AC/27.06.2025/RS1

SIES College of Arts, Science & Commerce (Empowered Autonomous)

RISE WITH EDUCATION

NAAC REACCREDITED "A" GRADE

SIES College of Arts, Science and Commerce
(Empowered Autonomous)
Sion (West) Mumbai: 400022

Affiliated to Mumbai University

Syllabus under NEP effective from June 2025

Offered by: Department of Botany

Program: T. Y. B.Sc.

Course: Botany

Choice Based Credit System (CBCS) with effect from the academic year 2025-26

SIES COLLEGE OF ARTS, SCIENCE & COMMERCE (EMPOWERED AUTONOMOUS)

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DEPARTMENT OF BOTANY

TYBSc Botany Credit Structure break-up from 2025-26								
Level	**Sem**	**Major**	**Elective**	**Minor**	**VSC**	**OJT, FP, RP, CEP**	**Credits**	**Degree/ Cum Cr**
5.5 (2025-26)	Sem V	(3T+1P) + (3T+1P) + (3T+1P)	(3T+1P)	(2T)	2P	FP 2	22	**132 UG Degree**
	Sem VI	(3T+1P) + (3T+1P) + (3T+1P)	(3T+1P)	(2T)	0	OJT 4 Internship	22	

SEMESTER – V THIRD YEAR BSc (BOTANY MAJOR) (Credits: 4)

Theory: Paper I – Plant Diversity V				
Paper Code	**Unit No.**	**Unit Name**	**Credits**	**Lectures/ Week**
SIUBOMJ311	1	Algae, Fungi & Plant Pathology	03	01
	2	Gymnosperm and Paleobotany		01
	3	Angiosperms		01
Practical I – Plant Diversity V – SIUBOMJP311				
SIUBOMJP311	Based on SIUBOMJP311 (Practical I)		01	02
		Total	**04**	**03+ 02**

SEMESTER – V THIRD YEAR BSc (BOTANY MAJOR) (Credits: 4)

Theory: Paper II – Functional Botany V				
Paper Code	**Unit No.**	**Unit Name**	**Credits**	**Lectures/ Week**
SIUBOMJ312	1	IKS1 - Vedic Botany I	03	01
	2	Plant Physiology & Biochemistry I		01
	3	Cytogenetics		01
Practical II – Functional Botany V				
SIUBOMJP312	Based on SIUBOMJP312 (Practical II)		01	02
		Total	**04**	**03+02**

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Theory: Paper III – Industrial Botany I				
Paper Code	**Unit No.**	**Unit Name**	**Credits**	**Lectures/ Week**
SIUBOMJ313	1	Plants in industry	03	01
	2	Plant Biotechnology I		01
	3	Environmental Botany		01
Practical III – Industrial Botany I				
SIUBOMJP313	Based on SIUBOMJP313 (Practical III)		01	02
		Total	**04**	**03+02**

SEMESTER – V THIRD YEAR BSc (BOTANY ELECTIVE) (Credits: 4)

Theory: Paper I – Horticulture and Gardening I				
Paper Code	**Unit No.**	**Unit Name**	**Credits**	**Lectures/ Week**
SIUBOEL311	1	Introduction to Horticulture	03	01
	2	Propagation Practices		01
	3	Fertilizers, Pest, and Diseases		01
Practical I – Horticulture and Gardening I				
SIUBOELP311	Based on SIUBOELP311 (Practical I)		01	02
		Total	**04**	**03+ 02**

SEMESTER – V THIRD YEAR BSc (BOTANY MINOR) (Credits: 2)

Theory: Paper I – Economic Botany				
Paper Code	**Unit No.**	**Unit Name**	**Credits**	**Lectures/ Week**
SIUBOMN311	1	Plants in Human Welfare - I	01	01
	2	Plants in Human Welfare - II	01	01

SEMESTER – V THIRD YEAR BSc (BOTANY VSC) (Credits: 2)

Practical I – Vertical Wall Gardening				
Paper Code	**Unit No.**	**Unit Name**	**Credits**	**Lectures/ Week**
SIUBOVSP311	1	Based on Vertical Wall Gardening (Practical I) SIUBVSLP311	02	02

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<table>
<tr><td colspan="2">Semester V – SIUBOMJ311 Plant Diversity V (Major) (3 Cr)</td><td>Hr. 45
Cr. 03</td></tr>
<tr><td colspan="2">Paper I: Plant diversity V</td><td></td></tr>
<tr><td colspan="2">• CO 1: Unit 1 (Algae, Fungi & Plant Pathology) – Analyze the general characteristics, structure, life cycle, and systematic position of algae, fungi, and plant pathogens. Evaluate their impact on plant health by identifying symptoms, disease cycles, and control measures.
• CO 2: Unit 2 (Gymnosperms & Paleobotany) – Understand the classification, life cycles, and reproductive adaptations of gymnosperms. Evaluate the significance of fossil plants in plant evolution.
• CO 3: Unit 3 (Angiosperms) – Classify flowering plants using Bentham and Hooker’s system. Compare and contrast different classification systems. Analyze the economic and medicinal importance of selected plant families.</td><td></td></tr>
<tr><td colspan="2">Unit I : Algae, Fungi & Plant Pathology</td><td>15</td></tr>
<tr><td>1</td><td>General Characters of Charophyceae and Structure, life cycle and systematic position of Chara. (3)</td><td></td></tr>
<tr><td>2</td><td>General Characters of Rhodophyta and Structure, life cycle and systematic position of Batrachospermum. (3)</td><td></td></tr>
<tr><td>3</td><td>Structure, life cycle and systematic position of Puccinia. (3)</td><td></td></tr>
<tr><td>4</td><td>General Characters of Deuteromycetae and Structure, life cycle and systematic position of Alternaria. (3)</td><td></td></tr>
<tr><td>5</td><td>Study of plant diseases: Causative organism, symptoms, disease cycle and control measures of the following. (3)
• Fungal Disease - White Rust – Albugo sp.
• Fungal Disease - Tikka Disease of Groundnut – Cercospora sp.
• Fungal Disease - Damping off disease in Tomato – Pythium sp.</td><td></td></tr>
<tr><td colspan="2">Unit II : Gymnosperms & Paleobotany</td><td>15</td></tr>
<tr><td>1</td><td>General characters of Gnetopsida and Systematic position and Life cycle of Gnetum and Ephedra. (7)</td><td></td></tr>
<tr><td>2</td><td>Calamites – All form genera root, stem, leaf, male and female fructification (3)</td><td></td></tr>
</table>

