Academic Council Meeting No. and Date : 4 / June 14, 2022

Agenda Number : 2 **Resolution Number : 4.1 & 4.9**

Vidya Prasarak Mandal's
B. N. Bandodkar College of Science (Autonomous), Thane

Syllabus for

Programme : Bachelor of Science

Specific Programme : Botany

[S.Y.B.Sc. Botany]

Revised under Autonomy

From academic year 2022 - 2023

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Preamble

The subject of Botany, also known as Plant Science or Phytology, is an integral part of Basic Science, included in the field of Biology. We can trace its origin from ancient texts and literature, describing medicinal, culinary or economically important plants. Such texts were used by our ancestors to gain knowledge on the 'floral wealth', and also to solve common health ailments. Indian history is also adorned with such wealth, as found in the Vedas. The Ayurvedic System of Traditional Indian medicine is well known. Thus, ever since historic times, herbalists and botanists were revered for their knowledge and relevance in different walks of life

Although Botany is described by many as mere study of structure and functioning of plants, the subject in real sense is multidisciplinary. It is an umbrella, which includes various other scientific aspects of nature. The subject also encompasses various aspects of agriculture, horticulture, forestry, biochemistry, biotechnology, molecular biology, genetics, environmental effects and statistics. As a result, a B.Sc. student in his/her graduation journey of 3 years, undergoes a thorough training in traditional, classical, applied and economical aspects of Biological Sciences in general, in addition to gaining a significant knowledge of useful and relevant plants, as part of B.Sc. Botany program.

Botany is best learnt on the field, rather than classroom. Visits to campus, fields, forests, parks and reserves etc. are an integral part of the program. Besides, the students are also exposed to the dynamic environment of a typical industry, by undertaking visits to Cosmetic industry, Food industry, Agro Industry, Drug industry, Paper industry etc. and other small scale industries. As part of the program, the students are also provided with a wholesome laboratory experience, which helps to generate interest towards the subject and trains them with respect to specific lab-based job requirements. Apart from gaining subject specific knowledge, students also learn important soft skills like leadership, team building, event management, outdoor exploration, disaster management etc. thanks to a plethora of side activities, thus ensuring overall and wholesome development of the student thus preparing them for the future.

Eligibility: Passed 12th standard (HSC) of Maharashtra State Board / CBSE / ICSE board or any other equivalent board with Biology as one of the subjects

Duration: 3 years

Mode of Conduct: Laboratory practical / Offline lectures / Online lectures

Program Outcome:

Program Specific Outcome:

- To build an interest in botanical science.
- To create awareness of different avenues in botanical sciences
- To explore the morphological, anatomical details as well as economic importance of algae, fungi, bryophytes, pteridophytes, gymnosperms and angiosperms.
- To understand physiological processes and adaptations of plants.
- To provide knowledge about environmental factors and natural resources and their importance in sustainable development.
- To explain how current medicinal practices are often based on indigenous plant knowledge and to get introduced to different perspectives on treating ailments according to ethnomedicinal principles.
- To be able to apply statistical tools to gain insights into significantly different data from different sources.
- Students can recall details of the unique ecological and evolutionary features of the local and Indian flora.

VPM's B.N.Bandodkar College of Science (Autonomous), Thane

S.Y.B.Sc. (Botany)

Structure of Programme

Course Code	Course Title	No. of lectures	Credits
BNBUSBO3T1	Plant Diversity II	**45**	**2**
BNBUSBO3T2	Forms and Function II	**45**	**2**
BNBUSBO3T3	Current Trends in Plant Sciences I	**45**	**2**
BNBUSBO3P3	Plant Diversity I Practical	**30**	**3**
	Forms and Function I Practical	**30**	
	Current Trends in Plant Sciences I	**30**	
Total		**225**	**09**

Course Code	Course Title	No. of lectures	Credits
BNBUSBO4T1	Plant Diversity 1I	**45**	**2**
BNBUSBO4T2	Forms and Function II	**45**	**2**
BNBUSBO4T3	Current Trends in Plant Sciences I	**45**	**2**
BNBUSBO4P4	Plant Diversity I Practical	**30**	**3**
	Forms and Function I Practical	**30**	
	Current Trends in Plant Sciences I	**30**	
Total		**225**	**09**

Semester III

Course Code	COURSE TITLE Plant Diversity II	2 Credits (45 lectures)
	MODIFIED SYLLABUS **BNBUSBO3T1**	**LECTURES**
	1) On completion of the course, student will be able to understand, apply, analyze the following: **2)** To relate to scheme and government laws with respect to agriculture **3)** To describe general characters of division Phaeophyta (brown algae) and Class Anthocerotae (hornworts), life cycle of *Sargassum* and *Anthoceros.*To apply the knowledge of nomenclature on traditional and modern classification systems. **4)** To determine the morphological/ diagnostic characteristics of plants belonging to families Brassicaceae, Asteraceae, Euphorbiaceae and Arecaceae. **5)** To construct green walls for sustainable development in urban areas.	
UNIT I	**HISTORY OF SCIENCE AND LAWS**	15
	1.1 HISTORY OF SCIENCE "History of Agriculture System in India: A Legal Perspective"	
	1.2 LAWS RELATED TO AGRICULTURE ● Brief overview of the major causes related to farmers' suicides in India ● Government laws and schemes in response to farmers' suicides (features, eligibility criteria, merits and demerits) - 1. Agricultural Debt Waiver & Debt Relief Scheme, 2008 (ADWDRS) 2. The Maharashtra Money Lending (Regulation) Act, 2014	
	1.3 Indian Nobel Laureates in Molecular biology - 1. Har Govind Khorana 2. Venkatraman Ramakrishnan	
UNIT II	**THALLOPHYTA (ALGAE) & BRYOPHYTA**	15
	2.1 General characters of Division Phaeophyta: Distribution, Cell structure, range of thallus, Economic importance. Structure, life cycle and systematic position of *Sargassum*.	
	2.2 General account of Class Anthocerotae. Structure, life cycle and systematic position of *Anthoceros*, *Funaria* and Musci	
	2.3 Algae in skincare and cosmetology- ● Diatomaceous earth ● *Laminaria* (Kelp) Economic and Ethnic Uses of Bryophytes ● *Marchantia polymorpha* ● *Plagiochasma appendiculata* ● *Polytrichum species* ● *Riccia*	
UNIT III	**ANGIOSPERMS**	15

