Karmaveer Bhaurao Patil University, Satara

Yashavantrao Chavan Institute of Science, Satara
(Autonomous)

Syllabus for
B. Sc. I (Botany)
As Per NEP-2020

w.e.f 2023 – 2024

Karmaveer Bhaurao Patil University, Satara

Yashavantrao Chavan Institute of Science, Satara (Autonomous)

Syllabus for Bachelor of Science (B. Sc.) Part - I

1. TITLE: Botany

2. YEAR OF IMPLEMENTATION: 2023 - 2024

3. PREAMBLE:

The B. Sc. Botany course under autonomy will be effective from the academic year 2023 - 2024. It has been prepared to keep in view the unique requirements of B. Sc. Botany students as per NEP-2020. The contents have been drawn up to accommodate the widening horizons of the discipline of biological sciences. The emphasis is to provide students with the latest information along with due weightage to the concepts of classical botany so that they can understand and appreciate the current interdisciplinary approaches in the study of plant sciences and their role in societal development. The course content also lists new practical exercises so the students get a hands-on experience with the latest techniques that are currently in use. The course will also inspire students to pursue higher studies in botany, for becoming an entrepreneur, and enable students to get employed in plant-based industries.

4. GENERAL OBJECTIVES OF THE COURSE:

i. To impart the knowledge of plant science is the basic objective of this course.

ii. To develop a scientific attitude among the students and to make the students open-minded, critical, and curious.

iii. To develop skills in practical work, experiments, and laboratory materials.

iv. To understand scientific terms, concepts, facts, phenomenon, and their relationships.

v. To make the students aware of natural resources and the environment.

vi. To enable the students to acquire knowledge of plants and related subjects to understand nature and the environment for the benefit of human beings.

vii. To develop the ability for the application of acquired knowledge to improve agriculture and related fields to make themselves self-reliant.

5. DURATION: 01 year

6. PATTERN: CBCS Semester

7. MEDIUM OF INSTRUCTION: English

8. STRUCTURE OF COURSE:

Course Structure as per NEP-2020

Level	Sem	Subject - 1 Major				Subject - 2 Minor		Subject - 3 GE / OE		VSEC		AEC, VEC, IKS			OJT, FP, CEP, CC, RP				Total	Non - CGPA
		DSC		DSE						VSC	SEC	AEC	IKS	VEC	CC	FP	CEP	OJT /Int/App/ RT		
		T	P	T	P	T	P	T	P											
4.5	I	4	2	---	---	4	2	4	2				2		2	---			22	
	II	4	2	---	---	4	2	4	2		2		---	2		---			22	DEGG
5	III	4	4	---	---	2	2			2	2	4	---	2					22	
	IV	4	4	---	---	2	2			2	2	4	---		2				22	
5.5	V	4	2	4	2	---	---	---		4			---		2	2	2		22	
	VI	4	2	4	2	---	---	---		2					2	2		4	22	IIC
6	VII	8	2	8		4	---	---		---		---	---			---			22	
	VIII	8	2	8		---	---	---		---		---	---			---		4	22	
Total		40	20	24	4	16	8	12		10	6	8	2	4	8	4	2	8	176	
		88				24		12		16		14			22					

1) **FIRST SEMESTER**

Sr. No.	Course Title	Theory					Practical	
		Course No. & Course Code	Title of Course	No. of lectures per week	Credits		No. of lectures Per week	Credits
1.	Botany (Major)	Course - I (BBT 111)	Diversity of Cryptogams	4	4	Practical Course – I (BBP 113)	4	2
		Course - II (BBT 112)	Economic Botany					
2.	Botany (Minor)	Course - I (BBT 114)	Industrial Botany	4	4	Practical Course – I (BBP 116)	4	2
		Course - II (BBT 115)	Landscape and Gardening					
3.	Generic Elective (For Botany Major Students)	Course - I	Business Organization and System	4	4	Practical Course - I	4	2
		Course - II	Business Communication Skills					
	Open Elective (For other faculty students)	Course- I (BBT 117)	Plant Nursery	4	4	Practical Course – I (BBP 119)	4	2
		Course- II (BBT 118)	Plant Nursery Management and Plant Propagation					
4.	IKS	Course – I (IKS 101)	Indian Agriculture	3	2	--	--	--
5	Cocurricular Course (CC)	(CC 102)			2	--	--	--

2) **SECOND SEMESTER**

Sr. No.	Course Title	Theory					Practical	
		Course No. & Course Code	Title of Course	No. of lectures per Week	Credits		No. of lectures Per week	Credits
1.	Botany (Major)	Course - III (BBT 121)	Diversity of Archegoniates	4	4	Practical Course – II (BBP 123)	4	2
		Course - IV (BBT 122)	Fundamentals of Plant Taxonomy					
2.	Botany (Minor)	Course - III (BBT 124)	Agri-tourism	4	4	Practical Course – II (BBP 126)	4	2
		Course- IV (BBT 125)	Mushroom Cultivation					
3.	Generic Elective (For Botany Major Students)	Course - III	Business Mathematics and Statistics	4	4	Practical Course - II	4	2
		Course - IV	Business Demography and Environmental Studies					
	Open Elective (For other faculty students)	Course- III (BBT 127)	Scope of Plant Nursery	4	4	Practical Course – II (BBP 129)	4	2
		Course- IV (BBT 128)	Advances in Nursery Techniques					
4.	SEC	Course - I (SEC 103)	Artificial Intelligence in Botany	3	2	--	--	--
5	VEC (Value Education Courses)	(VEC 104)	Digital Technology		2	--	--	--

2) Structure and titles of B. Sc. Course

B. Sc. I Semester I

Botany Major

Course I (BBT 111): Diversity of Cryptogams

Course II (BBT 112): Economic Botany

Practical Course – I (BBP 113): Practicals based on Theory Courses-I and II

Botany Minor

Course I (BBT 114) : Industrial Botany

Course II (BBT 115): Landscape & Gardening

Practical Course – I (BBP 116): Practicals based on Theory Courses-I and II

Generic Elective

Course I: Business Organization and System

Course II: Business Communication Skills

Practical Course -I: Practicals based on Theory Courses-I and II

Open Elective

Course I (BBT 117): Plant Nursery

Course II (BBT 118): Plant Nursery Management and Plant Propagation

Practical Course I (BBP 119) : Practicals based on Theory Courses-I and II

IKS (Indian Knowledge System)

Course I (IKS 101): Indian Agriculture

CC (Cocurricular Course) (CC 102)

B. Sc. I Semester II

Botany Major

Course III (BBT 121): Diversity of Archegoniates

Course IV (BBT 122): Fundamentals of Plant Taxonomy

Practical Course – II (BBP 123): Practicals based on Theory Courses-III and IV

Botany Minor

Course III (BBT 124) : Agri-tourism

Course IV (BBT 125) : Mushroom Technology

Practical Course –II (BBP 126) : Practicals based on Theory Courses-III and IV

Generic Elective

Course III: Business Mathematics and Statistics

Course IV: Business Demography and Environmental Studies

Practical Course II: Practicals based on Theory Courses-III and IV

Open Elective

Course III (BBT 127): Scope of Plant Nursery

Course IV (BBT 128) : Advances in Nursery Techniques

Practical Course – II (BBP 129) : Practical's based on Theory Courses-III and IV

SEC (Skill Enhancement Course)

Course - I (SEC 103): Artificial Intelligence in Botany

VEC (Value Education Courses) (VEC 104)**-**Digital Technology

3) OTHER FEATURES:

A) LIBRARY:

Reference books, Textbooks, journals, and Periodicals are available in Institute and Departmental Library. (Separate reference lists are attached along with the respective course syllabus)

B) EQUIPMENT:

a) Computer, LCD projector, visualizer, smart board

b) Laboratory Equipment:

1. Microscope with a digital camera
2. Hot Air Oven
3. Digital weighing balance
4. Incubator
5. pH meter
6. Refrigerator
6. Microtome
7. Autoclave

Karmaveer Bhaurao Patil University, Satara

Yashavantrao Chavan Institute of Science, Satara

Syllabus to be introduced from June 2023

Bachelor of Science (B. Sc.) Part - I

Botany (Major)

Semester-I

Course-I (BBT 111): Diversity of Cryptogams

Course Objectives: The students should be able to…….