3	*Lepidodendron* – All form genera root, stem, bark, leaf, male and female fructification (3)	
4	*Lyginopteris* – All form genera root, stem, leaf, male and female fructification (2)	
Unit III : Angiosperms		**15**
1	Morphology of fruit (2)	
2	Complete classification of Bentham and Hooker, Merits and demerits, Hutchinson's classification – merits and demerits (1)	
3	Bentham and Hooker's system of classification for flowering plants up to family with respect to the following prescribed families and economic and medicinal importance for members of the families: Rutaceae, Umbelliferae, Cucurbitaceae, Rubiaceae, Apocynaceae, Asclepiadaceae, Acanthaceae, Lamiaceae, Graminae. (12)	

Semester V – SIUSBOMJP311 Plant Diversity V (Major Practical I) (1 Cr)		**Hr. 20 Cr. 1**
Practical Paper I – Plant Diversity V		
• **CO 1: Identify** and **describe** the different stages in the life cycle of *Chara* and *Batrachospermum*. **Analyze** the structural characteristics of *Puccinia* and *Alternaria*. • **CO 2: Diagnose** fungal plant diseases like white rust, tikka disease, and damping-off. **Evaluate** control measures for disease management. • **CO 3: Identify** and **examine** the stages in the life cycles of *Gnetum* and *Ephedra* using preserved specimens. **Interpret** the structural characters from the fossil evidence of *Calamites*, *Lepidodendron*, and *Lyginopteris*. • **CO 4: Identify** and **classify** selected angiosperm families based on floral characteristics. **Apply** floral keys for species identification.		
1	**Algae -** Study of stages in the life cycle of the following Algae: • *Chara* • *Batrachospermum*	

2	**Fungi -** Study of stages in the life cycle of the following Fungi: • *Puccinia* • *Alternaria*	
3	**Plant Pathology -** Study of the following fungal diseases: • White rust • Tikka disease in Groundnut • Damping off disease in Tomato	
4	**Gymnosperms -** Study of stages in the life cycle of the following Gymnosperms: • *Gnetum* • *Ephedra*	
5	**Paleobotany -** Study of following using permanent slides/ photomicrographs: • *Calamites* • *Lepidodendron* • *Lyginopteris*	
6	**Angiosperms** • Morphology of fruit • Study of one plant from each of the following Angiosperm families: ➢ Rutaceae, ➢ Umbelliferae, ➢ Cucurbitaceae, ➢ Rubiaceae, ➢ Apocynaceae, ➢ Asclepiadaceae, ➢ Acanthaceae, ➢ Lamiaceae, ➢ Graminae • Morphological peculiarities and economic importance of the members of Angiosperms mentioned in the above families • Identifying the genus and species of a plant with the help of Flora	

Semester V – SIUBOMJ312 Functional Botany V (Major) (3 Cr)	**Hr. 45** **Cr. 03**
Paper II: Functional Botany V	
• **CO 1: Unit 1 (IKS1 - Vedic Botany I) – Understand** the traditional botanical knowledge from Vedic texts. **Analyze** ancient plant classifications, medicinal uses, and their relevance in modern botany.	

	• **CO 2: Unit 2 (Plant Physiology & Biochemistry) – Apply** the concepts of water relations, solute transport, and hormonal regulation in plants. **Evaluate** the role of plant growth hormones in physiological and commercial applications. • **CO 3: Unit 3 (Cytogenetics) – Analyze** genetic linkage, recombination, and DNA repair mechanisms. **Solve** genetic mapping problems and **evaluate** mutation effects in plant genetics.	
Unit I: IKS1 - Vedic Botany I		**15**
1	Study of Vedic botanical knowledge with special reference to the following: Common plants mentioned in Vedas, • Plant Morphology (2) • Plant Anatomy (2) • Plant Pathology (2) • Plant Taxonomy (4) ➢ Nomenclature of plants, ➢ Classification of plants based on Botanical principles, Medicinal properties and Dietetic value. • Plant Physiology (5) ➢ Seed Germination, ➢ Planting, ➢ Manuring, ➢ Nourishment in plants, ➢ Absorption, Transport, Transpiration and food assimilation ➢ Respiration, ➢ Movement, ➢ Growth, ➢ Age and Death, ➢ Consciousness in Plants, ➢ Sexuality, ➢ Reproduction ➢ Heredity	
Unit II: Plant Physiology and Biochemistry I		**15**
1	**Water relations:** Potential, osmosis, transpiration, imbibition (3)	
2	**Solute transport:** Transport of ions across cell membranes, active and passive transport, carriers, channels and pumps. Aquaporins and Water Transport in Plants (3)	

3	**Translocation of solutes:** Composition of phloem sap, girdling experiment, pressure flow model, phloem loading and unloading, anatomy of sieve tube elements, mechanisms of sieve tube translocation, Munch's hypothesis (3)	
4	**Mineral nutrition**: Significance and deficiency symptoms of macronutrients – N, P, K, Mg, Ca; micronutrients – S, B, Zn, Fe, Mn, Mo (2)	
5	**Physiological effects and commercial applications of Plant growth hormones:** Auxins, Gibberellins, Cytokinins, Ethylene and Abscisic acid (5) **Photoperiodism**: Role of phytochromes, Florigen. (2)	
Unit III: Cytogenetics		**15**
1	**Linkage & crossing over**: Theory and types of linkage, crossing over and gene recombination, Genetic mapping in eukaryotes, Construction of genetic maps, three-point crosses and mapping chromosomes, problems based on the same. (7)	
2	**Gene mutations:** definition, types of mutations, causes of mutations, induced mutations, the Ame's test. (3)	
3	**DNA repair:** Mechanism and the role of enzymes involved (2)	
4	**Metabolic Disorders:** Enzymatic and non-enzymatic: Gene control of enzyme structure Garrod's hypothesis of inborn errors of metabolism, Phenylketonuria, albinism, sickle cell anaemia (3)	