	3.1 Angiospermic Classification systems • Introduction to Traditional classification (Bentham & Hooker system; Linnaean system) and Modern classification (Angiosperm Phylogeny Group (APG) system) • Objectives and Goal of plant systematic and plant nomenclature • Concept of monomial, binomial and polynomial nomenclature • Principles of International Code of Nomenclature for algae, fungi and plants Taxonomy in relation to • Anatomy • Palynology • Chemical constituents • Embryology • Cytology • Ecology	
	3.2 With the help of Bentham and Hooker's system of Classification for flowering plants study the vegetative, floral characters and economic importance of the following families: • Brassicaceae • Asteraceae • Euphorbiaceae • Arecaceae • Leguminosae • Amaranthaceae	
	3.3 Green wall - Introduction, objectives and types of green walls • Plants used for green walls - *Epipremnum, Thunbergia, Dracaena* • Green walls for sustainable development in urban areas Preservation methods: Dry and wet method	

Course Code	COURSE TITLE Form and Function II	2 Credits (45 lectures)
	MODIFIED SYLLABUS **BNBUSBO3T2**	**LECTURES**
	On completion of the course, student will be able to understand, apply, analyze the following: 1. To outline cell division and its significance, chromosomal aberrations, sex determination in plants and background of transposons types, structure of nucleic acids, DNA replication and transcription 2. To identify extranuclear genetics in plants and effects of mitochondrial disease 3. To examine the ultrastructure and functions of the cell organelles (Mitochondria, Glyoxysomes and Ribosomes), eukaryotic chromosomes, Nucleic acids and control of mitosis 4. To develop electrophoresis skills as an effective separation technique.	
UNIT I	**CELL BIOLOGY**	15
	1.1 Ultra structure and functions - ● **Energy converter -** Mitochondria ● **Membranous cytoplasmic organelle**- Peroxisomes and Glyoxysomes ● **Non-membranous organelle** - Ribosomes (Prokaryotic and Eukaryotic)	
	1.2 Cell Division and its significance ● Structure and types of eukaryotic chromosome (Metacentric, submetacentric, acrocentric and telocentric), Autosomes and sex-chromosomes ● Cell cycle ● Structure of Interphase Nucleus (nuclear envelope, chromatic network, nucleolus and nucleoplasm) ● Check points (brief) ● **Cell division** - Mitosis and Meiosis	
	1.3 Introduction to - ● **Mitochondrial diseases** - CPEO, Leigh syndrome ● **Controlling Mitosis** - Apoptosis	
UNIT II	**CYTOGENETICS**	15
	2.1 Chromosomal Aberrations ● **Introduction to variation in Chromosome number (numeric aberrations) -** Euploidy (Monoploidy, diploidy, polyploidy - autopolyploidy, allopolyploidy), Aneuploidy - Monosomy, trisomy ● **Introduction to variation in Chromosome structure -** Deletions Duplications Inversions and Translocations	

	2.2 Classical Genetics and Sex determination ● Epistatic interactions - Recessive epistasis (9:3:4), Dominant Epistasis (12:3:1) and non epistatic interactions (9:3:3:1) ● **Sex determination -** Chromosomal Methods: heterogametic males and heterogametic females. Sex determination in monoecious and dioecious plants. ● Genic Balance Theory of sex determination in Drosophila, Lyon's Hypothesis of X chromosome inactivation. ● **Sex linked-** eye colour in *Drosophila*, Haemophilia, colour blindness ● **Sex influenced-** baldness in man **Extranuclear Genetics** ● Plastid transmission in *Mirabilis jalapa* ● Cytoplasmic male sterility (CMS) in maize	
	2.3 Transposable elements ● Barbara McClintock - Introduction ● The Discovery of Jumping Genes (Transposons)	
UNIT III	**MOLECULAR BIOLOGY**	15
	3.1 DNA replication : Modes of Replication, Messelson and Stahl Experiment, **DNA replication in prokaryotes and eukaryotes-** enzymes involved and molecular mechanism of replication	
	3.2 Molecular basis of heredity: ● Structure and types of DNA and RNA ● **Transcription** in prokaryotes and eukaryotes: promoter sites, initiation, elongation and termination. ● **RNA processing:** Adenylation & Capping. ● Central dogma of Protein synthesis	
	3.3 Electrophoresis: Principle and techniques of Horizontal and Vertical Electrophoresis	

