap using <i>Aloe vera</i> gel.                             | 1P |
| 10. Study of various methods used in storage and packaging of herbal products. | 2P |
| 11. Study of plants used in Aromatherapy.                                      | 1P |
| 12. Submission of any five herbal cosmetics.                                   | 1P |

## Mapping of Program Outcomes with Course Outcomes

**Class:** S.Y.B. Sc. (Sem. IV)

**Subject:** Botany

**Course:** Herbal cosmetics

**Course Code:** BOT -276-VSC

**Weightage:** 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

Course Outcomes	Programme Outcomes (POs)												
	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	P09	PO 10	PO 11	PO 12	PO 13
CO 1	3												
CO 2		2											
CO 3		3		3	3								
CO 4				3	3								
CO 5							3						
CO 6											3		
CO 7											3		

### Justification for the mapping

#### **PO1. Comprehensive Knowledge and Understanding.**

**CO1.** Identify and describe various herbal ingredients commonly used in cosmetics, including their sources, properties, and benefits.

#### **PO2. Practical, Professional, and Procedural Knowledge**

**CO2.** Gain hands-on experience in formulating basic herbal skincare products like creams, lotions, and face packs, understanding the role of each ingredient.

**CO3.** Demonstrate proficiency in different extraction techniques for active herbal ingredients, such as maceration, infusion, and distillation.

#### **PO4. Specialized Skills and Competencies**

**CO3.** Demonstrate proficiency in different extraction techniques for active herbal ingredients, such as maceration, infusion, and distillation.

**CO4.** Develop the ability to assess the quality and stability of herbal cosmetics, including understanding factors that affect product shelf life.

#### **PO5. Capacity for Application, Problem-Solving, and Analytical Reasoning**

**CO3.** Demonstrate proficiency in different extraction techniques for active herbal ingredients, such as maceration, infusion, and distillation.

**CO4.** Develop the ability to assess the quality and stability of herbal cosmetics, including understanding factors that affect product shelf life.

#### **PO7. Research-related Skills**

**CO5.** Evaluate the efficacy of herbal cosmetics through practical testing methods, including user trials and laboratory analysis.

#### **PO11. Value Inculcation and Environmental Awareness**

**CO6.** Understand and implement sustainable and ethical practices in sourcing, formulating, and packaging herbal cosmetics, promoting environmental and social responsibility.

**CO7.** Apply principles of sustainability in sourcing, formulating, and packaging herbal cosmetics, focusing on reducing environmental impact and promoting ethical practices.

**Name of the Programme** : B.Sc. Botany  
**Program Code** : USBT  
**Class** : S. Y. B. Sc.  
**Semester** : IV  
**Course Type** : Community Engagement Project - Practical  
**Course Code** : BOT-285-CEP  
**Course Title** : Community Engagement Project  
**No. of Credits** : 02  
**No. of Teaching Hours** : 60

### A) Learning Objectives:

1. To understand the role of botany in community development.
2. To identify local plant species and their significance in the community.
3. To develop skills in conducting botanical surveys and research.
4. To analyze the impact of plants on local ecosystems and communities.
5. To collaborate with community members on sustainable plant-based projects.
6. To promote awareness about the conservation of local flora.
7. To prepare a comprehensive report on the findings and outcomes of the project.

### B) Learning Outcomes:

By the end of the course, students will be able to:

- CO1.** Understand the role of botany in community development.  
**CO2.** Identify and document local plant species and their significance.  
**CO3.** Conduct botanical surveys and research within the community.  
**CO4.** Analyze and interpret the impact of plants on local ecosystems.  
**CO5.** Work collaboratively with the community on sustainable projects.  
**CO6.** Promote and educate others about the importance of conserving local flora.  
**CO7.** Prepare and present a detailed report on the community engagement project.

**Credit: 1** **(30L)**

Topic selection, Study design, Survey preparation, Field work, Analysis.

**Credit: 2** **(30L)**

Report writing and Oral presentation based on Community Engagement Project work.

Choice Based Credit System Syllabus (NEP Pattern)

### Mapping of Program Outcomes with Course Outcomes

**Class:** S. Y. B. Sc. (Sem. IV)

**Subject:** Botany

**Course:** Community Engagement Project-Practical

**Course Code:** BOT-285-CEP

**Weightage:** 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

Course Outcomes	Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO 1	03												03
CO 2				03							02		
CO 3		03					03						
CO 4	02				03								
CO 5			02			03							
CO 6						03					03		
CO 7								02	02			02	

## **Justification for the mapping**

### **PO.1 Comprehensive Knowledge and Understanding:**

CO1: Understand the role of botany in community development.