Semester V – SIUSBOMJP312 Functional Botany V (Major Practical II) (1 Cr)		**Hr. 20 Cr. 1**
Practical Paper II – Functional Botany V		
• **CO 1: Interpret** ancient Indian plant classification based on zodiac signs, navagrahas, and vastu principles. **Analyze** the historical significance of plants in rituals. • **CO 2: Determine** osmotic potential using the plasmolytic method. **Perform** chromatography techniques to separate plant sugars and organic acids. • **CO 3: Solve** genetic mapping problems using three-point crosses. **Identify** types of mutations from given DNA sequences.		
1	**Vedic Botany** • Study of plants as per zodiac signs and constellations • Study of plants as per navagrahas	

	• Study of plants as per vastushatra	
2	**Physiology and Biochemistry** • Estimation of Phosphate phosphorus (Plant acid extract) • Estimation of Iron (Plant acid extract) • Determination of osmotic potential of cell sap by plasmolytic method • Determination of stomatal frequency and stomatal index in leaf • Chromatography of sugars • Chromatography of organic acids	
3	**Cytogenetics** • Problems based on three-point crosses, construction of chromosome maps • Identification of types of mutations from given DNA sequences • Study of mitosis using pre-treated root tips of *Allium*	

Semester V – SIUBOMJ513 Industrial Botany I (Major) (3 Cr)		**Hr. 45** **Cr. 03**
Paper III: Industrial Botany I		
• **CO 1: Unit 1 (Plants in Industry) – Identify** plant-derived industrial products and **analyze** their applications in dyes, cosmetics, and food industries. • **CO 2: Unit 2 (Plant Biotechnology I) – Explain** micropropagation, DNA sequencing, and hybrid selection. **Apply** biotechnological methods for crop improvement. • **CO 3: Unit 3 (Environmental Botany) – Analyze** the causes and consequences of biodiversity loss. **Evaluate** bioremediation techniques and **develop** strategies for environmental conservation.		
Unit I: Plants in Industry		**15**
1	**Plant based Dyes:** Botanical source, properties and applications of herbal dyes – Red (Annatto), brown (Henna), Yellow-Orange (Marigold), Green (Spinach) and blue (Indigofera) dyes. (3)	
2	**Plants as Herbal Cosmetics:** Botanical source, properties and applications of Shoe-flower, Nagarmotha, Ashwagandha, Asparagus, Coconut, Jujuba, Tulsi as herbal cosmetic plants. (3)	

3	**Herbal Essences, Flavours and Perfumes:** Botanical source, Properties and applications of herbal essences – Dill, Tuberose, Plumeria, Orange, Strawberry (3)	
4	**Bio-enzymes**: Source, properties and applications of amylase, protease, lipase, pectinase (2)	
5	**Plant based Meat:** Plant protein & its processing for meat production. (1)	
Unit II: Plant Biotechnology I		**15**
1	Production of Secondary Metabolites with reference to Multiple Shoot Cultures (2) Applications of micropropagation with reference to Orchid culture (2)	
2	Embryo rescue, Selection of hybrid cells and regeneration of hybrid plants; symmetric and asymmetric hybrids, cybrids. Conventional versus non-conventional methods for crop improvement (4)	
3	**DNA Sequencing** – Maxam – Gilbert Method and Sanger's method (2) Pyrosequencing and Next generation sequencing (2) Polymerase Chain reaction: Basic and variants. (3)	
Unit III: Environmental Botany		**15**
1	**Biodiversity:** Definition and Importance, Levels of Biodiversity, Loss of Biodiversity (causes & consequences), IUCN categories of threats to Biodiversity, Methods of Biodiversity conservation. (6)	
2	**Water Pollution:** Eutrophication, Measures of water pollution assessment (DO, BOD, Hardness, Salinity, and Chlorinity), Nygard's index as indicator of water pollution. (3)	
3	**Bioremediation:** • **Microremediation**: Definition, Advantages & Disadvantages, Factors affecting microremediation, Management of oil spills through microremediation. (3) • **Phytoremediation**: Definition, Advantages & Disadvantages, Methods, Natural phytoremediators. (3)	

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Semester V – SIUBOMJP313 Industrial Botany I (Major Practical III) (1 Cr)		**Hr. 20 Cr. 1**
Practical Paper III – Industrial Botany I		
• **CO 1: Identify** plants used for herbal dyes, cosmetics, and perfumes. **Extract** and **analyze** the activity of beta-amylase from sweet potatoes. • **CO 2: Perform** DNA sequencing using Sanger's method. **Apply** micropropagation techniques like callus induction and encapsulation of axillary buds. • **CO 3: Measure** dissolved oxygen (DO) and biological oxygen demand (BOD) in water samples. **Evaluate** the impact of pollution using Nygaard's index.		
1	**Plants in Industry** • Study of plants as a source of herbal dyes • Study of plants as a source of herbal cosmetics • Study of plants as a source of herbal essence, flavours and perfumes • Isolation of Beta-amylase from sweet potato and checking its activity	
2	**Plant Biotechnology I** • DNA Sequencing by Sanger's method • Encapsulation of Axillary buds • Callus induction • Problems based on PCR • Preparation of stock solutions for preparation of MS medium (Note: Concept of preparation of specified molar solutions should be taught and problems based on preparation of stock solutions for tissue culture media will be given).	
3	**Environmental Botany** • Estimation of Dissolved oxygen demand of the water sample • Estimation of Biological oxygen demand of the water sample • Determination of Nygard index of algae in a water body. • Estimation of Hardness of the water sample • Estimation of Salinity and Chlorinity of the water sample • Calculation of Simpson's diversity index.	