1. understand knowledge of different plant groups.
2. gain the knowledge of the biodiversity of lower plant groups.
3. know importance of lower plant groups.
4. impart knowledge of opportunities for a career in the uses of lower plant groups.

Credits (02)	Course -I (BBT 111): Diversity of Cryptogams	No. of hours per unit
Unit I	**Introduction to the Plant Kingdom** 1.1 Evolutionary history of Plants, Evolutionary time scale 1.2 Systems of classification (Two, Three, and Five kingdom systems), General outline of the plant kingdom	07
Unit II	**Algae** 2.1 General Characters of Algae 2.2 Classification System of Algae (by G. M. Smith) 2.3 Economic Importance of Algae 2.4 Morphology and life cycles (excluding developmental stages) of *Nostoc* and *Spirogyra*	08
Unit III	**Fungi** 3.1 General Characters of Fungi 3.2 Classification System of Fungi (by G. C. Ainsworth) 3.3 Economic Importance of Fungi 3.4 Morphology and life cycle (excluding developmental stages) of *Mucor* and *Penicillium*	08
Unit IV	**Lichens** 4.1 General characters of Lichens 4.2 Types of Lichens based on thallus morphology	07

	4.3 Methods of Reproduction in Lichens 4.4 Economic Importance of Lichens	

Course Outcomes: The students will be able to….

1. explain the features and uses of lower cryptogams.
2. discuss concepts regarding lower cryptogams.
3. write answers and brief notes about the plant diversity of lower cryptogams.
4. seek career opportunities in academics, research, and entrepreneurship with respect to lower cryptogams.

References Books:

1. Vashishtha, B. R. and Sinha, A. K., Anil Kumar,2016, Botany for Degree Students- Fungi, S. Chand and Company, New Delhi.
2. Alexopoulus, C. J., Mims, C. W., and Blackwell, M., 2007, Introductory Mycology, 4th Edition Wiley India Pvt. Ltd, India.
3. Awasthi, D. D.,Bishen Singh and Mahindra Pal Singh, ,2000, A Handbook of Lichens Kolkata.
4. Gangulee, H. S. and Kar, A. K, 1992, College Botany Vol. I and II., New Central Book Agency (P) Ltd., New Delhi.
5. Sharma, O. P.,1992, Textbook of Thallophytes. , Tata Mc Graw Hill, New Delhi.
6. Sharma, P. D.,1991 The Fungi, Rastogi and Company, Meerut.
7. Kumar, H. D. ,1990, Introductory Phycology East Western Press, New Delhi.
8. Dube, H. C. Vikas, 1990, An Introduction to Fungi., Publishing House Pvt. Ltd., Delhi.
9. Sharma, O. P.,1989, Textbook of Fungi Tata Mc Graw Hill, New Delhi.
10. Smith, G. M.1971, Cryptogamic Botany, Vol. I Algae and Fungi, Tata McGraw Hill Publishing Co., New Delhi.
11. Ainsworth, G. C., Sussman, A. S and Sparrow, F. K. 1965, The Fungi- an advanced treatise, Vols. I-V. Academic Press, New York.

Botany (Major)

Course -II (BBT 112): Economic Botany

Course Objectives: The students should be able to…….

1. impart knowledge of plant biology and how humans use different plant structures.
2. understand the botanical aspects and origins of important food, medicinal, and economically important plants.
3. make the students knowledgeable about the importance of plants and their different roles.
4. empower the students with the ability to analyze the plant structures and interactions with hands-on field experiments.

Credits (02)	Course-II (BBT 112): Economic Botany	No. of hours per unit
Unit I	**Origin of Cultivated Plants**	**07**
	1.1 Introduction, Concept of Centers of Origin, and their Importance with Reference to Vavilov's Work 1.2 Examples of major plant introductions; Crop domestication and loss of genetic diversity; evolution of new crops/varieties, the importance of germplasm diversity	
Unit II	**Cereals, Legumes and Millets**	**08**
	2.1 Cereals: Origin, Botanical Name, Morphology, Sources, and Economic Importance of Rice and Wheat. 2.2 Legumes: Origin, Botanical Name, Morphology, Sources, and Economic Importance of Gram and Pigeon Pea. 2.3 Millets: Origin, Botanical Name, Morphology, Sources, and Economic Importance of Finger Millet and Foxtail Millet	
Unit III	**Oil-yielding Plants and Spices**	**08**
	3.1 Oils and Fats: Origin, Botanical Name, Morphology, Sources, and Economic Importance of Groundnut and Soybean. 3.2 Spices and Condiments: Origin, Botanical Name, Morphology, Sources, and Economic Importance of Ginger and Chilly	
Unit IV	**Beverages and Fibers**	**07**
	4.1 Beverages: Origin, Botanical Name, Morphology, Sources, and Economic Importance of Tea and coffee. 4.2 Fibre-yielding Plants: Origin, Botanical Name, Morphology, Sources, and Economic Importance of Cotton and *Agave*.	

Course Outcomes: The students will be able to….

1. get knowledge and understanding of the range of plant diversity in terms of function and environmental relationships.
2. carry out practical work, in the field and in the laboratory, with minimal risk.
3. get knowledge and understanding of current trends in economic botany.
4. think logically and organize tasks to transfer appropriate knowledge and methods in economic botany.

References Books:

1. Alphonse De Candolle, 2022, Origin of Cultivated Plants, Legare Street Press Publication
2. Susan Cho and Almeida N , 2017, Dietary Fiber and Health, CRC Press Publication (1st edition)
3. Levetin, E. and McMahon, K., 2016, Plants & Society, 7th Edition. McGraw-Hill, New York.
4. Kocchar, S.L.,2011, Economic Botany in Tropics, 4th Edition. Macmillan India Ltd., New Delhi.
5. Sharma, O.P.,1996, Economic Botany, Tata McGraw Hill Publishing Company Ltd., New Delhi.
6. Sambamurthy, A.V. and Subramanyam, N.S.,1989, A Textbook of Economic Botany., Wiley Eastern Ltd., New Delhi.
7. Simpson, B.B., 1986, Economic Botany - Plants in Our World. McGraw Hill, New York.

Botany (Major)

Practical Course-I (BBP 113)

Course Objectives: The students should be able to…….

1. learn and identify lower plant groups.
2. give practical knowledge to students about economic uses of plants.
3. participate students in experiential learning with these practicals.
4. enable students to think about novel uses of plants.

Credits (02)	**Practical Course-I (BBP 113) (Practicals based on Theory Courses-I and II)**	**No. of hours per unit/ credits 60 Hrs (4 Hrs /Practical)**
	1. Study of Microscope 2. Study of algae -*Nostoc.* 3. Study of algae -*Spirogyra.* 4. Study of fungi -*Mucor.* 5. Study of fungi -*Penicillium.* 6. Study of types of lichens (based on morphology). 7. Study of the botanical name, morphology, parts used, and economic importance of Wheat. 8. Study of the botanical name, morphology, parts used, and economic importance of Rice 9. Study of the botanical name, morphology, parts used, and economic importance of Gram and Pigeon pea. 10. Study of the botanical name, morphology, parts used, and economic importance of Finger millet and Foxtail millet 11. Study of the botanical name, morphology, parts used, and economic importance of Ginger, and Chilly. 12. Study of the botanical name, morphology, parts used, and economic importance of Tea, and Coffee.	

	13. Study of the botanical name, morphology, parts used, and economic importance of Groundnut and Soybean. 14. Study of the botanical name, morphology, parts used, and economic Importance of Cotton and *Agave*. 15. Field visit any suitable place	

Course Outcomes: The students will be able to…….

1. observe and describe general characters of lower plant groups through representative members.
2. recognize the members of lower plant groups and identify the plant parts.
3. identify the plants and relate their economic uses.
4. compare and predict novel economic uses of the plants.