Course Code	COURSE TITLE Current Trends In Plant Sciences I	2 Credits (45 lectures)
	MODIFIED SYLLABUS **BNBUSBO3T3**	**LECTURES**
	On completion of the course, student will be able to understand, apply, analyze the following: **1)** To explain social forestry, agroforestry, urban forestry, deforestation, reforestation, afforestation **2)** To identify paper, fiber, spice yielding plants **3)** To apply knowledge of Pharmacopeia, substitutes-adulterants, cellulase, protease, biofuels in industry **4)** To perceive knowledge about space foods and role model personalities **5)** To evaluate the aromatic plants, nutraceuticals and superfoods **6)** To develop practical skills of compound microscope, muffle furnace and TLC	
UNIT I	**PHARMACOGNOSY AND PHYTOCHEMISTRY**	15
	1.1 Introduction to Pharmacognosy and Pharmacopoeia, • Concept of Pharmacognosy • Indian Pharmacopoeia, • Indian Herbal Pharmacopoeia • Ayurvedic Pharmacopoeia	
	1.2 Concept of Monograph w.r.t example of *Eclipta alba* • Concept and types of Substitution/ Adulteration, • Substitute - E.g. Jaipatri and Jaiphal • Adulterant - E.g. Henna (*Lawsonia inermis)* & p-phenylenediamine (PPD)	
	1.3 Instruments used in Pharmacognostic study Working principle and uses: • Compound Microscope & Electron microscope • Muffle Furnace • Chromatography - TLC Career opportunities in Pharmaceutical Industry	
UNIT II	**FORESTRY AND ECONOMIC BOTANY**	15
	2.1 Forestry Forestry: Outline of types of forest in India • Aims and objectives of Social Forestry Programmes • Concept and significance of Agroforestry, Urban Forestry, Deforestation, Reforestation • Waste land management by Afforestation	
	2.2 Economic Botany • Fibre yielding plants (Cotton, Jute), Paper yielding plants (Eucalyptus, Bamboo), Spice yielding plants (Cardamom, Saffron) • Current trends in Marketing of Fibre and Spices	
	2.3 Role Model Personalities: • Padmashri Jadav Payeng (Forestman of India), • Padmashri Tulsi Gowda (Encyclopedia of Forest) • Kandal Pokkudan (Environmental activist and Writer from Kerala) • organic farming, Silviculture	

UNIT III	**INDUSTRY BASED ON PLANT PRODUCTS**	15
	3.1 PLANT-BASED INDUSTRIES **Enzyme industry** ● Source, properties, industrial & medicinal uses of - Cellulase, Protease (papaya & pineapple), Bromelain **Biofuel industry** ● Introduction, need & scope of biofuels, merits and demerits ● Concept of - 1st generation biofuels, 2nd generation biofuels, 3rd generation biofuels & 4th generation biofuels	
	3.2 PLANT BASED THERAPIES & NUTRITION **Integrative & Alternative medicines - AROMATHERAPY** ● Introduction, branches, applications, scope of Aromatherapy ● Botanical source, Physical & Chemical properties, application & uses of - Sandalwood, lemon, Jasmine, Jojoba **Botanical & Nutraceutical industry** ● Importance & scope ● Source, properties, uses of Vanilla, synthetic vanilla ● Source, nutritional profile, benefits & culinary uses of Pomegranate and Spinach, / *Garcinia cambogia, Kale*	
	3.3 CURRENT TRENDS & FUTURE OF NUTRACEUTICALS **Superfoods** ● Concept; source, nutritional profile & benefits of desi-superfoods : Kokum, Moringa **Space foods & Astrobotany** ● Concept; foods used in current space programmes; algae used as space foods - *Spirulina*, *Chlorella*	

	PRACTICAL Paper I – PLANT DIVERSITY II	
SR. NO.	**BNBUSBO3P3**	**LECTURE/ CREDIT**
	On completion of the course, the students will be able to: **1)** Identify and understand the morphology, anatomy and sexual reproduction in *Sargassum* and *Anthoceros* **2)** Outline the uses of algae in cosmetology, bryophytes in ethnobotany, plants in green walls. **3)** Demonstrate qualitative Tests for Phenols and Flavonoids. **4)** Identify, classify and describe the characteristics of Families Asteraceae, Brassicaceae, Euphorbiaceae and Arecaceae **5)** Make use of Government laws & schemes for farmers **6)** Recognize contributions by Har Govind Khorana and Venkatraman Ramakrishnan	
	History Of Science And Laws	30 L
1.	Case studies on Government laws & schemes for farmers • ADWRDS (any two)	
2.	Contributions by 1. Har Govind Khorana 2. Venkatraman Ramakrishnan	
	Algae & Bryophyta	
3.	Study of stages in the life cycle of *Sargassum* from fresh/ preserved material and permanent slides.	
	Study of stages in the life cycle of *Funaria* from fresh/ preserved material and permanent slides.	
4.	Algae in skincare and cosmetology- • Facemask • Shampoo and conditioner • Eye gel	
5.	Economic importance and range of thallus in Phaeophyta	
	Angiosperms	
6.	Study of plants for anatomy in relation to taxonomy	
7.	Study of one plant from each family prescribed for theory: morphological peculiarities and economic importance of the members of these families. Asteraceae, Brassicaceae, Euphorbiaceae, Arecaceae	
8.	Preparation of layout - • Indoor vertical wall • Outdoor vertical wall	
9.	Identification of plants used for Green walls - *Epipremnum*, *Thunbergia*, *Dracaena*, *Tradescantia*, *Adiantum*, *Chlorophytum*, *Zephyranthes* (Rain lily), *Nephrolepis*, *Syngonium*, *Codiaeum*	
10.	Preparation of herbarium and wet preservation technique	
11.	Chromatography: Separation of amino by circular paper chromatography	
12.	Separation of Carotenoids by thin layer chromatography	
13.	Horizontal and Vertical Gel Electrophoresis – Demonstration	