Semester V – SIUBOEL311 Horticulture and Gardening I (Elective) (3 Cr)	**Hr. 45**

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Paper I: Horticulture and Gardening I		**Cr. 03**
• **CO 1: Unit 1 (Introduction to Horticulture) – Understand** the scope and career opportunities in horticulture. **Evaluate** the importance of research institutes and strategic plantation programs. • **CO 2: Unit 2 (Propagation Practices) – Apply** propagation techniques, including seed propagation, grafting, and budding. **Create** effective propagation plans for various plant species. • **CO 3: Unit 3 (Fertilizers, Pests, and Diseases) – Differentiate** between chemical and organic fertilizers. **Analyze** pest and disease management strategies for sustainable horticulture.		
Unit I: Introduction to Horticulture		**15**
1	**Horticulture**: Definition and Objectives (2)	
2	**Branches of Horticulture:** Pomology, Olericulture, Floriculture Landscape Gardening (4)	
3	**Allied branches of Horticulture:** Apiculture & Sericulture (4)	
4	**Horticulture Research Institutes:** National Research Centre for grapes, Pune; Horticulture Training Centre (H.T.C.) – Talegaon; Central Potato Tuber Research Institute (CPTRI) – Shimla. (3)	
5	Horticulture as Career & Horticultural Consultancy (1)	
6	**Strategy Plantation**: Lakhi Baug Yojana (1)	
Unit II: Propagation Practices		**15**
1	**Propagation by Seeds:** Advantages and disadvantages, method of seed propagation, production of seeds, handling, collection and storage sowing, transplanting of seedlings and hardening, seed treatment to control diseases, seedling diseases and their control. (3)	
2	**Propagation by specialised Vegetative structures:** Bulbs, Tubers, Corms, Rhizomes, Root stock, Runners, Offsets and Suckers. (2)	
3	**Artificial methods of plant propagation:** • **Cutting** – Root cutting, Stem cuttings, and leaf cuttings. Use of PGRs for rooting. • **Layering** – Definition, Types: Simple, Compound, (Serpentine) Tip, Trench, Mound, Air Layering.	

	• **Grafting**-Definition, advantages and disadvantages. Cacti grafting, Types: Splice, Whip/ Tongue, side, veneer, cleft, bark, epicotyls, approach, repair grafting – Enarching, bridge and bracing. • **Budding** – Definition advantages and disadvantages. Types: T-budding, shield, patch, ring budding. • **Developing new varieties –** Technique of Emasculation and bagging, role of polyploidy in production of seedless varieties in plants. (8)	
4	Application of Tissue Culture in Horticulture. (2)	
Unit III: Fertilizers, Pests and Diseases		**15**
1	**Fertilizers**: Definition, Types – Straight, Compound and mixed. Nitrogenous (Ammonium sulphate, Urea), Phosphatic (Superphosphate, Bone meal), Potassic (Muriate of potash, Potassium sulphate), Advantages and disadvantages of chemical and organic fertilizers; Case studies. (4)	
2	**Biofertilizers**: Bacteria, Cyanobacteria, Mycorrhiza, Sea weeds. (1)	
3	**Manures**: Definition, importance, important manures FYM (compost), oilcakes, green manure, organic manures and vermicompost. (1)	
4	**Diseases**: Horticultural plant diseases and their control. Fungal diseases- Rust, Smut, Powdery mildew. Bacterial – Citrus canker, Bacterial wilt. Viral – TMV, Leaf curl. (6)	
5	**Pests**: Common pests on horticultural crops – Aphids, beetles, mealy bugs, caterpillars, snails and rats. (2)	
6	**Friends of farmers:** Earthworms and Snakes. (1)	

Semester V – SIUBOELP311 Horticulture and Gardening I (Elective Practical I) (3 Cr)	**Hr. 20 Cr. 1**
Practical Paper I – Horticulture and Gardening I	
• **CO 1: Identify** and correctly use different garden tools and implements. **Apply** potting and repotting techniques for plant maintenance. • **CO 2: Demonstrate** seed, cutting, layering, grafting, and budding techniques. **Analyze** the effects of plant growth regulators on propagation success. • **CO 3: Test** soil pH and electrical conductivity. **Evaluate** the effectiveness of different fertilizers and manures.	

• **CO 4: Diagnose** fungal, bacterial, and viral diseases affecting horticultural plants. **Apply** control measures using natural insecticides.		
1	Study of different garden implements and their uses.	15
2	Study of different types of pots, potting media, potting and repotting operations	
3	Study of propagation practices: Propagation by seed, Vegetative propagation, Cutting, Layering, Budding and Grafting.	
4	Identification of the following: • **Fertilizers**: Identification of Urea, Ammonium sulphate, Potassium sulphate, Super phosphate by physical and chemical methods. • **Manures:** Identification of green manure plants – *Gliricidia, Crotolaria, Leucaena.* • **Biofertilizers** – Identification of *Nostoc,* and *Rhizobium.*	
5	Testing of pH of Soil by pH paper, digital pH meter, Lovibond comparator using universal indicator	
6	Checking electrical conductivity of water.	
7	Estimation of organic carbon using soil testing kit	
8	Identification of Diseases and Pests: • **Fungal diseases**: Powdery mildew, Rust, Wilt, Blight and Smut. • **Bacterial diseases:** Bacterial Wilt. • **Viral diseases:** Leaf curl, Yellow Vein Mosaic. • **Insect-pests:** Sucking, Biting, Chewing, Borers & Ants. • **Non Insects-pests:** Nematodes and Rodents.	
9	Study of Natural insecticides: Neem Arka, Dashparni Arka, Seetaphal Powder and Tobacco Extract	

Semester V – SIUBOMN311 Economic Botany (Minor) (2 Cr)	**Hr. 30**
Paper I: Economic Botany	**Cr. 01**