Reference Books:

1. Bendre, A.,2010, Practical Botany, Rastogi Publications, Meerut.
2. Pande, B.P.,1979, Modern Practical Botany, Vol. II. , S. Chand Publishers, New Delhi.
3. Pande, B.P.,1979, Modern Practical Botany, Vol. I. , S. Chand Publishers, New Delhi.
4. Walllis, C. J.1966, Practical Botany for Advanced Level and Intermediate Students, 5th Edition. William Heinemann Medical Books Ltd.

Botany (Minor)

Course -I (BBT 114): Industrial Botany

Course Objectives: The students should be able to……..

1. impart the knowledge of the role of plants in human welfare.
2. make the students aware of the industrial applications of plant resources.
3. update the students about plant-dependent industries.
4. encourage students to think about entrepreneurship and start-ups.

Credits (02)	Course -I (BBT 114): Industrial Botany	No. of hours per unit
Unit I	**Utilization of Plants** 1.1 Plant resources utilization: Introduction, Food, fodder, fibers, medicines, timber, dyes, gum, tannins (Two examples of each resource) 1.2 Relevant industries associated with the above plant resources 1.3 Industrial Mycology: Important genera of fungi used in various industries and their products [*Penicillium*, *Aspergillus,* and *Saccharomyces* (yeast)] 1.4 Mushroom cultivation: Plant resources, cultivation practices of Oyster mushroom (*Pleurotus* sps.), uses of mushrooms, value-added products	**08**
Unit II	**Bio-Fertilizers and Bio-Control** 2.1 Biofertilizers: concept and need, Types of bio-fertilizers, Nitrogen fixing biofertilizer: *Azotobacter*, *Rhizobium*, BGA (*Nostoc*, *Anabaena*), *Azolla*, Phosphorus solubilizing bacteria and Mycorrhiza, Potash mobilizing bacteria. 2.2 Bio-control: Introduction, sources, and advantages 2.3 Important commercial products – Source, preparation, and uses of Pyrethrins, Azadiractin, *Trichoderma*, *Trichogramma*	**07**
Unit III	**Plant Pharmaceutical Industry** 3.1 Concept and advantages. 3.2 Types of pharmaceutical products: Churna, Asava, and Arishta, Drug plants with reference to the botanical source, active principles, and medicinal uses of *Adathoda zeylanica*, *Tinospora cordifolia,* and *Asparagus racemosus*.	**07**

	3.3 Manufacture of Churna (*Triphala churna*), Arishta (Ashokarishta), and Asava (Kumariasava). 3.4 Concept of nutraceuticals and cosmeceuticals. 3.5 Commercial significance of Amla and Aloe.	
Unit IV	**Horticulture Industry** 4.1 Horticulture Industry: Introduction, Branches of horticulture, Local, National, and overseas horticulture market. 4.2 Propagation methods: Seed propagation, Vegetative propagation – natural propagation and artificial propagation (Cutting: Stem; Layering: Air layering; Grafting: Stone grafting; Budding: T budding) 4.3 Greenhouse technology: Principle (site selection, structure material, covering material, temperature, and humidity control), the structure of greenhouse, Types of greenhouses	**08**

Course Outcomes: The students will be able to…….

1. know and analyze the role of plants in human welfare.
2. know the industrial applications of plant resources.
3. discuss ideas related to plant-based entrepreneurship and start-ups.

References Books:

1. Singh, R. and Singh, B. K.,2020, Textbook of Horticulture, New India Publishing Agency, New Delhi.
2. Singh, J., 2018, Fundamentals of Horticulture, Kalyani Publishers, New Delhi.
3. Deshmukh, L. P. ,2013, Medicinal Plants of India. , Oxford Book Co., New Delhi.
4. Kocchar, S.L., 2011, Economic Botany in Tropics, 4th Edition. Macmillan India Ltd., New Delhi.
5. Gupta, M.K.,2007, Handbook of organic farming and biofertilizers., ABD Publisher, Jaipur.
6. Drury, C. H.,2006, Ayurvedic Useful Plants in India Asiatic Publishing House, New Delhi.
7. Saman, B.C. and Sharma, V.P., 2005, Mushroom Cultivation, Processing and Uses., Agrobios, India.
8. Sadashivam, K., 2002, Biotechnology of biofertilizers., Springer Science and Business Media, India.
9. Nadkarni, K. M., 2002, Indian Materia Medica Vol. I and II. , Popular Prakashan, Mumbai.
10. Maheshwari, J. K. , Kunkel, G., Bhandari, M. M. and Duke, J. ,1993,Ethnobotany in India. , Scientific Publishers. Jodhpur, Rajasthan.
11. Simpson, B.B., Conner-Ogorzaly, M., 1986, Economic Botany - Plants in Our World. McGraw Hill, New York.

Botany (Minor)

Course-II (BBT 115): Landscape and Gardening

Course Objective: The students should be able to….

1.knowledge about the planning, design, implementation and management of the proposed scheme to bring functionality and beauty within a building using plants.

2.understand beautification of factories and industrial townships to create a better environment for living working, recreation and circulation.

Credits (02)	Course-II (BBT 115): Landscape and Gardening	No. of hours per unit
Unit I	**Planning** 1.1 Introduction of Landscape (Relation of a man with nature, ecology, landscape character & type of garden) 1.2 Design elements & Principles: Point, line, plane, mass, symmetry, rhythm, Balance, Texture, etc. attitude toward landscape 1.3 Garden furniture & ergonomics: feature in landscaping-Nature & artificial like fences, gates, Pathways, edging, gaze boos, barbeques, ornaments, bird features, Children's play equipment, rockeries, fountains, waterfalls, etc.) 1.4 Introduction of building material: Natural & artificial. 1.5 Preparing site: Groundwork, identifying soil, improving soil conditions, garden compost. 1.6 Garden plan-Reading & interpreting contours on the site plan	**08**
Unit II	**Graphics & Design** 2.1 Graphic material, process & communications, using graphical material, line work lettering, and orthographic, isometric views, understanding scales & proportions. 2.2 Interior landscape & Design symbols-sketching (freehand), rendering, using different media, symbolic presentation, sections, freehand views, etc. 2.3 Design composition & Presentations: Preparing presentation drawings etc. 2.4 Design ideas, solutions, and case studies 2.5 Residential design (designing landscape for a residential Purpose considering, existing features, land contours, owners' requirements, and climatology) 2.6 Commercial design	**07**

	2.7 shopping malls, industry images preferences	
Unit III	**Landscape Gardening**	**08**
	3.1 Definition, scope and objectives 3.2 Indoor Garden – Indoor plants, bottle garden, dish garden, hanging basket, Bonsai, Vertical Garden 3.3 Outdoor Garden – Lawns, Preparation of lawn, lawn types, Rockery, Terrace Garden, Water Garden, greenhouse, and polyhouse 3.4 Important Aesthetic Gardens of India: i) Mughal Garden, Delhi; ii) Vrindavan Garden, Mysore	
Unit IV	**Gardening Techniques**	**07**
	4.1 Plant variety, propagation & morphology & identification 4.2 Garden implements 4.3 Manures, Fertilizers, and Nutrients 4.4 Vegetable and Fruit Garden 4.5 Potted plant, Method, aftercare	

Course Outcomes: The students will be able to……..

1. design a landscape project and install landscape plants.
2. perform the Schedule a fertilization program.
3. demonstrate employability skills in the field of landscaping and horticulture.

References Books:

1. Halpin, A. M., 2004, Window Box Gardening, Rockport Publishers Inc., USA.
2. Kumar, N., 1997, Introduction to Horticulture Rajalakshmi Publications, Nagercoil.
3. Lancaster, P.,1997, Gardening in India, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
4. Khan, M.R., 1995, Horticulture and Gardening, Nirali Prakashan, Pune. India.
5. Mukhopadhyay G.S ,1986, A., Floriculture in India. Randhawa, Allied Publishers, New Delhi.
6. Jules, J., 1979, Horticultural Science, 3rd Edition, W. H. Freeman and Co., San Francisco, USA.
7. Hunter, M. K. and Hunter, E. H., 1978, The Indoor Garden John Wiley & Sons Inc., USA.
8. Gains, R. L. , 1977, Interior Plantscaping McGraw Hill Higher Education, USA.
9. Field and Xenia, 1965, Planning and Planting Designs of Home Gardens ICAR, New Delhi.
10. Edmond, J. B. , Musser, A. M., and Andrews, F. S.,1957, Fundamentals of Horticulture, McGraw Hill Book Co., New Delhi.