	PRACTICAL Paper II – FORM AND FUNCTION II	
On completion of the course, the student would be able to: **1)** Describe the structure and functioning of cell organelles using photomicrographs. **2)** Acquaint themselves with the technique of electrophoresis and quantitatively estimating DNA and RNA from plant material. **3)** Describe inheritance patterns with reference to plastid inheritance. **4)** Identify and describe laggards and ring chromosomes from photomicrographs. **5)** Learn the technique of squash and smear slide preparations, essential for understanding the stages seen in mitosis and meiosis. **6)** Understand the concepts Sanger sequencing and determination of amino acid sequence from m-RNA strand in prokaryotes and eukaryotes.		
SR. NO.	**BNBUSBO3P3**	**LECTURE/ CREDIT**
	Cell Biology	30 L
1.	Study of the ultrastructure of cell organelles from photomicrographs - Mitochondria, glyoxysomes and ribosome	
	Cytogenetics	
2.	Study of inheritance pattern with reference to Plastid Inheritance	
4.	Identification of Transposons/Jumping genes (Ac and Ds elements in Maize) and cytological consequences of chromosomal aberrations-Laggards, Chromosomal Bridge, Ring chromosome, chromosome clumping, C-mitosis with the help of photomicrograph	
5.	Smear preparation and examining various stages of meiosis from suitable plant material	
	Molecular Biology	
6.	Horizontal and Vertical Gel Electrophoresis – Demonstration	
7.	DNA sequencing- Sanger's method	
8.	Determining the sequence of amino acids in the protein molecule synthesised from the given m-RNA strand (prokaryotic and eukaryotic)	
9.	Estimation of DNA from plant material (one Std & one Unknown, No Std Graph)	
10.	Estimation of RNA from plant material (one Std & one Unknown, No Std Graph)	
11.	Study of metacentric, sub-metacentric, acrocentric telocentric chromosome, B-Form, A-Form, and Z-Form of DNA, tRNA and different stages in cell cycle from photomicrographs	

	PRACTICAL Paper III – CURRENT TRENDS IN PLANT SCIENCES I	
On completion of the course, the student would be able to: **1)** Describe the macroscopic and microscopic characters of *Lawsonia inermis and Eclipta alba* **2)** Understand the biodiversity by visiting a Campus/ National Park (SGNP)/Urban Garden **3)** Learn about the sources of paper, fibres, spices and condiments. **4)** Acquaint the knowledge regarding the preparation of herbal cosmetics. **5)** Describe the method of estimation of alpha amino nitrogen, vitamin C and sugar **6)** To recognize the contribution of role model personalities		
SR. NO.	**BNBUSBO3P3**	**LECTURE/ CREDIT**
1.	1. Study of Instruments: Working principle and uses of Compound Microscope and Muffle Furnace 2. Study of monograph of *Eclipta alba* w.r.t. Macroscopy, Microscopy, Ash-Extractive values (demonstration) and TLC 3. Study of *Lawsonia inermis* w.r.t. Macroscopy, Microscopy, Ash-Extractive values (demonstration) and TLC 4. Preparation of herbal cosmetics (Face pack, De-tanning cream and Herbal Hair oil)	
2.	5. Visit to Campus/ National Park (SGNP)/Urban Garden 6. Study of sources of Fibres, Paper and Spices plants (as in theory) 7. Role Model Personalities - Padmashri Jadav Payeng (Forestman of India), Padmashri Tulsi Gowda (Encyclopedia of Forest), Kandal Pokkudan (Environmental activist and Writer from Kerala)	
3.	8. Evaluation of nutraceutical value of mushroom/wheat germ. A. Alpha amino nitrogen estimation B. Vitamin C estimation by Titrimetric method C. Sugar estimation by DNSA method	
4.	Estimation of crude fibre in cereals & their products (to be added in TY)	
5.	Preparation & evaluation of probiotic foods	