	• **CO 1: Unit 1 (Plants in Human Welfare - I) – Identify** and **describe** the botanical sources of essential oils and medicinal plants. **Analyze** their extraction methods and health benefits. • **CO 2: Unit 2 (Plants in Human Welfare - II) – Compare** the economic significance of spices, condiments, and timber plants. **Evaluate** their role in human welfare and trade.	
Unit I - Plants in human welfare - I		**15**
1	**Essential oils yielding plants:** Botanical source, extraction and health benefits of perfume oils from sandalwood, patchouli, mint, champa, *Citronella* and Lemon. (5)	
2	**Fatty oils yielding plants:** Classification of vegetable oils, Botanical source, extraction and health benefits of vegetable oils - Drying oil (linseed and soyabean oil), semi-drying oils (cotton seed, sesame oil) and non-drying oils (olive oil and peanut oil), Hydrogenation of vegetable oils. (5)	
3	**Plants in health management I: Plant cure for physical ailments:** Plants used to cure - Digestive disorders, respiratory disorders, cold and cough, infections of ear, eye, nose, urinary tract, etc., fever, acidity, piles, anaemia, arthritis, dental problems, hair, and skin problems. (5)	
Unit II - Plants in human welfare - II		**15**
1	**Plants in health management II: Plant cure for lifestyle disorders and Adolescent and Reproductive Healthcare:** Diabetes, hypertension, atherosclerosis, mental stress and fatigue, etc., menstrual problems, leucorrhea, dysmenorrhea, ante-natal care, Post-natal care, problems associated with reproductive system. (5)	
2	**Spices and Condiments yielding plants:** Botanical source, properties, active constituents and uses of Black pepper, Nutmeg and Mace, Cardamom, Clove and Saffron (5)	
3	**Timber yielding plants:** Botanical source, properties and uses of Teak, Sal, Mahogany, Pine and Cedar (5)	

Semester V – SIUBOVSP311 Vertical Wall Gardening (VSC Practical I) (2 Cr)	**Hr. 20**

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Practical I: Vertical Wall Gardening		**Cr. 02**
• **CO 1:** Identify and categorize different types of vertical wall gardens. Recall and list the essential setup components such as irrigation systems, potting media, and structural materials required for vertical gardening. • **CO 2:** Prepare and apply organic fertilizers to improve plant health in vertical gardening systems. Interpret the effectiveness of organic fertilizers (Panchagavya, banana peel fertilizer, compost) in plant growth. • **CO 3:** Install and set up different types of vertical gardens, including green facades, pillar gardens, and vegetable gardens. • **CO 4:** Compare the growth and maintenance requirements of different plants in indoor and outdoor vertical gardens. • **CO 5:** Inspect and troubleshoot common maintenance issues in vertical wall gardens, such as nutrient deficiencies and irrigation failures. • **CO 6:** Assess the sustainability and cost-effectiveness of different vertical garden designs. • **CO 7:** Design and execute a vertical garden project for the college campus, integrating efficient irrigation and plant selection. • **CO 8:** Document and present a detailed project report on the setup, maintenance, and outcomes of vertical gardening		
1	Study of types of vertical wall gardens	
2	Study of basic requirements for setting up vertical walls - Light, Irrigation, Types of pots, Potting media	
3	Study of designs and planning for vertical gardens	
4	Study of plants suitable for indoor vertical gardening	
5	Study of plants suitable for outdoor vertical gardening	
6	Study setting up of green facades/ living walls	
7	Study setting up of vertical wall garden	
8	Study setting up of vertical pillar garden	
9	Study setting up of vertical vegetable garden and basket farming	
10	Study of maintenance and aftercare of vertical walls	

11	Preparation of fertilizers: Panchagavya, Banana peel fertilizer, Compost/ Manure – Home-scale composting and Nirmalya	
12	Visit to Vertical Wall Garden and submission of report	
13	Project report submission on set up and maintenance of vertical wall gardens in college campus	

SEMESTER – VI THIRD YEAR BSc (BOTANY MAJOR) (Credits: 4)

Theory: Paper I – Plant Diversity VI

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Paper Code	Unit No.	Unit Name	Credits	Lectures/ Week
SIUBOMJ321	1	Microbiology	03	01
	2	Bryophyta and Pteridophyta		01
	3	Palynology and Embryology		01
Practical I – Plant Diversity V				
SIUBOMJP321	Based on SIUBOMJP321 (Practical I)		01	02
		Total	04	03+ 02

SEMESTER – VI THIRD YEAR BSc (BOTANY MAJOR) (Credits: 4)

Theory: Paper II – Functional Botany V				
Paper Code	**Unit No.**	**Unit Name**	**Credits**	**Lectures/week**
SIUBOMJ322	1	IKS 2 – Vedic Botany II	03	01
	2	Plant Physiology & Biochemistry II		01
	3	Molecular Biology		01
Practical II – Functional Botany V				
SIUBOMJP322	Based on SIUBOMJP322 (Practical II)		01	02
		Total	04	03+ 02

SEMESTER – VI THIRD YEAR BSc (BOTANY MAJOR) (Credits: 4)

Theory: Paper III – Industrial Botany II				
Paper Code	**Unit No.**	**Unit Name**	**Credits**	**Lectures/ week**
SIUBOMJ323	1	Biostatistics	03	01
	2	Bioinformatics		01
	3	Plant Biotechnology II		01
Practical III – Industrial Botany I				
SIUBOMJP323	Based on SIUBOMJP323 (Practical III)		01	02
		Total	**04**	03+ 02

SEMESTER – VI THIRD YEAR BSc (BOTANY ELECTIVE) (Credits: 4)

Theory: Paper I – Horticulture and Gardening – II

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Paper Code	Unit No.	Unit Name	Credits	Lectures/ week
SIUBOEL321	1	Advancements in Horticulture	03	01
	2	Horticultural Operations and Techniques		01
	3	Post-harvest Management		01
Practical I – Horticulture and Gardening – II				
SIUBOELP321	Based on SIUBOELP321 (Practical III)		01	02
		Total	04	03+ 02

SEMESTER – VI THIRD YEAR BSc (BOTANY MINOR) (Credits: 4)

Theory: Paper I – Post Harvest Technology				
Paper Code	**Unit No.**	**Unit Name**	**Credits**	**Lectures/ week**
SIUBOMN321	1	Post Harvest Operations	02	01
	2	Post Harvest Preservation and Processing		01