Botany (Minor)

Practical Course-I (BBP 116)

Course Objectives: The students should be able to…….

1. impart the knowledge of the role of plants in human welfare.
2. make the students aware of the industrial applications of plant resources.
3. update the students about designs in landscape and gardening.
4. encourage students to think about entrepreneurship and start-ups.

Credits (02)	**Practical Course-I (BBP 116) (Practicals based on Theory Courses-I and II)**	**No. of hours per unit/ credits** **60 hrs (4 Hrs /Practical)**
	1. Study of plant resources in industries: medicine, timber, and gum (Two examples of each) 2. Study of plant resources in industries: food, fodder, fiber (Two examples of each) 3. Cultivation of *Oyster* mushroom: Demonstration of various stages 4. Study of types of Bio-fertilizers: *Rhizobium*, *Azotobacter*, BGA, *Azolla* 5. Study of vegetative plant propagation: corms, suckers, and runners. 6. Study of vegetative plant propagation: tubers, bulbs, rhizomes, 7. Study of artificial plant propagation: stem cutting, Air Layering. 8. Study of artificial plant propagation: Approach grafting, and T-budding. 9. Preparation of garden plan including Estimating & Costing of the garden, Graphic material & Design. 10. Identification of tools and implements used in landscape gardening. 11. Identification of plants and processes of manure application. 12. Plant preparation; soil leaching-potting, cleaning, pest	

	prevention measures. 13. Study of training (Bonsai preparation/ Hanging basket/ Bottle Garden/ Rockery) and pruning techniques used for ornamental plants. 14. Study of lawn preparation and its maintenance. 15. Field Visit to any local garden.	

Course Outcome: The students will be able to…….

1. formulate and compare plant-based products and synthetic products.
2. propagate horticultural plants using different techniques.
3. gain basic knowledge of landscape gardening and preparation of garden plans.
4. understand knowledge about estimating & costing of garden.

Reference Books:

1. Matthews Jackie , 2017, Practical Gardening: Techniques, Plants, Planning, Design, Lorenz Books.
2. Batth A S, 2016, Home Gardeners' Guide Indian Garden Flowers, Fingerprint! Publishing.
3. Franklin R E , 2015, Hand Book of Practical Landscape Gardening, Palala Press.
4. Drury, C. H. 2006, Ayurvedic Useful Plants in India, Asiatic Publishing House, New Delhi.
5. Sadashivam, K. 2002, Biotechnology of biofertilizers Springer Science and Business Media, India.
6. Lancaster, P., 1997, Gardening in India , Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
7. Simpson, B.B., 1986, Economic Botany - Plants in Our World Conner-Ogorzaly, M., McGraw Hill, New York.

Botany (OE) (Open Elective)

Course-I (BBT 117): Plant Nursery

Course Objectives: The students should be able to….

1. introduce students to the concept and importance of plant nurseries.
2. explain the basic material, tools, and techniques required to establish a plant nursery.
3. demonstrate various practices followed in plant nurseries.
4. comprehend knowledge and skills required for plant nurseries.

Credits (02)	Course-I (BBT 117): Plant Nursery	No. of hours per unit
Unit-I	**Introduction to the Plant nursery** 1.1 Introduction to the nursery industry, nursery techniques, Importance and Drainage management. 1.2 Types of nurseries 1.3 Nursery standards 1.4 Establishment of Nursery: Selection of site and location, Design, Irrigation	**07**
Unit-II	**Requirements of Plant nursery** 2.1 Nursery beds: types and precautions taken during bed preparations 2.2 Nursery tools, implements and containers for seedlings 2.3 Seeds and other vegetative material required 2.4 Watering, weeding, and nutrients 2.5 Seasonal activities and routine operations in plant nursery	**08**
Unit-III	**Soil and Media for nursery plants** 3.1 Soil and soil factors (pH, Nutrition) 3.2 Growth media and potting mixers 3.3 Transplanting, Potting, pruning, and in ground production	**08**
Unit-IV	**Nursery Registration and Entrepreneurship Development** 4.1 Registration of Nursery 4.2 Accreditation of Nursery 4.3 Certification of Nursery	**07**

	4.4 Government Policies for Nursery Development	

Course Outcomes: The students will be able to……

1. categories the requirements to establish plant nursery
2. design plant nursery
3. demonstrate different techniques required in plant nursery
4. perform routine practices to maintain plant nursery

References Books:

1. Priya Lokare , 2022, Plant Nursery Development & Management, Notion Press Publication (1st edition).
2. Bailey I H ,2021, The Nursery-book, Legare Street Press Publication.
3. Krishnan, P. R., Kalia, R. K., Tewari, J. C., and Roy, M. M. ,2014, Plant nursery management: principles and practices., Central Arid Zone Research Institute, Jodhpur.
4. Ray, P.K. 2012, Plant Nursery Management: How to Start and Operate a Plant Nursery. , Scientific Publishers, Jodhpur.
5. Hartmann, H.T., Kester D. E., Davis, F. T., and Geneve, R. L. 2010, Plant Propagation: Principles and practices (8^{th} Edition). , Pearson Education Limited, England.
6. Mason, J. 2004, Nursery management, Landlinks Press, Australia
7. Dole J M and Wilkins H F., 1998, Floriculture: Principles and Species , Pearson Publication

Botany (OE) (Open Elective)

Course-II (BBT 118) Plant Nursery Management and Plant Propagation

Course Objectives: The students should be able to……..

1. introduce students to the different plant propagation methods.
2. explain the basic material, tools, and techniques required to establish a plant nursery.
3. demonstrate various practices followed in plant nurseries.
4. comprehend knowledge and skills required for plant nurseries.

Credits (02)	Course-II (BBT 118) Plant Nursery Management and Plant Propagation	No. of hours per unit
Unit I	**Disease and pest management** 1.1 Different diseases of nursery plants 1.2 Different pest infections faced by nursery plants 1.3 Factors affecting nursery establishment	07
Unit II	**Vegetative propagation** 2.1 Vegetative Propagation through layering 2.2 Vegetative Propagation through cutting 2.3 Vegetative Propagation through budding 2.4 Vegetative Propagation through grafting	08
Unit III	**Vegetative propagation by specialized structures** 3.1 Propagation by bulb 3.2 Propagation by corm 3.3 Propagation by rhizome 3.4 Propagation by tuber 3.5 Propagation by off-set	08
Unit IV	**Plant growth regulators** 4.1 Definition of growth regulators 4.2 Types of growth regulators 4.3 Use of growth regulators in plant nurseries	07

Course Outcomes: The students will be able to……

1. identify different diseases and pests in plant nurseries
2. perform nursery plants propagation by vegetative methods
3. use different specialized structures for vegetative propagation of nursery plants

4. employ various plant regulators in nurseries

References Books:

1. Bal J S , 2020, Plant Growth Regulators in Fruit Science, Kalyani Publishers(1st Edition)
2. Carlos T L ,2017, Plant Growth Regulators, Arcler Education Inc Publication
3. Ratha Krishnan, M.,2014, Plant nursery management: Principles and practices., Central Arid Zone Research Institute (ICAR), Jodhpur
4. Kumar, N.1997, Introduction to Horticulture Rajalakshmi Publications, Nagercoil.
5. Mishra, K., and Mishra, N. K., 1994, Plant Propagation., Chand, S. John Wiley & Sons, New Jersey.
6. W. Godfrey-Sam-Aggrey and Norman J. C.1996, Handbook of Common Vegetative Propagation Methods for Fruit Crops and Ornamental Plants, Vantage Publication
7. De.L.C. 2018, Insect Pests, Diseases & Post-Harvest Management of Horticultural Crops, Pointer Publishers, Jaipur

Botany (OE) (Open Elective)

Practical Course -I (BBP 119)

Course Objectives: The students should be able to……..

1. introduce students to the different plant propagation methods.
2. explain the basic material, tools, and techniques required to establish a plant nursery.
3. demonstrate various practices followed in plant nurseries.
4. comprehend knowledge and skills required for plant nurseries.