Semester IV

Course Code	COURSE TITLE Plant Diversity 1I	2 Credits (45 lectures)
tion of the course, student will be able to understand, apply, analyze the following: **1.** To describe general characters of class Ascomycetae (sac fungi), lichens, Chamberlains classification of Gymnosperm, life cycle of *Xylaria*, *Alternaria*, *Selaginella* and *Pinus* **2.** To identify plant diseases caused by fungi and Virus (Powdery Mildew and Yellow Vein Mosaic). **3.** To discover the economic importance of lichens, pteridophytes and gymnosperms. **4.** To interpret geological timescale with respect to fossils of pteridophytes and gymnosperms.		
	BNBUSBO4T1	**LECTURES**
UNIT I	**THALLOPHYTA: FUNGI, PLANT PATHOLOGY AND LICHENS**	15
	1.1 Fungi & Lichen: ● General characters of Ascomycetes ● Structure, life cycle and systematic position of *Xylaria and Alternaria*, *Erysiphe* ● Classification, Structure of Lichens	
	1.2 Plant Pathology: Symptoms, causative organism, disease cycle and control measures of ● Powdery Mildew ● Late blight of potato ● Yellow Vein Mosaic Bhindi	
	1.3. Interesting facts - ● Bioluminescent fungi - *Armillarria sps., Mycena sps.* ● Lichens as spices - *Parmelia* ● Lichens in cosmetics – *Usnea* Lichens- Classification, Structure, Method of Reproduction,	
UNIT II	**PTERIDOPHYTA AND PALEOBOTANY**	15
	2.1 Pteridophyta: ● Systematic position, external morphology, anatomy of leaf, stem and life cycle of *Selaginella* Salient features and classification upto orders (with examples of each) of Psilophyta and Lepidophyta (G M Smith's system of classification to be followed)	
	2.2 Paleobotany: ● The geological time scale; ● Formation and types of fossils; ● Structure and systematic position of form genus *Rhynia*	
	2.3 Economic importance ● Uses of *Azolla* as biofertilizer ● Use of *Salvinia* as pollution indicator ● Use of *Pteris* in phytoremediation	

UNIT III	**GYMNOSPERMS**	15
	3.1 Living Gymnosperm Chamberlains classification of gymnosperms (upto order level) Structure, life cycle and systematic position of *Pinus*	
	3.2 Fossil Gymnosperm Structure, life cycle and systematic position of form-genus *Cordaites*	
	3.3 Economic importance of Conifers - Gymnosperms in indigenous medicines - ● *Cedrus deodara* - Deodar ● *Abies spectabilis* - Talispatra Gymnosperms in modern medicines - ● *Taxus wallichiana* - Taxol ● *Ephedra sinica* - Ephedrine	

Course Code	COURSE TITLE Form and Function II	2 Credits (45 lectures)
On completion of the course, student will be able to understand, apply, analyze the following: **1)** To demonstrate aerobic and anaerobic respiration, photoperiodism and vernalization. **2)** To apply principles of sustainable development and eco-friendly practices in daily life **3)** To compare ecological successions w.r.t. hydrosere and xerosere, normal secondary growth in dicot root and stem, various types of vascular bundles and mechanical tissues. **4)** To evaluate soil as an edaphic factor and plants as ecological indicators. **5)** To develop skills of microtomy & permanent slide preparation.		
	BNBUSBO4T2	**LECTURES**
UNIT I	**ANATOMY**	15
	1.1 Secondary growth ● Types of Vascular Bundles ● Normal Secondary Growth in Dicotyledonous stem and root. ● Growth rings, periderm, lenticels, tyloses, heart wood and sap wood	
	1.2 Distribution of Mechanical tissues a) Inflexibility, b) Incompressibility, c) Inextensibility and d) Shearing stress	
	1.3 Microtomy ● Introduction, importance, uses of Microtome ● Preparation of permanent slides	
UNIT II	**PLANT PHYSIOLOGY AND PLANT BIOCHEMISTRY**	15
	2.1 Respiration: ● Aerobic**:** Glycolysis, TCA Cycle, ETS & Energetic of respiration ● Anaerobic respiration : Ethanol fermentation and Lactic acid fermentation.	
	2.2 Photoperiodic receptors : ● Phytochromes : Physico-chemical properties of phytochrome, Pr-Pfr interconversion, role of phytochrome in flowering of SDPs and LDPs. ● Cryptochromes: function in plants	
	2.3 Physiology of flowering ● Vernalization: mechanisms and applications ● ABC model of flower development	
UNIT III	**ECOLOGY AND ENVIRONMENTAL BOTANY**	15
	3.1 Pedology Soil as an edaphic factor, Soil composition, types of soil, soil formation, soil profile. Biogeochemical Cycles- Carbon, Nitrogen and Water.	

	3.2 Ecological Succession • Hydrosere, Xerosere, Climax concept • Plant as ecological indicators (*Oscillatoria*, Lichens/Moss, *Salvadora*, *Butea*, *Calotropis*, *Polygonum* Concept of environmental factors	
	3.3 Sustainable Development Concept, 3 pillars, Sustainable Development Goals (SDGs), Environment Friendly Practices - 4R principle (Reduce, Reuse, Recycle and Recover) Community ecology- Characters of community - Quantitative characters and qualitative characters	