Semester VI – SIUBOMJ321 Plant Diversity VI (Major) (3 Cr) **Paper I: Plant Diversity VI**	**Hr. 45** **Cr. 03**
• **CO 1: Unit 1 (Microbiology)** – **Classify** different types of microbes. **Analyze** their roles in fermentation, biotechnology, and environmental applications. • **CO 2: Unit 2 (Bryophyta & Pteridophyta) – Understand** the structure and reproduction of bryophytes and pteridophytes. **Evaluate** their evolutionary significance. • **CO 3: Unit 3 (Palynology & Embryology) – Analyze** pollen morphology and viability. **Apply** palynological techniques in forensic science and the honey industry.	
Unit I: Microbiology	**15**
1 **Types of Microbes** – Bacteria, Archaea, Viruses, Fungi, Algae (6)	

2	**Culturing**: Sterilization, media, staining, colony characters (2)	
3	Pure cultures (2)	
4	Role of microbes in fermentation: Alcohol and Antibiotics (2)	
5	Plantibodies (1)	
6	Microbes in sewage disposal (2)	
Unit II: Bryophyta & Pteridophyta		**15**
1	General characters of Hepaticopsida and structure, Life cycle and systematic position *Marchantia* (3)	
2	General characters of Musci and structure, Life cycle and systematic position of *Funaria* (3)	
3	Structure, Life cycle and systematic position of *Lycopodium* (3)	
4	Structure, Life cycle and systematic position of *Adiantum* (3)	
5	Evolution of sporophytes in bryophytes (2)	
6	Types of sori and evolution of sori in pteridophytes. (1)	
Unit III: Palynology & Embryology		**15**
1	**Pollen Morphology** – Structure of pollen grain, shape and size variations in pollen, polarity, symmetry, pollen wall, excrescences, apertures, NPC classification, exine ornamentations. (4)	
2	**Pollen viability** - Concept, deficiency, tests, pollen storage (1)	
3	**Application of Palynology** in the honey industry, forensic science. (2)	
4	**Microsporogenesis** and its stages, T.S. of mature anther in Angiosperms (2)	
5	**Megasporogenesis** - Development of monosporic type (8 nucleate & 7 celled) (2)	
6	**Double fertilization** & its Significance (2)	
7	**Development of embryo in dicots**: study of development of embryo in *Capsella.*(2)	

Semester VI – SIUBOMJP321 Plant Diversity VI (Major Practical) (1 Cr)	**Hr. 20**

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DEPARTMENT OF BOTANY

<table>
<tr><td colspan="2">Practical Paper I – Plant Diversity VI</td><td>Cr. 1</td></tr>
<tr><td colspan="2">CO 1: Perform bacterial culturing and staining techniques. Measure bacterial growth using aeromicroflora assessment methods.
CO 2: Identify morphological structures of Marchantia, Funaria, Lycopodium, and Adiantum. Compare sporophyte evolution in different groups.
CO 3: Analyze pollen morphology using NPC classification. Perform in vitro pollen germination and study embryo development stages in monocots and dicots.</td><td></td></tr>
<tr><td>1</td><td>Microbiology:
Determination of Minimum Inhibitory Concentration (MIC) of sucrose against E. coli
Study of Bacterial growth curve (E. coli)
Study of aeromicroflora (Bacterial culture) by petriplate exposure method
Study of aeromycoflora (Fungal culture) by petriplate exposure method</td><td></td></tr>
<tr><td>2</td><td>Bryophyta:
Study of stages in the life cycle of the following Bryophyta from fresh / preserved material and permanent slides
Marchantia
Funaria
Study of types of sporophytes in Bryophyta</td><td></td></tr>
<tr><td>3</td><td>Pteridophyta:
Study of stages in the life cycles of following Pteridophytes from fresh / preserved material and permanent slides
Lycopodium
Adiantum
Types of sori and soral arrangement in Pteridophyta</td><td></td></tr>
<tr><td>4</td><td>Palynology:
Study of pollen morphology (NPC Analysis) of Hibiscus, Datura, Ocimum, Crinum, Pancratium and Canna by Chitale’s Method
Determination of pollen viability
Pollen analysis from honey sample – unifloral and multifloral honey
Effect of varying concentration of sucrose on In vitro Pollen germination.</td><td></td></tr>
<tr><td>5</td><td>Embryology:
Study of stages of Microsporogenesis, Megasporogenesis and Embryo Development with the help of permanent slides
Study Monocot (Maize) and Dicot (Castor and Gram) embryo</td><td></td></tr>
</table>

	• Study of *In-vivo* growth of pollen tube in *Vinca*	

Semester VI – SIUBOMJ322 Functional Botany VI (Major) (3 Cr)		**Hr. 45 Cr. 03**
Paper II: Functional Botany VI		
• **CO 1: Unit 1 (IKS2 - Vedic Botany II)** – **Interpret** Vedic concepts related to plant ecology, evolution, and Ayurveda. **Evaluate** their applications in agriculture and medicine. • **CO 2: Unit 2 (Plant Physiology & Biochemistry II) – Understand** nitrogen metabolism, enzyme kinetics, and biomolecular structures. **Apply** biochemical techniques to study plant metabolism. • **CO 3: Unit 3 (Molecular Biology)** – **Describe** DNA replication, transcription, and translation. **Analyze** genetic code and RNA processing mechanisms.		
Unit I: IKS 2 - Vedic Botany - II		**15**
1	Study of Vedic botanical knowledge with special reference to the following: • Plant Ecology • Plant Evolution • Agricultural Science • Medicinal Science (*Charaka Samhita* and *Susruta samhita*) (2)	
2	**Ayurvedic Botany:** Introduction to Ayurveda, objective, History, Branches, Theories in Ayurveda – Panchamahabhuta & Tridosha, Saptadhatu, Three pillars in Ayurveda, Agni, Ama, Prakruti, Types of Prakriti, Prakruti Pariksha, Panchakarma Therapy, **(8-10)**	
3	**Applications of Vedic Botany** - • Economic predictions • Ascertaining the presence of water in a dreary region • Ritualistic significance (3)	
Unit II: Plant Physiology & Biochemistry II		**15**
1	**Nitrogen metabolism:** Nitrogen cycle, root nodule formation, and leg haemoglobin, nitrogenase activity, assimilation of nitrates, (NR, NiR activity), assimilation of ammonia, (amination and transamination reactions), nitrogen assimilation and carbohydrate utilisation. (5)	