Credits (02)	**Practical Course-I (BBP 119) (Practicals based on Course-I and II)**	**No. of hours per unit/ credits 60Hrs. (4Hrs/ Practical)**
	1. Demonstration of nursery bed preparation. 2. Demonstration of nursery media preparation. 3. Study of nursery tools. 4. Study of budding techniques. 5. Study of layering techniques. 6. Study of cutting techniques 7. Study of grafting techniques 8. Study of propagation of succulents. 9. Study of potting technique. 10. Study of soil pH of different soil types used in nursery. 11. Study of water holding capacity of different soil types used in nursery. 12. Study of application of different nutrients used in nursery. 13. Study of growth regulators in plant nurseries 14. Study of Growth media and potting mixers 15. Visit to any local plant nursery and report submission.	

Course Outcomes: The students will be able to……

1. demonstrate different techniques required in plant nursery.
2. perform routine practices to maintain plant nursery.
3. use different specialized structures for vegetative propagation of nursery plants
4. employ various plant regulators in nurseries

References Books:

1. May Alsisto Castillo ,2022, Plant Propagation 101: A Practical Guide in Plant Propagation, Poetry Planet Book Publishing House, United Kingdom.
2. Mary Hansen, 2022, Handbook of Insect, Pest and Disease Management, Bookfort
3. Ray, P.K.,2012, Plant Nursery Management: How to Start and Operate a Plant Nursery. Scientific Publishers, Jodhpur.
4. Mason, J. 2004, Nursery management Landlinks Press, Australia. (2004).
5. Kumar, N., 1997 Introduction to Horticulture, Rajalakshmi Publications, Nagercoil
6. Mishra, K. and Mishra, N. K., 1994, Plant Propagation, Chand, S. John Wiley & Sons, New Jersey.

Botany (IKS) (Indian Knowledge System)

Course-I (IKS 101): Indian Agriculture

Course Objectives: The students should be able to…….

1. impart knowledge of traditional agricultural practices followed in India.
2. develop awareness about the glorious history of Indian agriculture.
3. make the students knowledgeable about ancient agricultural techniques.
4. empower the students with the ability to compare ancient, medieval, and modern agriculture trends.

Credit (02)	Course-I (IKS 101): Indian Agriculture	No. of hours per unit
Unit-I:	**History of Indian Agriculture** 1.1 Introduction and importance of Agriculture in India 1.2 History of Indian agriculture: The significance of agriculture and irrigation as emphasized in the Indian Mythological texts like Ramayana, Mahabharata and other. Mention of Indian agriculture by Greek historians and later travelers.	**(5)**
Unit-II	**Ancient Irrigation Techniques** 2.1 Significance of Agriculture and irrigation for the Kings of Indian tradition. 2.2 Major water bodies of ancient times. The Ery system of south India.	**(5)**
Unit-III	**Indian Agriculture Technologies** 3.1 Excellence of Indian agricultural technologies as observed by more recent European observers. 3.2 Productivity of Indian agriculture in medieval Thanjavur and eighteenth-century Allahabad, Chengalpattu, etc.	**(5)**
Unit-IV	**Agriculture and Indian Society** 4.1 Indian attitude towards agriculture in ancient times. 4.2 Indian attitude towards agriculture in medieval times. 4.3 Indian attitude towards agriculture in modern times.	**(5)**

Course Outcomes: The students will be able to……..

1. discuss about ancient Indian agriculture and compare the different ancient agriculture traditions with the current scenario.
2. explain the irrigation techniques in India and demonstrate the various irrigation techniques followed in India.

3. evaluate the effectiveness of different agriculture technologies implemented in India.
4. compare the Indian attitude towards agriculture during the history of India.

References Books:

1. Basu, R. N., Bose, T. K., and Chakraborty, C. S.,2017, History of Science in India - Agricultural Science (Volume V). , The National Academy of Science, India (NASI) & The Ramakrishna Mission Institute of Culture, India.
2. Bunce, F. W. D. K. 2013, The Iconography of Water: Well and Tank Forms of the Indian Subcontinent., Printworld Pvt. Ltd., New Delhi.
3. Bhadani, B. L.2012, Water Harvesting, Conservation and Irrigation in Mewar (AD 800-1700). ,Manohar Publishers & Distributors, New Delhi.
4. Chakravarty, K. K., Badam, G. L. and Paranjpye, V.,2006, Traditional Water Management Systems of India, Aryan Books International, New Delhi.
5. Lokopakara (For the Benefit of People) - An Ancient Text on Indian Agriculture Ayangarya, V. S. Asian Agri-History Foundation, India. (2006).
6. Mukundan, T. M., 2005, The Ery Systems of South India. ,Akash Ganga Trust, Chennai.
7. Agarwal, A., Narain, S., Dying Wisdom: Rise, Fall and Potential of India Traditional Water-Harvesting Systems, Centre for Science and Environment, New Delhi. (1997).
8. Srinivasan, T. M.,1991, Irrigation and Water Supply: South India, 200 BC to 1600 AD. , South Asia Books, Hyderabad.

Bachelor of Science (B. Sc.) Part - I:

Botany (Major)

Semester II

Course-III (BBT 121): Diversity of Archegoniate

Course Objectives: The students should be able to…….

1. make the students aware of the higher plants and their evolution.
2. impart the knowledge and importance of fossil plants.
3. make the students aware of the economic importance of archegoniate.

Credits (02)	Course-III (BBT 121) Diversity of Archegoniate	No. of hours per unit
Unit I	**Bryophytes** 1.1 General characters of Bryophytes 1.2 Classification System in Bryophytes (by G. M. Smith) 1.3 Alteration of Generation 1.4 Economic importance of Bryophytes 1.5 Morphology, anatomy, and life cycle (excluding developmental stages) of *Riccia* and *Funaria*	07
Unit II	**Pteridophytes** 2.1 General characters of Pteridophytes 2.2 Classification system in Pteridophytes (by G. M. Smith) 2.3 Economic importance of Pteridophytes 2.4 Morphology, anatomy, and life cycles (excluding developmental stages) of Lycopsida - *Selaginella*, Pteropsida - *Pteris* 2.5 Heterospory and seed habit	08
Unit III	**Gymnosperms** 3.1 General characters of Gymnosperms 3.2 Classification system in Gymnosperms (by Sporne)	08

	3.3 Economic importance of Gymnosperms 3.4 Morphology, anatomy, and life cycle (excluding developmental stages) of Cycadopsida- *Cycas* (primitive) and Gnetopsida - *Gnetum* (advanced)	
Unit IV	**Palaeobotany** 4.1 Introduction to Palaeobotany 4.2 Geological time scale 4.3 Fossil formation process 4.4 Types of fossils - Compression, Impression, Petrification, Pith Cast, Coal balls	**07**

Course Outcomes: The students will be able to……..

1. explain the features and uses of vascular plants.
2. define concepts regarding vascular plants and fossils.
3. write answers and brief notes about plant diversity of vascular plants.

References Books:

1. Sporne, K. R. 2018, Morphology of Pteridophytes ,Creative Media partners Ltd, USA.
2. Arnold, C. A. 2008, An Introduction to Palaeobotany., Read Books, England.
3. Parihar, N. S. 1996, The Biology and Morphology of Pteridophytes. , Central Book Publishers, Allahabad.
4. Vashishtha, P. C. , 1993, Pteridophyta - Vascular Cryptogams. , S. Chand and Company, New Delhi.
5. Stewart, W. N., 1983, Paleobotany and the evolution of plants. , Cambridge University Press, USA.
6. Vashishtha, P. C., 1976, Botany for Degree Students - The Gymnosperms. ,S. Chand and Company, New Delhi.
7. Parihar, N. S. 1972, An Introduction to Embryophyta: Vol. I Bryophyta. , Central Book Depot, Allahabad.
8. Andrews, H. N., 1967, Studies in Palaeobotany. ,John Wiley and Sons, London.
9. Sporne, K. R., 1965, Morphology of Gymnosperms. , Hutchinson Publishers, London.