Course Code	COURSE TITLE Current Trends In Plant Sciences I	2 Credits (45 lectures)
completion of the course, student will be able to understand, apply, analyze the following: **1)** To understand the concept of horticulture, different types of gardens, totipotency and r-DNA technology. **2)** To apply knowledge of garden features, indoor gardening, PTC lab organization and hairy root cultures **3)** To conclude using statistical tools (Chi square test and coefficient of correlation). **4)** To examine different tools of Excel and Bioinformatics. **5)** To develop practical skills of laminar air flow, autoclave and hot air oven		
	BNBUSBO4T3	**LECTURES**
UNIT I	**HORTICULTURE AND GARDENING**	15
	1.1 Horticulture ● Introduction, Branches of Horticulture ● Gardening - Locations in the garden- edges, hedges, lawn, flower beds, avenue, water garden, Focal point(with names of two plants for each category).	
	1.2 Types of garden ● Formal and informal gardens ● Public and Private garden (VJBU and Hiranandani Garden)	
	1.3 Indoor gardening Importance, basic concepts w.r.t. maintenance (easy, medium, high), beautification, utility National Park: Sanjay Gandhi National Park. o Botanical Garden:	
UNIT II	**BIOTECHNOLOGY**	15
	2.1 Introduction to plant tissue culture ● Laboratory organization and techniques in plant tissue culture ● Totipotency ● Organogenesis, callus. regeneration of multiple shoots ● Hairy root culture Organ culture – root cultures, meristem cultures, anther and pollen culture, embryo culture.	
	2.2 R-DNA technology ● Gene cloning ● Enzymes involved in Gene cloning ● Vectors used for Gene cloning plasmid - pBR322, pUC19, Ti-plasmid, bacteriophage, cosmid, BAC, YAC	
	2.3. Instruments - ● Laminar air flow ● Autoclave ● Hot air oven	
UNIT III	**BIOSTATISTICS AND BIOINFORMATICS**	15
	3.1 BIOSTATISTICS: ● Chi square test. ● Correlation – Calculation of coefficient of correlation	

	3.2 BIOINFORMATICS: ● **Introduction to Bioinformatics** ● **Tools of Bioinformatics**: tools for web (FASTA, BLAST, BLAT, RASMOL) ● **Databases:** GENBANK, Pubmed, PDB ● Applications of Bioinformatics. ● Information technology: History and tools of IT, Internet and its uses**.**	
	3.3 EXCEL - INTERMEDIATE ● Tabs used in excel ● Data entry and graphical representation	

	PRACTICAL Paper I – PLANT DIVERSITY 1I	
On completion of the course, the student would be able to: **1)** Identify specimens of *Erysiphe, Alternaria, Selaginella* and *Pinus.* **2)** Describe bioluminescent fungi, fungal diseases and lichens **3)** Outline the uses of lichens, pteridophytes and medicinal gymnosperms **4)** Discover fossil plants *Rhynia* & *Cordaites* using permanent slides		
SR. NO.	**MODIFIED SYLLABUS BNBUSBO4P4**	**LECTURE/ CREDIT**
	Fungi and Plant Pathology	30 L (1 Credit)
1.	Study of stages in the life cycle of *Xylaria* from fresh/ preserved material and permanent slides.	
2.	Study of stages in the life cycle of *Alternaria* from fresh/ preserved material and permanent slides.	
3.	Study of fungal diseases as prescribed for theory	
4.	Study of Lichens (crustose, foliose, & fruticose).	
	Study of Bioluminescent fungi and economic importance of lichens with the help of permanent slides/ photomicrographs	
	Study of stages in the life cycle of *Erysiphe* from fresh/ preserved material and permanent slides.	
	Pteridophyta and Palaeobotany	
5.	Study of stages in the life cycle of *Selaginella* from fresh/ preserved material and permanent slides.	
6.	Study of form genera *Rhynia* with the help of permanent slides/ photomicrographs	
	Economic importance of Pteridophytes - • *Azolla* as biofertilizer • *Salvinia* as pollution indicator • *Pteris* in phytoremediation	
7.	Study of stages in the life cycle of *Pinus* from fresh/ preserved material and permanent slides.	
8.	Study of the form genus *Cordaites* with the help of permanent slide/ photomicrographs	
9.	Medicinal Gymnosperms sources & uses of - deodar, talispatra, taxol, ephedrine	

	PRACTICAL Paper II – FORM AND FUNCTION II	
SR. NO.	**MODIFIED SYLLABUS BNBUSBO4P4**	**LECTURE/ CREDIT**
On completion of the course, the student would be able to: **1)** Study normal secondary growth in dicotyledonous root and stem, mechanical tissue systems, types of vascular bundles, lenticels, tyloses, growth rings, heartwood and sapwood through sectioning and staining. **2)** Learn the technique of performing experiments to study Q10, NR activity and estimate proteins. **3)** Understand the working and use of various ecological instruments and study soil composition. **4)** Learn the technique of kitchen waste management **5)** Understand plant as ecological indicators and SDG		
	Anatomy	30 L (1 Credit)
1.	Staining technique: Double staining (T.S. of Sunflower stem)	
2.	Study of normal secondary growth in the stem and root of a Dicotyledonous plant	
3.	Distribution Mechanical tissues • Inflexibility (Sunflower stem) • Incompressibility (Arum petiole) • Inextensibility (Maize stem) • Shearing stress (Banana leaf/ Typha stem)	
4.	Identification of the following using microphotograph/ specimen • Growth rings • Periderm • Lenticels • Tyloses • Heart wood and sap wood • Types of Vascular Bundles • Microtome	
5.		
	Plant Physiology and Plant Biochemistry	
6.	Q10 – germinating seeds using Phenol red indicator	
7.	NR activity – *in-vivo*	
8.	Estimation of proteins by Lowry's method (Prepare standard graph).	
	Ecology and Environmental Botany	
9.	Study of the working of the following Ecological Instruments- Soil thermometer, Soil testing kit, pH Meter, Wind anemometer.	
10.	Mechanical analysis of soil by the sieve method & Soil pH Plants as ecological indicators - *Oscillatoria,* Lichens/Moss, *Salvadora, Butea, Calotropis, Polygonum*	
11.	Sustainable development goals (SDGs)	
12.	Kitchen waste management (DEMONSTRATION)	