2	**Structure of biomolecules:** Carbohydrates (sugars, starch, cellulose, pectin, lipids (fatty acids and glycerol), proteins (amino acids) (5)	
3	**Enzymes:** Nomenclature, classification, mode of action, Enzyme kinetics, Michaelis Menten equation, competitive non-competitive, and uncompetitive inhibitors. (5)	
Unit III: Molecular Biology		**15**
1	**DNA replication**: Modes of Replication, Meselson and Stahl Experiment (1) **DNA replication in prokaryotes and eukaryotes**- enzymes involved and molecular mechanism of replication. (4)	
2	**Central dogma of Protein synthesis: Transcription in prokaryotes and eukaryotes**: promoter sites, initiation, elongation and termination. (4)	
3	**RNA processing**: Splicing, Capping and Polyadenylation. (1)	
4	**The genetic code**: Characteristics of the genetic code (1)	
5	**Translation** in prokaryotes & Eukaryotes (4)	

Semester VI – SIUBOMJP322 Functional Botany VI (Major Practical) (1 Cr)		**Hr. 20** **Cr. 1**
Practical Paper II – Functional Botany VI		
• **CO 1: Examine** the ritualistic significance of plants in Indian mythology. **Evaluate** the effectiveness of vedic plants used for stress relief and immunity boosting. • **CO 2: Estimate** protein content using the Biuret method. **Analyze** the effects of temperature, pH, and substrate concentration on amylase activity. • **CO 3: Isolate** and **examine** giant chromosomes from *Chironomus* larvae. **Interpret** amino acid sequences using bioinformatics tools.		
1	**Vedic Botany - II** • Study of plants in Indian mythology for rituals and festivals • Study of vedic knowledge about plants used for stress management, weight loss, infertility management, as immunity booster. • Study of vedic knowledge about plants used as pesticides and for carbon sequestration	
2	**Plant Biochemistry** • Estimation of proteins by Biuret method • Effect of temperature on the activity of amylase • Effect of pH on the activity of amylase	

	• Effect of substrate variation on the activity of amylase	
3	**Plant Physiology** • Determination of alpha-amino nitrogen • Estimation of reducing sugars by DNSA method	
4	**Cytology and Molecular Biology** • Mounting of Giant chromosomes from Chironomus larva • Smear preparation from *Tradescantia* buds • Amino acid sequencing (Eukaryote): Polypeptide formed by translation	

Semester VI – SIUBOMJ323 Industrial Botany II (Major) (3 Cr)		**Hr. 45** **Cr. 03**
Paper III: Industrial Botany 2		
• **CO 1: Unit 1 (Biostatistics) – Apply** statistical methods (chi-square, correlation, t-test, ANOVA) in biological research. **Evaluate** experimental data using biostatistical tools. • **CO 2: Unit 2 (Bioinformatics) – Use** biological databases and computational tools for sequence alignment. **Analyze** protein structures and genomic data. • **CO 3: Unit 3 (Plant Biotechnology II) – Explain** DNA barcoding, genomic library construction, and gene cloning. **Evaluate** their applications in plant biotechnology.		
Unit I: Biostatistics		**15**
1	The Chi square test	
2	Correlation – Calculation of coefficient of correlation.	
3	Regression Analysis	
4	Test of significance student's *t*-test (paired and unpaired)	
5	ANOVA (one way)	
Unit II: Bioinformatics		**15**
1	**Information Technology**: History and tools of IT, Internet and its uses. Introduction to Bioinformatics- goal, need, scope and limitation, Aims of Bioinformatics: Data organization, Tools of Bioinformatics- tools for web search.	

2	Organization of biological data, types of databases	
3	Exploration of databases, retrieval of desired data, Entrez & BLAST. Protein structure analysis and application	
4	Multiple sequence analysis and phylogenetic analysis	
5	Bioinformatics programme in India.	
Unit III: Plant Biotechnology II		**15**
2	• **DNA barcoding**: Basic features, nuclear genome sequence, chloroplast genome sequence, *rbc*L gene sequence, *mat*K gene sequence, present status of barcoding in plants. (4)	
1	• Construction of genomic DNA libraries, Chromosome libraries and c-DNA libraries. (5) • Identification of specific cloned sequences in cDNA libraries and Genomic libraries (2) • **Analysis of genes and gene transcripts** – Restriction enzyme analysis of cloned DNA sequences.(2) • **Hybridization**: Nucleic acid hybridization and Southern Hybridization (2)	

Semester VI – SIUBOMJP323 Industrial Botany II (Major Practical) (1 Cr)		**Hr. 20 Cr. 01**
Practical Paper III – Industrial Botany II		
• **CO 1: Solve** statistical problems using chi-square tests, correlation, and regression analysis. **Apply** ANOVA for experimental data interpretation. • **CO 2: Retrieve** and analyze DNA sequences using BLAST. **Compare** phylogenetic relationships using sequence alignment tools. • **CO 3: Perform** plasmid DNA isolation and gel electrophoresis. **Construct** restriction maps and analyze DNA barcoding data.		
1	**Biostatistics:** Problems based on • Chi square • Correlation • Regression analysis • *t*-test (paired and unpaired) • ANOVA	
2	**Bioinformatics** • BLAST: nBLAST, pBLAST • Multiple sequence alignment • Phylogenetic analysis	

	• RASMOL/ SPDBV	
3	**Plant Biotechnology II** • DNA barcoding of plant material by using suitable data • Plasmid DNA isolation and Separation of DNA using AGE • Restriction mapping (problems), Southern blotting	