Botany (Major)

Course-IV (BBT 122): Fundamentals of Plant Taxonomy

Course Objectives: The students should be able to……

1. demonstrate to the student how to recognize and identify the common vascular plants.
2. acquaint the student with the principles, methods, and history of plant taxonomy.
3. understand the various aspects of plant nomenclature and classification.
4. develop in the student an appreciation of the scientific and aesthetic values of plants in the local flora.

Credits (02)	Course-IV (BBT- 122) Fundamentals of Plant Taxonomy	No. of hours per unit
Unit-I	**Introductory Taxonomy** 1.1 Introduction, Importance of Taxonomy 1.2 Functions of Taxonomy: Identification, Nomenclature, Classification 1.3 Ranks, Categories, and Taxonomic Groups	**07**
Unit-II	**Botanical Nomenclature** 2.1 Principles and rules (ICN); Salient features of International Code of Botanical Nomenclature (ICBN) 2.2 Binominal system, Typification, Author citation, Valid publication, Rejection of names, the principle of priority, and its limitations.	**08**
Unit-III	**Tools for Taxonomic Studies** 3.1 Herbarium: Introduction, Role, and Significance. 3.2 Botanical Gardens: Introduction, Role, and Significance. Study of A. J. C. Bose Botanical Garden, Howrah; Lead Botanical Garden, Shivaji University, Kolhapur. 3.3 Taxonomic literature – Flora, Monograph	**08**
Unit -IV	**Systems of Classification of Angiosperms** 4.1 General characters; Life cycle pattern in angiosperms 4.2 Systems of Classifications: Natural, Artificial, and Phylogenetic 4.3 Bentham and Hooker's System of Classification (up to Series); Engler and Prantl System of Classification (up to Series)	**07**

Course Outcomes: The students will be able to……

1. employ diverse taxonomic resources for plant identification, including electronic and print media, reference materials, and herbarium collections.
2. understand plant morphological terminology and use it accurately in the description.
3. recognize ecologically and economically important plant species by sight.
4. discuss current questions in plant evolution and classification

References Books:

1. Patil, D. A.,2021, Plant Taxonomy: Theory, Principles & Practices., Scientific Publishers, Jodhpur
2. Sharma, O. P.,2017, Plant Taxonomy, 2nd Edition. Tata McGraw-Hill Publication Com. Ltd. New Delhi.
3. Singh, G., 2004, Plant Systematics: An Integrated Approach. Science Publishers Inc.
4. Pandey, B.P. 2001, A Textbook of Botany: Angiosperms. , S. Chand Publications, New Delhi.
5. Manilal, K.S. and Muktesh Kumar, M.S.,1998, A Handbook of Taxonomic Training., DST, New Delhi.
6. Naik, V.N., 1984, Taxonomy of Angiosperms. , Tata McGraw-Hill Publication Com. Ltd. New Delhi

Botany (Major)

Practical Course-II (BBP 123)

Course Objectives: The students should be able to……..

1. give practical knowledge to students about the identification of members of archegoniatae around them.

2. give practical knowledge to students about fossil plants and the plants around them.

2. give practical knowledge about morphological and anatomical variations in plants

4. give practical knowledge about use of taxonomic literature and preservation of plants.

Credits (02)	**Practical Course-II (BBP 123)** **Practicals based on Theory Course-III and IV**	**No. of hours per unit/ credits 60 Hrs. (4 Hrs / practical)**
	1. Study of Bryophytes through representative members *Riccia* 2. Study of Bryophytes through representative members *Funaria* 3. Study of Pteridophytes through representative members *Selaginella* 4. Study of Pteridophytes through representative members *Pteris.* 5. Study of Gymnosperms through representative members *Gnetum.* 6. Study of Gymnosperms through representative members *Cycas.* 7. Study of types of fossils (Compression, Impression, Petrification, Cast, and Coal Balls). 8. Study of flowering twig morphology - Vegetative characters. 9. Study of flowering twig morphology - Floral/reproductive characters. 10. Preparation of botanical key using vegetative characters. 11. Preparation of botanical key using reproductive characters.	

	12. Study of preparation of herbarium. 13. Study of use of flora for identification of plants. 14. Visit to botanical garden. 15. Field visit.	

Course Outcome: The students will be able to……

1. identify general characteristics of Archegoniate through representative members.
2. identify the fossil types.
3. describe the plants around them.
4. use taxonomic literature for angiosperm plant identification.

Reference Books:

1. Bendre, A.,2010, Practical Botany. Rastogi Publications, Meerut.
2. Pande, B.P., 1979, Modern Practical Botany, Vol. I. , S. Chand Publishers, New Delhi.
3. Pande, B.P., 1979, Modern Practical Botany, Vol. II. , S. Chand Publishers, New Delhi
4. Walllis, C. J. , 1966, Practical Botany for Advanced Level and Intermediate Students, 5th Edition. William Heinemann Medical Books Ltd.

Botany (Minor)

Course-III (BBT 124): Agri-tourism

Course Objectives: The students should be able to…….

1. introduce the students to the basic concepts and significance of Agri-Tourism.
2. aware students of different perspectives of Agri-Tourism.
3. understand the role of value-added products in both tourism and agricultural products.
4. identify multiple career opportunities in these fields.

Credits (02)	Course-III (BBT 124) Agri-tourism	No. of hours per unit
Unit-I	**Introduction to Agri-tourism** 1.1 Concept of agri-tourism-definition, nature and scope of agri tourism. 1.2 Needs and opportunities of agri-tourism. 1.3 Agri-Tourism and Traditional Tourism. 1.4 Types of Agri-tourism	08
Unit-II	**Factors affecting agri-tourism** 2.1 Location for agri-tourism centre. 2.2 Geographical factors: relief, climate, drainage pattern, soil. 2.3 Socio-economic factors: Capital, transportation facilities, market, and holding of farmers, tradition, cropping pattern.	07
Unit-III	**Establishment of Agri-tourism Centre** 3.1 Enlisting and Understanding Daily activities in the agriculture farm/Agri-Tourism centers like. i. Animal Feeding, Guided field visits and tour, Watching domestic animals, Harvest Festival. 3.2 Rural Festival/Jatra, Farmer's markets, Milking the Cow and Buffalos, Religious Temple visits. 3.3 Swimming at well, ponds, or river, fishing, Local site seeing 3.4 Rural games to be demonstrated and played- Bullock cart, Bicycle, Tractor rides. Vittidandu, Surparambhya, Kabaddi, Langadi, Kho-Kho, Bullock ploughing, Lagore & Gallori. 3.5 Arranged adventure Activities like mountaineering, trekking, river crossing, cycling etc.	08
	Concerns of Agri-tourism	

Unit-IV	4.1 Who Can Start Agri-Tourism Centers. 4.2 Requirements for Agri-Tourism Centers- Infrastructure Facilities, livestock, Recreation facilities, 4.3 Agri-tourism policies. 4.4 Benefits of Agri-Tourism Centers. 4.5 Problems of the Agri-Tourism centers.	**07**

Course Outcomes: The students will be able to……..

1. define agri-tourism and food tourism and articulate the latest trends and changing demographics.
2. discuss interdisciplinary academic approaches, theories, and critical lenses on tourism.
3. explain the regulations, impediments, key organizations, and partnerships required for small scale farmers to get involved with tourism opportunities.
4. identify multiple career opportunities in Tourism and Agri-Tourism.