	PRACTICAL Paper III – CURRENT TRENDS IN PLANT SCIENCES I	
On completion of the course, the student would be able to: **1)** Know and understand the different plants used in various garden locations and indoor gardening **2)** Demonstrate the method of preparing garden plans for formal, informal, private and public garden **3)** Acquaint themselves with the knowledge regarding different sterilization techniques, seed sterilization and stock preparation **4)** Describe various cloning vectors **5)** Understand the concepts of Chi-Square test and Coefficient of Correlation. **6)** Learn and practice BLAST and Excel		
SR. NO.	**MODIFIED SYLLABUS BNBUSBO4P4**	**LECTURE/ CREDIT**
	Horticulture	30 L (1 Credit)
1.	Study of five examples of plants for each of the garden locations as prescribed for theory	
2.	Preparation of garden plans – formal and informal garden, private and public garden	
3.	Plants used in indoor gardening • *Phalaenopsis (*Moth orchid) • *Echeveria* • *Zebrina* (Wandering Jew) • *Liriope* (Spider plant) • *Sansevieria (*Mother-in-law's Tongue) • *Dieffenbachia* (Dumb cane)	
	Biotechnology	
4.	Various sterilization techniques - (Wet & Dry Sterilization)	
5.	Preparation of Stock solutions for MS medium	
6.	Calculation and Preparation of MS medium (25ml, 50 ml and 100 ml) - (liquid and solid media)	
7.	Seed sterilization and inoculation, callus induction, Regeneration of plantlet from callus	
8.	Identification of the cloning vectors – pBR322, pUC 18, Ti plasmid, bacteriophage, cosmid, BAC, YAC	
	Biostatistics and Bioinformatics	
9.	Chi square test	
10.	Calculation of coefficient of correlation	
11.	BLAST	
12.	Excel - pi-chart, Bar chart, Histogram	

Evaluation Scheme

Internal Assessment:

The internal assessment of 40 Marks for each course will be as follows:

Continuous Internal Assessment (I. A.) will be conducted by Department of Botany independently (30 M for curriculum and Extra-curriculum & 10 M for Attendance & Leadership qualities)

Curriculum and Extra-curriculum	Attendance & Leadership qualities	Total
30	10	40

Internal Assessment may include:

Curriculum and Extracurricular (30M)

Research – Presentation/ Paper review/ Book review/ Project/ Publication of Research Paper

OR

Writing skills - Essay writing/ Report on - Campus visit/ Industry Visit/ Field Trip/ Visit to a garden/ Report on Conference – Workshop – Seminar – Webinar attended/ Intercollegiate competition participation/ Science movies review/ Assignment/ Case studies on topics assigned

OR

Skill development – Flip the class/ Open Viva/ Debate/Group Discussion/ Quiz/ e-herbarium/ Photogallery- Nature Photography, Flora & Fauna/ Botanical illustrations/ Model making/ Survey of topic assigned

OR

Green Campus efforts - Raising and maintaining plant/ maintenance of departmental garden

OR

Active participation in Departmental Club (Botany Club/ Movie & Journal Club)

OR

Class test

OR

Certification from Swayam / NPTEL (Courses in Biosciences), Certificate courses related to Botanical sciences (minimum 5 hours = 10 marks in only one paper)

OR

Introduction to Basic MS-Excel/ Advanced MS-Excel /Python (minimum 5 hours = 10 marks in only one paper)

*Note – If a candidate failed to submit assigned work in time due to genuine reason, then it can be compensated by assigning a new task for the benefit of the candidate.

Theory Examination: Suggested Format of Question paper

Duration : 2 Hours **Total Marks : 60**

- **All questions are compulsory**

Q. 1	Answer ***any two*** of the following		**16**
	a	Based on Unit I	
	b	Based on Unit I	
	c	Based on Unit I	
	d	Based on Unit I	
Q. 2	Answer ***any two*** of the following		**16**
	a	Based on Unit II	
	b	Based on Unit II	
	c	Based on Unit II	
	d	Based on Unit II	
Q. 3	Answer ***any two*** of the following		**16**
	a	Based on Unit III	
	b	Based on Unit III	
	c	Based on Unit III	
	d	Based on Unit III	
Q. 4	Choose and write the correct option for the following questions (Attempt all MCQs)		**12**
	a - d	Based on Unit I	
	e - h	Based on Unit II	
	i - l	Based on Unit III	

** [4 questions of 8 marks each with 50% options/1MCQ of 1 mark (total 12) can be asked]

Books and References:

Sr. No.	Title	Author/s	Publisher	Edition	Year
1.	College Botany Volume I and II	Gangulee, Das and Dutta	Central Education enterprises 2		1989
2.	A Text Book of Botany – Algae	Pandey, B.B	S. Chand & Co. (P) Ltd, New Delhi.		
3.	Botany for Degree students	Dutta, A.C.	India: Oxford University Press	2nd	1988
4.	An Introduction to Mycology	Mehrotra R. and Aneja K.R	New Age International (P) Limited, Publishers	1st	2015
5.	A Text Book of Bryophyta, Pteridophyta and Gymnosperms.	Sambamurty, A. V. S. S.	I.K. International Publishing House Pvt. Limited.	1st	2006