CO4: Analyze and interpret the impact of plants on local ecosystems.

### **PO2. Practical, Professional, and Procedural Knowledge:**

CO3: Conduct botanical surveys and research within the community.

### **PO3. Entrepreneurial Mindset and Knowledge:**

CO5: Work collaboratively with the community on sustainable projects.

### **PO4. Specialized Skills and Competencies:**

CO2: Identify and document local plant species and their significance.

### **PO5. Capacity for Application, Problem-Solving, and Analytical Reasoning:**

CO4: Analyze and interpret the impact of plants on local ecosystems.

### **PO6. Communication Skills and Collaboration:**

CO5: Work collaboratively with the community on sustainable projects.

### **PO7. Research-related Skills:**

CO3: Conduct botanical surveys and research within the community.

### **PO8. Learning How to Learn Skills:**

CO7: Prepare and present a detailed report on the community engagement project.

### **PO9. Digital and Technological Skills:**

CO7: Prepare and present a detailed report on the community engagement project.

### **PO11. Value Inculcation and Environmental Awareness:**

CO2: Identify and document local plant species and their significance.

CO6: Promote and educate others about the importance of conserving local flora.

### **PO12. Autonomy, Responsibility, and Accountability:**

CO7: Prepare and present a detailed report on the community engagement project.

### **PO13. Community Engagement and Service:**

CO1: Understand the role of botany in community development.

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(Empowered Autonomous)

**Standard Operating Protocols for Community Engagement Project (CEP)**  
**UG (Year-II Semester-IV)**

In NEP 2020 (2023 Pattern) we are offering to UG (Second Year -Fourth Semester) students **Community Engagement Project (CEP)** for **TWO (2)** credits i.e. **50 Marks**. The total time allocation for the student to carry out Community Engagement Project is **60 hours**. The actual field work should be carried out after college hours or on holidays.

**1. Community-Based Learning:**

Students should participate in community-based field projects under the supervision of faculty.

**2. Learning Hours Requirement:**

A minimum of 30 hours of learning per credit in a semester is required.

**3. Assignment of Project Topics:**

Project topics should be assigned to individual students or groups of students (2 or 3 students in one group; Commerce faculty can have 5 students per group). One faculty member from the department will act as a GUIDE for the student or group of students.

**4. Preparation of Questionnaire:**

Students should prepare a questionnaire (20-30 questions or more) related to their project topic in Marathi or English. If the project is related to work that does not involve SURVEY work, then the questionnaire part can be replaced accordingly.

**5. Finalization of Questionnaire:**

The departmental coordinator/guide should review and finalize the questionnaire. Questions that may create unnecessary complications should be avoided. The questions should be both qualitative and quantitative.

**6. Field Data Collection:**

Students should visit their chosen field with the questionnaire and collect information regarding the questions from the concerned people. Collect as much information as possible by gathering 25 or more questionnaires or related data. The more data collected, the better it will be for analysis.

**7. Data Compilation and Analysis:**

Students should compile all relevant data and carry out its analysis.

**8. Project Report Writing:**

Write a project report in the standard format (2 Copies): Index, Chapter-1, Chapter-2, ... Conclusion, References, etc. The report should clearly mention the OUTPUT derived from the study. The typed project report should have a minimum of 25 pages, with a font size of 12 and line spacing of 1.5.

**9. Submission of Project Report:**

Submit the project report with the Guide's signature to the department (to the Departmental CEP Coordinator).

**10. Oral Presentation:**

The department should arrange an oral presentation for all projects. To evaluate the project, TWO examiners should be appointed by the HoD (details about the appointment of examiners, weightage to internal and external marks, etc., will be provided by the examination section).

**11. Project Evaluation:**

The total project work, including preparation of the questionnaire to the oral presentation, should be evaluated for 2 credits (50 Marks). The details about the allocation of time, marks, and the scheme of examination for the Community Engagement Project are given in the Table. The departmental CEP coordinator/HoD should submit the marks as per the regular procedure to the examination section.

**12. Compulsory Subject:**

Since this is a compulsory subject in our syllabus, passing the Community Engagement Project is a MUST to complete the degree.

**Typical Time and marks allocation for the different stages of the Community Engagement Project is:**

<b>Step of Project</b>	<b>Individual students work in hours</b>	<b>Marks</b>
Topic Selection/ Study Design	5	5
Survey preparation / Fieldwork	25	20
Analysis	10	5
Report writing	20	10
Oral Presentation		10
<b>Total</b>	<b>60</b>	<b>50</b>