References Books:

1. Bhatia, A. K. 2012, Travel Agency and Tour Operations. , Sterling Publications, New Delhi.
2. Goeldner, C. R. and Brent Ritchie, B. J., 2011, Tourism: Practices, Principles and Philosophies. , John Wiley and Sons, London.
3. Roday, S., Biwal, A. and Joshi. V. 2009, Tourism Operations and Management., Oxford University Press, New Delhi.
4. Reeder D. M., and R. J. USDA, 2007, Farm-Based Recreation: A Statistical Profile Brown, Economic Research Service, USA.
5. Holloway, J.C. 2002, The Business of Tourism. Prentice Hall, London.
6. Dev, M. S.,1996, Agricultural Policy Framework for Maharashtra: Issues and Options. , Proceeding/Project Report No. 21, July 1996, Indira Gandhi Institute of Development Research, Mumbai.
7. Agri-Tourism: Innovative Supplementary Income Generating Activity for Enterprising Farmers. Taware, P. https://www.agritourism.in/

Botany (Minor)

Course-IV (BBT 125): Mushroom Technology

Course Objectives: The students should be able to……

1. enable the students to identify edible and poisonous mushrooms
2. provide hands-on training for the preparation of beds for mushroom cultivation and spawn production

Credits (02)	Course-IV (BBT 125) Mushroom Technology	No. of hours per unit
Unit I	**Introduction to Mushrooms** 1.1 Introduction, history, and importance of mushrooms, mushroom morphology 1.2 Mushroom Types: edible and poisonous mushrooms 1.3 Nutrient profile of mushrooms 1.4 Health Benefits of Mushrooms 1.5 Present Scenario and prospects for Mushroom Cultivation	07
Unit II	**Common edible Mushrooms** 2.1 General morphology, distinguishing characteristics, spore germination and life cycle of button mushroom, straw mushroom, and oyster mushroom 2.2 Other economically important and medicinal mushrooms- Shiitake Mushroom (Lentinula edodes), Kabul Dhingri (King Oyster) Mushroom	08
Unit III	**Commercial cultivation of Mushrooms** 3.1 Cultivation technology: Infrastructure and requirement 3.2 Preparation of spawn substrate, preparation of pure culture and culture maintenance, storage of spawn 3.3 Cultivation of commercially important Mushrooms – Paddy straw mushroom, Wheat Straw Mushroom (Oyster Mushroom), Button Mushroom	08
Unit IV	**Harvesting, Pest management, and post-harvest processing of Mushrooms** 4.1 Harvesting: sanitation during harvesting; the process of harvesting; post-harvest processing 4.2 Storage: long term and short-term storage of mushroom	07

	4.3 Diseases and pests: Dry Bubble and wet bubble- Major diseases of cultivated mushroom; Major insect pest's Mushroom flies / nematodes/mites 4.4 Post-harvest processing**:** Value-added products/recipes, Quality assurance, Packing and packaging, Market opportunities.	

Course Outcomes: The students will be able to…….

1. identify edible and poisonous types of mushrooms
2. understand the life cycle of mushrooms
3. commercially cultivate mushrooms
4. harvest, process, and sell mushrooms and their products

References Books:

1. Pinkerton, M. H.,2013, Commercial Mushroom Growing. , British Library Cataloging-in-publication.
2. Pathak, V. N. and Yadav, N. 2010, Mushroom Production and Processing Technology., Agrobios, Jodhpur, India.
3. Ahlawat, O. P. and Tewari, R. P., 2007, Cultivation technology of Paddy straw mushrooms., National Research Centre for Mushroom (ICAR), Chambaghat, Solan, India.
4. Gogoi, R., Rathaiah, Y. and Borah, T. R. ,2006 Mushroom cultivation technology., Scientific Publishers, Jodhpur, India.
5. Nita, B.,2000, Handbook of Mushrooms. Vol 1 & 2., Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
6. Pandey, B. P. 1996, A textbook of fungi., S. Chand and Company, New Delhi.

Botany (Minor)

Practical Course-II (BBP 126)

Course Objectives: The students should be able to……..

1. augment participants' knowledge of Agri-tourism and create economic opportunities.
2. provide students with knowledge of the tools and techniques for Agri-tourism.
3. learning cultivation of different edible mushrooms.
4. acquaintance with climatic requirements of mushroom cultivation.

Credits (02)	**Practical Course-II (BBP 126)** **Practicals based on Theory Course-III and IV**	**No. of hours per unit/ credits 60 Hrs (4 Hrs /Practical)**
	1. List out the main content of the packages tour – Report. 2. Prepare a model package tour of your own – Report. 3. Draw chart with comparative statements of all components involved in tour package costing and pricing – Report 4. Agri-tourism business plan development and design. 5. Case study of Agri-tourism in the nearby area. 6. Different parts of a typical mushroom & variations in mushroom morphology. 7. Sterilization of glassware, equipment, and culture media used in mushroom cultivation. 8. Preparation of culture media: Potato Dextrose medium. 9. Preparation of spawn, compost, and known compost formulations. 10. Mushroom bed preparation - paddy straw, sugarcane trash, maize straw. 11. Cultivation of White button mushroom 12. Cultivation of Paddy straw mushroom 13. Cultivation of Oyster mushroom.	

	14-15. Visit to mushroom cultivation unit and submission of report	

Course Outcome: The students will be able to…….

1. define agro-tourism and food tourism and articulate the latest trends and changing demographics.
2. discuss interdisciplinary academic approaches, theories, and critical lenses on tourism.
3. start small scale industry of Mushroom cultivation.
4. learned the prospects and scope of mushroom cultivation in small scale industry.

Reference Books:

1. Pinkerton, M. H. 2013, Commercial Mushroom Growing. , British Library Cataloging-in-publication.
2. Goeldner, C. R., Brent Ritchie, B. J., 2011, Tourism: Practices, Principles and Philosophies. , John Wiley and Sons, London.
3. Pathak, V. N and Yadav, N.,2010, Mushroom Production and Processing Technology. , Agrobios, Jodhpur, India.
4. Roday, S., Biwal, A. and Joshi. V. 2009, Tourism Operations and Management. ,Oxford University Press, New Delhi.
5. Ahlawat, O. P., 2007, Tewari, R. P., Cultivation technology of Paddy straw mushrooms. , National Research Centre for Mushroom (ICAR), Chambaghat, Solan, India.
6. Gogoi, R., Rathaiah, Y. and Borah, T. R., 2006, Mushroom cultivation technology. , Scientific Publishers, Jodhpur, India.
7. Holloway, J.C. 2002, The Business of Tourism. ,Prentice Hall, London.

Botany (OE) (Open Elective)

Course-III (BBT 127) : Scope of Plant Nursery

Course Objectives: The students should be able to…….

1. introduce the students to the scope of plant nursery.
2. explain the economically important nursery plants.
3. demonstrate preparation of land as well as cultivation of various kinds of plants.
4. comprehend knowledge and skills of ornamental and medicinal plants.

Credits (02)	Course-III (BBT 127): Scope of Plant Nursery	No. of hours per unit
Unit-I	**Olericulture**	07
	1.1 Definition, objectives, and Importance of Olericulture. 1.2 Cultivation and management of onion, ginger, garlic, brinjal, tomato, okra, capsicum, chilly, and cauliflower (any four). 1.3 Processing of olericulture produce, Transportation, and marketing of olericulture produce.	
Unit-II	**Pomiculture**	08
	2.1 Definition, objectives, and importance of pomiculture, National and International Status of pomiculture. 2.2 Principles of pomiculture, basic requirements for practicing pomiculture (land, equipment, seeds, post-harvest storage) 2.3 Cultivation and management of banana, chickoo, mango, strawberry, grapes, pomegranate, dragon fruit, raspberry, custard apple, amla (any four)	
Unit-III	**Types of Gardens**	08
	3.1 Concept of special types of gardens vertical garden, roof garden, rock garden, clock garden. 3.2 Garden plant components, arboretum, shrubbery, fernery, palmatum, arches and pergolas, edges and hedges, succulents, flower borders and beds. 3.3 Lawns: Establishment, and Maintenance.	
Unit-IV	**Medicinal Plants**	07
	4.1 Definition, history, present and future needs. 4.2 Introduction to medicinally important secondary metabolites of	

	plants. 4.3 Importance of medicinal plants- Amla (*Phyllanthus emblica*), Ginger (*Zingiber officinalis*), Aloe (*Aloe vera*), Turmeric (*Curcuma longa*), Narkya (*Nothopodytes nimmoniana*)	

Course Outcomes: The students will be able to……..

1. know and analyze the role of plants in human welfare.
2. develop basic a horticultural farm and design nursery of horticultural plants.
3. know the industrial applications of plant resources.
4. discuss ideas related to plant-based entrepreneurships and start-ups.

