Academic Council dated 20th May, 2021 as per Item Number: 2.03

DOMBIVLI SHIKSHAN PRASARAK MANDAL'S,

K.V. PENDHARKAR COLLEGE OF ARTS, SCIENCE AND COMMERCE(AUTONOMOUS), DOMBIVLI (EAST), DIST. THANE

(Affiliated to University of Mumbai)

Faculty of Science

DEPARTMENT OF BOTANY

(Programme: Bachelor of Science: B.Sc.)

SYLLABUS FOR

F.Y.B.Sc. – BOTANY (Semester I and II)

Choice Based Credit System (CBCS)

(with effect from Academic Year: 2021-22)

FACULTY OF SCIENCE

DEPARTMENT OF BOTANY
PROGRAMME: BACHLOR OF SCIENCE (B.Sc.)

F.Y. B.Sc.

Semester I and II Paper I and II

Syllabus w.e.f Academic Year 2021-22

Syllabus w.e.f Academic Year 2021-22 (CBCS)

F.Y.B.Sc. Semester- I
Botany-I
Course Code: PCUSBOI21-111 Credit: 02

Course Outcomes: On completion of this course the student would be able to: CO1: Gain knowledge about the general characters of division Chlorophyta and Cyanophyta (i.e. and its economic importance) and to understand the systematic position, life cycle of Spirogyra and Nostoc. CO2: Know economic importance of Algae with respect to Chlorophyta and Cyanophyta. CO3: Understand the life cycle of Rhizopus and Aspergillus and to learn the mode of nutrition in Fungi especially Saprophytism and Parasitism. CO4: Understand the general characters of Class Hepaticae and the systematic position, structure, life cycle of Riccia.

Unit	BOTANY PAPER 1:PLANT DIVERSITY I	Lectures (45)
I	**ALGAE**	**15**
1.1	General characters of the class Cyanophyta and Chlorophyta	
1.2	Structure, life cycle & systematic position of *Nostoc*(Cyanophyta) & *Spirogyra*(Chlorophyta)	
1.3	Economic importance of Cyanophyta and Chlorophyta: algae as a source of food, industry and pharmaceutical	
II	**FUNGI**	**15**
2.1	Structure, life cycle and systematic position of *Rhizopu*s and *Aspergillus*	
2.2	Economic importance of Phycomycetes with reference to organic acid production	
2.3	Introduction to plant pathology and study of early blight of tomato/potato	
III	**BRYOPHYTA**	**15**
3.1	Evolution of Hepaticae with reference to sporophytes	
3.2	Structure, life cycle and systematic position of *Riccia*.	
3.3	Economic importance of Bryophytes (Only Hepaticae)	

Botany-II
Course Code: PCUSBOI21-112 Credit: 02

Course Outcomes: On completion of this course the student would be able to: CO1: Understand general structure of plant cell. CO2: Gain knowledge about ultrastructure, composition and functions of various plant cell organelles such as cell wall, Nucleus and chloroplast. CO3: Learn about energy pyramids and how energy flows in an ecosystem. CO4: Acquire knowledge about terrestrial and aquatic ecosystem. Importance of urban water bodies for ecosystem. CO5: Have an understanding about phenotype and genotype and to understand mendelian genetics monohybrid, dihybrid; test cross; back cross ratios. Concept of Karyotype CO6: Introduction of Biostatistics with reference to mean, mode, median, standard deviation and frequency distribution.

Unit	BOTANY PAPER 2:FORM AND FUNCTION I	Lectures (45)
I	**CELL BIOLOGY**	**15**
1.1	General structure of plant cell: cell wall Plasma membrane (lipid bilayer structure, fluid mosaic model)	
1.2	Ultra structure and functions of the following cell organelles: Chloroplast and Nucleus	
1.3	Study of various stages of mitosis	
II	**ECOLOGY**	**15**
2.1	Energy pyramids, energy flow in an ecosystem.	
2.2	Types of ecosystems: aquatic (fresh water, marine water and estuarine system) and terrestrial(forest ecosystem, grassland and desert ecosystem)	
2.3	Importance of urban water bodies for ecosystem	
III	**GENETICS AND BIOSTATISTICS**	**15**
3.1	Phenotype/Genotype, Mendelian Genetics-monohybrid, dihybrid; test cross; back cross ratios.	
3.2	Concept of karyotype (*Allium cepa* and Normal male and female)	
3.3	Introduction to Biostatistics: Study of Mean, Mode and Median, Standard Deviation, Frequency Distribution	

SEMESTER I
PRACTICAL PAPER I: PLANT DIVERSITY I **PCUSBOI21-P111**

Course Outcomes: On the completion of the course the student would be able to: CO1: Identify and describe the morphological and anatomical characteristics of Nostoc and Spirogyra. CO2: Describe the economic importance of Algae. CO3: Develop an understanding of economic importance of fungi along with the demonstration skills in laboratory, field and glasshouse work related to mycology and develop an understanding of fungi like Rhizopus and Aspergillus. CO5: Demonstrate an understanding of antheridia, archegonia, and sporophyte of Bryophytes using Riccia as a specimen