Semester VI – SIUBOEL321 Horticulture and Gardening – II (Elective) (3 Cr)		**Hr. 45** **Cr. 03**
Paper I: Horticulture and Gardening - II		
• **CO 1: Unit 1 (Advancements in Horticulture) – Evaluate** advanced horticultural methods such as hydroponics, aeroponics, and greenhouse technology. **Create** innovative solutions using precision agriculture techniques. • **CO 2: Unit 2 (Horticultural Operations & Techniques) – Apply** horticultural practices like irrigation, pest control, and pruning. **Analyze** the impact of different techniques on plant productivity. • **CO 3: Unit 3 (Post-Harvest Management) – Develop** strategies for post-harvest handling, storage, and preservation. **Evaluate** methods to increase market value and shelf life of horticultural produce.		
Unit I - Advancements in Horticulture		**15**
1	**Soil-less cultivation:** Definition, methods, advantages and scope, Substrate culture, Hydroponics, Aeroponics. (4)	
2	**Wineries and breweries**: Botanical sources, health benefits of Fermented beverage (Wines, Cider, Perry), Brewed & fermented beverages (Beer & Sake) (5)	
3	Production of new varieties using breeding methods. (2)	
4	**High-tech Horticultural production using Green-house technology:** Meaning, types, layout & construction, irrigation systems, care & attention. (4)	
5	**Current trends in Smart Horticulture:** (4) • Use of robotics, drones in horticulture • Application of digital monitoring and digital phenotyping in horticulture • Application of Precision Agriculture technique in sustainable horticulture • Space gardens, Microgreens, Miyawaki Garden	
Unit II - Horticultural operations & techniques		**15**

1	**Garden operations:** Preparation of site for garden, Mulching, Top-dressing, Blanching, Sowing, Transplanting, Fertilizer application, Harvesting and its types, Weeding, Pruning (7)	
2	**Pest and disease management:** Control of pest and diseases using physical, chemical and biological methods (4)	
3	**Water management –** Irrigation and its types (Overhead, Surface, Underground) and conservation of water through horticulture (4)	
Unit III - Post harvest management		**15**
1	**Maturity:** Factors responsible for maturity & ripening; methods used for delaying ripening. (2)	
2	**Harvest:** Time of harvest; harvesting and handling of harvested products. (2)	
3	**Storage of fresh produce:** Types of storage of fruits and vegetables. (2)	
4	**Fruit and vegetable preservation technology:** Drying (natural, artificial), Freezing, Canning, Pickling, Preservation using sugar concentrates, Preservation using chemical preservatives and antioxidants. (3)	
5	**Post-harvest operations:** Cleaning, Sorting, Grading, Packing, Transportation (2)	
6	**Marketing:** methods of increasing the market value and shelf life of horticultural produce. (2)	
7	**Entrepreneurship development:** Horticulture as a business- definition, nature and scope. (2)	

Semester VI – SIUBOELP321 Horticulture and Gardening – II (Elective Practical) (1 Cr)		**Hr. 20 Cr. 01**
Practical Paper I – Horticulture and Gardening – II		
• **CO 1: Set up** and maintain a hydroponic system. **Evaluate** different soil-less cultivation techniques for efficiency. • **CO 2: Prepare** fermented beverages like kombucha and kanji. **Demonstrate** the process of drying, freezing, and pickling fruits and vegetables. • **CO 3: Assess** methods to increase the market value of horticultural produce. **Develop** an entrepreneurship plan for a horticultural business.		
1	Hydroponic cultivation of leafy vegetables/ ornamentals/ microgreens	
2	Plant nursery management and submission of report on the same	

3	Identification of varieties of: • **Vegetables**: Tomato, Brinjal & Chilli • **Fruits**: Mango, Grapes & Coconut	
4	Identification of following Green house plants with respect to their soil, temperature, irrigation, fertilizer requirements and propagation methods: Anthurium, Gerbera, Orchids, Tuberose, Carnation, Roses, Capsicum	
5	Preparation of Kimichi, Alepak, Fruit leather, Mukhwas, Vegetable chips/fryums	
6	Preparation of beverages: Kombucha, Kanji, Ginger bug, Wine	
7	Preparation of bio-articles with resin arts using dried herbs, leaves, flowers, grains, seeds	
8	Preparation, organoleptic evaluation and exhibition cum sale of botanical products	

Semester VI – SIUBOMN321 Post Harvest Technology (Minor) (2 Cr)		**Hr. 30** **Cr. 01**
Paper I: Post Harvest Technology		
• **CO 1: Unit 1 (Post-Harvest Operations)** – **Explain** the importance of post-harvest technology. **Analyze** post-harvest losses and develop solutions to mitigate them. • **CO 2: Unit 2 (Post-Harvest Preservation & Processing)** – **Apply** preservation techniques such as drying, freezing, and canning. **Evaluate** their effectiveness in maintaining food quality.		
Unit I: Post Harvest Operations		**15**
1	**Introduction to post-harvest technology:** Concept, Objectives, Scope, and importance of post-harvest technology in horticultural industry, Post-harvest Losses: Causes and Mitigation (3)	
2	**Post-harvest handling operations:** Overview of post-harvest handling. **Floriculture:** Propagation, post-harvest handling, packing and marketing of Gerbera, Roses, Carnations and Orchids. **Olericulture and Pomology**: Propagation, post-harvest handling, packing and marketing of: Tomato, Mango, Chilli, and **Medicinal plant:** *Stevia rebaurdina* (Madura). (7)	
3	**Storage of horticulture produce**: Types of storage; Preservation technology. (2)	

4	**Marketing**: Grading, packing & transportation. Ways of increasing the market value and shelf life of horticultural produce.(3)	
Unit II: Post-harvest Preservation and Processing		**15**
1	**Post-harvest processing and preservation techniques:** Drying (Sun-drying, Hot air drying, Vacuum drying, Osmotic drying), freezing (Cold air blast freezing, Plate Freezing, Cryogenic Freezing, Dehydro-freezing, Freeze-drying), Irradiation. (6)	
2	**Canning** of fruits and vegetables (1)	
3	**Processing and preservation of fruits using sugar concentrates:** Definition, Principle and preparation of Jam, jelly, fruit candies, and fruit leather. (4)	
4	**Processing and preservation of vegetables using salt concentrates:** Definition, Principle of Pickling, Types and preparation of Pickles (Brine, Vinegar, Indian pickles). Preparation of mix herb powder, vegetable powder, vegetable chips. (4)	