Reference Books:

1. Arora, J.,2014, Introductory Ornamental Horticulture. , Kalyani Publishers, New Delhi.
2. Dutt, A. 2009, An Introduction to Medicinal Plants. ,1st Edition. Adhyayan Publishers and Distributors, New Delhi.
3. Chaudhry, R. D.,1996, Herbal Drug Industry: : A Practical Approach to Industrial Pharmacognosy. ,Eastern Publishers, India.
4. Raphael, I. 1991, Natural Products: A Lab Guide ,2nd Edition. Academic Press, USA.

Botany (OE) (Open Elective)

Course-IV (BBT 128): Advances in Nursery Techniques

Course Objectives: The students should be able to……..

1. introduce students to the advanced methods of nursery techniques.
2. explain the basic material, tools, and techniques required to establish a plant tissue culture laboratory.
3. demonstrate the production of artificial seeds.
4. comprehend knowledge and skills required for hydroponic techniques.

Credits (02)	Course-IV (BBT 128) Advances in Nursery Techniques	No. of hours per unit
Unit-I	**Introduction to Plant Tissue Culture** 1.1 Introduction, the importance of Plant Tissue Culture. 1.2 Explants selection, sterilization, and inoculation. 1.3 Equipment's Principle and working - pH meter, Hot air oven, Autoclave, LAF, Rotary Shaker.	**07**
Unit-II	**Somatic Embryogenesis** 2.1 Concept Somatic Embryogenesis. 2.2 Process of Somatic Embryogenesis 2.3 Factors affecting embryogenesis 2.4 Production of artificial seeds; Cryopreservation.	**08**
Unit-III	**Micropropagation** 3.1 Introduction, stages of Micropropagation, factors affecting micropropagation, advantages and applications. 3.2 Organogenesis - formation of shoots and roots, production of virus-free plants by meristem and shoot-tip culture. 3.3 Advantages and Limitations of Micropropagation, Importance of Micropropagation in Crop Improvement.	**08**
Unit-IV	**Hydroponics** 4.1 Concept, Advantages of Hydroponics 4.2 Techniques in Hydroponics – Static solution culture, Continuous –Flow Solution culture, Aeroponics, Dutch bucket, Deep water culture, Bubbleponics.	**07**

	4.3 Media and substratum used for Hydroponics: Hoagland's solution, Clay, Rock wool, Cocopeat, Perlite, Pumice, Vermiculite, Sand, Gravel, Hydroton, Polystyrene packing peanuts, and wood fiber.	

Course Outcomes: The students will be able to…….

1. perform plant tissue culture techniques.
2. perform steps in micropropagation of plants.
3. employ cryopreservation techniques for plant preservation.
4. establish a unit of hydroponics and use different media for hydroponics.

References Books:

1. Razdan M K ,2019, Introduction to Plant Tissue Culture, Oxford and IBH Publishing
2. Bhojwani, S. S. and Razdan, M. K., Elsevier, 2005, Plant Tissue Culture: Theory and Practice., New Delhi
3. Smith, R. H., 2000, Plant Tissue Culture: Techniques and Experiments. ,2nd Edition, Academic Press, USA.
4. Lindsey K, 1997, Plant Tissue Culture Manual, Springer Publication.
5. Dr. A. Anami Augustus Arul & C. Prasanna Kumari , An Introduction To Hydroponics, Notion Press
6. Tom Gordon ,2019, Hydroponics: A Beginner's Guide to Building Your Own Hydroponic Garden, Novelty Publishing
7. Howard M. Resh , 2022, Hydroponic Food Production, CRC Press; 8th edition
8. Singh D K ,2017, Micropropagation Technologies, ATPA; 1st edition

Botany (OE) (Open Elective)

Practical Course-II (BBP 129)

Course Objectives: The students should be able to…..

1. explain the economically important nursery plants.
2. comprehend knowledge and skills of ornamental and medicinal plants.
3. explain the basic material, tools, and techniques required to establish a plant tissue culture laboratory.
4. comprehend knowledge and skills required for hydroponic techniques.

Credits (02)	**Practical Course-II (BBP 129) (Practicals based on Course-III and IV)**	**No. of hours per unit/ credits 60 Hrs.**
	1. Identification of locally available common medicinal plants. 2. Study of agronomy of any four vegetable plants. 3. Study of agronomy of any four fruits plants. 4. Study of agronomy of Ginger, Turmeric, 5. Study of agronomy of Awala, Aloe and Narkya. 6. Study of Hydroponics 7. Study of types of gardens. 8. Sterilization Techniques - Autoclave and Hot Air Oven. 9. Study of equipment - pH meter & Hot air oven 10. Study of equipment - Autoclave, LAF & Rotary Shaker. 11. Preparation of M. S. media. 12. Establishment of callus culture. 13. Organogenesis in callus cultures. 14. Preparation of Hoagland's solution. 15. Visit to plant tissue culture laboratory and report submission.	

Course Outcomes: The students will be able to….

1. establish nursery for economically important plants.
2. develop various plant-based products.
3. perform steps involved in plant tissue culture.
4. set-up a hydroponic unit and performs hydroponic techniques.

References Books:

1. Deepa, H., Bharti, N. Satish, 2019, A Handbook for Skill Development Nursery Management of Horticultural Crops., Serial Publishing House, New Delhi.
2. Razdan M K ,2019, Introduction to Plant Tissue Culture, Oxford and IBH Publishing
3. Horticultural Nursery Management under National Agricultural Innovation Project- ICAR New Delhi. Bhujbal, B. Yashwantrao Chavan Maharashtra Open University, Nashik. (2017).
4. Bhojwani, S. S., Razdan, M. K., and Elsevier, 2005, Plant Tissue Culture: Theory and Practice New Delhi.
5. Lindsey K, 1997, Plant Tissue Culture Manual, Springer Publication.
6. Bhojwani S.S and Razdan M. K ,1996, Plant Tissue Culture: Theory and Practice, Elsevier Science

Botany (SEC) (Skill Enhancement Course)

Course-I (SEC 103) Artificial Intelligence in Botany

Course Objectives: The students should be able to……

1. aware about the upcoming field of AI.
2. know the uses of AI in different branches of plant sciences.

Credits (02)	Course-I (SEC 103) : Artificial Intelligence in Botany	No. of hours per unit
Unit I:	**Basics of Artificial Intelligence** 1.1 Introduction to artificial intelligence, IoT and machine learning 1.2 Intelligent agents and their types 1.3. Artificial neural networks 1.4 Deep learning 1.5 Problem solving	**(08)**
Unit II	**AI in Plant Taxonomy and Ecology** 2.1 Image-based automated recognition of plant species 2.2 Use of drones to assist vegetation mapping 2.3 Deep learning for alpha, beta and gamma diversity study 2.4 AI in the estimation of the conservation status of species	**(07)**
Practicals	**Practicals** 1. Study of mobile phone applications for plants species identification 2. Survey of plant diversity in any three local areas 3. Study of alpha, beta and gamma diversity from local areas 4. Generation of plant database for QR code 5. Generation of QR codes of different plants 6-10. Project work- Identification and submission of report of local plant diversity studied using AI enabled plant identification apps 11-15. Case study on conservation status of species in local area	**(30)**

Course Outcomes: The student will be able to……

1. define and discuss about AI.
2. explain and predict the applications of AI in plant sciences.
3. demonstrate the use of AI based application in plant sciences.

4. generate new ideas based on use of AI in plant sciences.

References Books:

1. Bonnet, P., Joly, A., Davis, C., eds. 2022. Plant Biodiversity Science in the Era of Artificial Intelligence. Lausanne: Frontiers Media SA. doi: 10.3389/978-2-83250-561-8
2. Yuanyuan Zhou, Qing Xia, Zichen Zhang, Mengqi Quan & Haoran Li ,2022, Artificial intelligence and machine learning for the green development of agriculture in the emerging manufacturing industry in the IoT platform, Acta Agriculturae Scandinavica, Section B — Soil & Plant Science, 72:1, 284-299, DOI:10.1080/09064710.2021.2008482
3. Qiao, Y., Valente, J., Zhang, Z., Su, D., He, D., eds. , 2022. AI, sensors and robotics in plant phenotyping and precision agriculture. Lausanne: Frontiers Media SA. doi: 10.3389/978-2-83250-977-7