On the completion of the course the student would be able to: CO1: Examine various stages of mitosis in root tip cells of Allium. CO2: Demonstrate and identify cell inclusions such as concentric and eccentric type of starch grains, Aleurone layer, Cystolith, Raphides and Sphaeraphides. CO3: Identify various plant cell organelles such Plastids: Chloroplast, Amyloplast, Endoplasmic Reticulum and Nucleus with the help of photomicrograph. CO4: Observe and learn about different types of ecological adaptations through specimens of Pistia/Eichornia, Nymphaea, Hydrilla, Typha/Cyperus, Opuntia, Nerium, Avicennia pneumatophore. CO5: Develop the skills of statistics by calculating mean, median, mode and standard deviation. CO6: Understand about Frequency distribution, graphical representation of data- frequency polygon, histogram, and pie chart. CO7: Learn about Karyotype of normal male, female and Allium cepa.

	SEMESTER I	**L**	**Cr**
	PRACTICAL PAPER I: PLANT DIVERSITY I **PCUSBOI21-P111**	**30**	**1**
1	How to use a compound microscope		
2	Life cycle of *Nostoc* from fresh/ preserved material and permanent slides.		
3	Life cycle of *Spirogyra* from fresh/ preserved material and permanent slides.		
4	Economic importance of Chlorophyta and Cyanophyta *Ulva* (Biofuel) and *Spirulina* (Nutraceutical)		
5	Life cycle of *Rhizopus* from fresh/ preserved material and permanent slides.		
6	Life cycle of *Aspergillus* from fresh/ preserved		

	material and permanent slides.		
7	Early blight of Potato / Tomato (Identification only)		
8	Economic importance of Phycomycetes		
9	Life cycle of *Riccia* from fresh/ preserved material.		
10	Economic importance of hepaticae		
	PRACTICAL PAPER II- FORM AND FUNCTION I PCUSBOI21-P112	**30**	**1**
1	Cell inclusions**:** Starch grains (Potato and Rice); Aleurone Layer (Maize)		
2	Cystolith (*Ficus*); Raphides (*Pistia*); Sphaeraphides (*Opuntia*).		
3	Identification of cell organelles with the help of photomicrograph: Chloroplast and Nucleus		
4	Identification of plants adapted to different environmental conditions: Hydrophytes: Floating, Free floating (*Pistia*/*Eichhornia*); Rooted floating (*Nymphaea*); Submerged (*Hydrilla*)		
5	Mesophytes (Sunflower/Vinca/Maize); Hygrophytes (*Typha*/*Cyperus*)		
6	Xerophytes: Succulent (*Opuntia*); Woody Xerophyte (*Nerium*); Halophyte (*Avicennia* pneumatophore) No sections in ecology, only identification and description of specimens. Morphological adaptations only.		
7	Study of various stages of Mitosis using Onion root tip		
8	Calculation of mean, median and mode.		
9	Calculation of standard deviation.		
10	Frequency distribution, graphical representation of data- frequency polygon, histogram, pie chart.		
11	Study of karyoptypes in plants and Human		
12	Field Report (One day botanical excursion)		

F.Y.B.Sc. Semester- II
Botany-I
Course Code: PCUSBOI21-211 Credit: 02

Course Outcomes: The student would be able to: CO1: Understand life cycle, the systematic position and alternation of generations in Nephrolepis CO2: Learn the Stelar evolution in Pteridophytes. CO3: Know life cycle, the systematic position and alternation of generations of Cycas as well as to know economic importance of Gymnosperm. CO4: Develop critical understanding on morphology of leaf, flower and Inflorescence. CO5: Identify, classify and describe the characteristics of Families Leguminosae (Fabaceae, Caesalpinae, Mimosae), Combretaceae and Amaryllidaceae

Unit	BOTANY PAPER 1:PLANT DIVERSITY II	Lectures (45)
I	**PTERIDOPHYTES**	**15**
1.1	Classification of Pteridophytes up to classes proposed by G. M. Smith	
1.2	Structure, life cycle, systematic position and alternation of generations in *Nephrolepis*	
1.3	Concept of stele, Steler theory Types and Evolution of Stele	
II	**GYMNOSPERMS**	**15**
2.1	Classification of Gymnosperms upto classes (Chamberlain's system of classification)	
2.2	Structure life cycle systematic position and alternation of generations in *Cycas*	
2.3	Economic importance of Cycadophyta	
III	**ANGIOSPERMS**	**15**
3.1	Leaf: simple leaf, types of compound leaves, Incisions of leaf, venation, phyllotaxy, types of stipules, leaf apex, leaf margin, leaf base, leaf shapes.	
3.2	Morphology of flowers (Details of all whorls) Inflorescence: Racemose: simple raceme, spike, catkin, spadix, panicle. Cymose: monochasial, dichasial, polychasial. Compound: corymb, umbel, cyathium, capitulum, verticellaster, hypanthodium.	