6.	The Ayurvedic Pharmacopoeia of India. Part 1 Vol II	Government of India, Ministry of AYUSH,	Pharmacopoeia Commission For Indian Medicine & Homoeopathy Ghaziabad		2001
7	Indian Pharmacopoeia 2018	Indian Pharmacopoeia Committee	Indian Pharmacopoeia Committee		2021
8	Indian Herbal Pharmacopoeia	Indian drug Manufacturers' Association	Mumbai : Indian drug Manufacturers' Association		2002
9	Textbook of Pharmacognosy	Gokhale, S.B., Kokate C.K. and Purohit, A.P.	Nirali Prakashan	29th	2009
10	Pharmacognosy - Fundamentals, Applications and Strategies	Maccreath, S.B. and Delgoda, R.	Elsevier Publishers	1st	2016
11	Practical Pharmacognosy	Kokate C.K. and Gokhale, S.B.	Nirali Prakashan		2009
12	Indian Forestry: A breakthrough approachto Forest Service	Manikandan & Prabhu	Jain Brothers, New Delhi	7th	2012
13	Objective Forestry : For All Competitive Examination	Parthiban, K.T., Vennila, S., Durairasu, P and Kanna, S.U.	Competition Tutor	3rd	2014
14	Economic Botany	Pandey B.P.	S. Chand Publishers		1978
15	Economic Botany - A Comprehensive Study	Kochhar S.L.	Cambridge University Press India Pvt. Ltd.	5th	2016
16	Fundamentals of Biostatistics	Rastogi, V.B	Ane Book India	2nd	2009
17	Cell biology	Rastogi, S.C.	TATA McGraw Hill publishing Co, New Delhi		2005

18	Fundamentals of Ecology	E P Odum and G W Barrett	United States: Saunders		1967
19	Ecology & Environment	Sharma P.D.	Rastogi Publications	12th	2007
20	Textbook of Soil Science	Mukherjee S.K.	Tata-McGraw Hill New Delhi	2nd	1994
21	Ecological Indicators Vol I	McKenzie, Daniel H., Hyatt, D. Eric, McDonald, V. Janet	Popular Science		1992
22	Environment & Sustainable Development	Fulekar M.H., Pathak B. and Kale R.K.	Springer		2013
23	The Age of Sustainable Development	Jeffrey Sachs	Columbia University Press		2015
24	Cell and Molecular Biology : Concept and Experiments Vol. 2	Karp, G.	John Wiley and Sons, Inc., USA.		1999
25	Genetics	Singh B.D	Kalyani Publication, Ludhiana		2004
26	Molecular Biology of the Cell	Albert B. Bray, D Lewis, J Raff, M. Robert, K. and Walter	Garland Publishing Inc, New York.	2nd	1989
27	Genetics	Russel	Wesley Longman inc publishers	5th	2000
28	Practical Volume 1 and 2	Bendre and Kumar	Rastogi Publication, Meerut	1st	2008
29	Botany for Degree Students: Gymnosperms	Sinha, A. K., Kumar, A. and Vashishta, P.C	S. Chand & Company Pvt.	3rd	2006
30	Cryptogamic Botany Volume I and II	G M Smith	Tata McGraw Hill		
31	Pteridophyta, Gymnosperm and Paleobotany	Singh, Panday and Jain,	Rastogi publication, Meerut	1st	2017
32	College Botany Volume I and II	Gangulee, Das and Dutta	Central Education enterprises 2		1989
33	Botany for Degree students	Dutta, A.C..	India: Oxford University Press	2nd	1988

34	A Text Book of Bryophyta, Pteridophyta and Gymnosperms.	Sambamurty, A. V. S. S.	I.K. International Publishing House Pvt. Limited.	1st	2006
35	Anatomy	Pandey, B.P.	S. Chand and Co., New Delhi.		2012
36.	A Text Book of Plant Physiology	Verma, V.	Ane Books India	4th	2007
37.	Plant Physiology	Zeiger, E., Taiz, L.	United Kingdom: Sinauer Associates.		2010
38.	Medicinal Plants: Ethnobotanical approach	Trivedi P.C.	Agrobios India		2006
39.	Practical Volume 1 and 2	Bendre and Kumar	Rastogi Publication, Meerut	1st	2008
40.	Basic Bioinformatics	S. Ignacimuthu	Narosa Publication		2013
41.	The Green wall as sustainable tool in Mediterranean cities - The case study of Limassol, Cyprus	N. T. J. Georgi & J. Sophocleus	WSEAS Transactions.		
42.	Aromatherapy, a way of life	Kochhar, B.	Hay House		2016

Marks Distribution and Passing Criterion for Each Semester

Theory					**Practical**		
Course Code	Internal	Min marks for passing	Theory Examination	Min marks for passing	Course Code	Practical Examination	Min marks for passing
BNBUSBO3T1	**40**	**16**	**60**	24	BNBUSBO3P3	**50**	**20**
BNBUSBO3T2	**40**	**16**	**60**	24		**50**	**20**
BNBUSBO3T3	**40**	**16**	**60**	24		**50**	**20**

Theory					Practical		
Course Code	Internal	Min marks for passing	Theory Examination	Min marks for passing	Course Code	Practical Examination	Min marks for passing
BNBUSBO4T1	**40**	**16**	**60**	24	BNBUSBO4P4	**50**	**20**
BNBUSBO4T2	**40**	**16**	**60**	24		**50**	**20**
BNBUSBO4T3	**40**	**16**	**60**	24		**50**	**20**

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