3.3	Study of following families: 1. Leguminosae (Fabaceae, Caesalpinae, Mimosae) 2. Combretaceae 3. Amaryllidaceae	

Botany-II

Course Code: **PCUSBOI21-212** Credit: 02

Course Outcomes: The student would be able to: CO1: Learn about simple and complex plant tissues. CO2: Gain knowledge of primary structure of dicot and monocot root, stem and leaf and to identify types of epidermal hair, monocot and dicot stomata and learn about epidermal tissue system. CO3: Have an understanding of Light reactions, photolysis of water, cyclic and non cyclic photophosphorylation, C3, C4 and CAM pathways involved in the process of photosynthesis. CO4: Get familiar with the concept of primary and secondary metabolites, difference between primary and secondary metabolites. CO5: Introduction to AYUSH, Ayurveda and Tridosha. Know about botanical source, part of the plant used, active constituents present and medicinal uses of plants of grandma's pouch using examples of *Oscimum sanctum, Adathoda vasica, Zinziber officinale, Curcuma longa, Terminalia bellarica, Emblica officinalis* and *Azadiracta indica*. Concept of Nutraceutical Science with introduction, scope and applications

Unit	BOTANY PAPER 2:FORM AND FUNCTION II	Lectures (45)
I	**ANATOMY**	**15**
1.1	Concept of tissue: Permanent tissue (Simple and Complex)	
1.2	Primary structure of dicot and monocot root and stem	
1.3	Epidermal tissue system: types of hair, monocot and dicot stomata.	
II	**PHYSIOLOGY**	**15**
2.1	Concept of Photosynthesis, Pigment system, Photolysis of water	
2.2	Light reactions (Cyclic and Non-cyclic photophosphorylation)	
2.3	Dark reactions (C_3, C_4 and CAM pathway), Importance of photosynthesis with respect to O_2 - CO_2 balance	
III	**MEDICINAL BOTANY**	**15**
3.1	Concept of primary and secondary metabolites, difference between primary and secondary metabolites.	
3.2	Introduction to AYUSH, Ayurveda and Tridosha Concept	

	Grandma's pouch: Following plants have to be studies with respect to botanical source, part of the plant used, active constituents present and medicinal uses: *Oscimum sanctum, Adathoda vasica, Zinziber officinale, Curcuma longa, Terminallia chebula, Terminalia bellarica, Emblica officinalis* and *Azadiracta indica*	
3.3	Concept of Nutraceutical Science: Introduction, scope and applications	

SEMESTER II
PRACTICAL PAPER I: PLANT DIVERSITY II **PCUSBOI21-P211**

Course Outcomes: On the completion of the course the student would be able to: CO1: Demonstrate an understanding of Pteridophytes through the study of life cycle, the systematic position and alternation of generations in Nephrolepis. CO2: Develop critical understanding on morphology, anatomy and reproduction of Gymnosperms like Cycas. CO3: Develop critical understanding on morphology of leaf and inflorescence through study of common plant of nearby locality. CO4: To identify, classify and describe the characteristics of Families Leguminosae (Fabaceae, Caesalpinae, Mimosae), Combretaceae and Amaryllidaceae

On the completion of the course the student would be able to: CO1: Demonstrate and learn about primary structure of monocot and dicot root, stem and stomata. CO2: Understand about unicellular, multicellular, glandular, Peltate, Stellate and T- shaped epidermal outgrowths in plants. CO3: Develop the skills of chromatography by performing separation of chlorophyll pigments and amino acids in laboratory. CO4: Perform of the colour of anthocyanin changes with the change in pH. CO5: Test the amount of tannins from tea powder or *Acacia catechu.* CO6: Identify various plants of grandma's pouch.

	SEMESTER II	**L**	**Cr**
	PRACTICAL PAPER I: PLANT DIVERSITY II **PCUSBOI21-P211**	**30**	**1**
1	Life cycle of *Nephrolepis:* Mounting of ramentum, hydathode, T.S. of rachis.		
2	T.S. of pinna of *Nephrolepis* passing through sorus.		
3	Stelar evolution with the help of permanent slides: Haplostele, Actinostele, Plectostele, Mixed protostele, Siphonostele: Ectophloic, Amphiphloic, Dictyostele, Eustele and Atactostele.		
4	*Cycas:* Sporophyte of *Cycas*, T.S. of leaflet (*Cycas* pinna)		
5	Megasporophyll, microsporophyll, coralloid root, microspore, L.S. of ovule of *Cycas* – all specimens to be shown		
6	Economic importance of Cycadophyta		
7	Leaf morphology : as per theory		
8	Morphology of flower and types of inflorescence: as per theory		

9	Study of families prescribed in the syllabus 1. Leguminosae (Fabaceae, Caesalpinae, Mimosae) 2. Combretaceae 3. Amaryllidaceae		
10	Field Report (One day botanical excursion)		
	PRACTICAL PAPER II- FORM AND FUNCTION II PCUSBOI21-P212	**30**	**1**
1	Primary structure of dicot and monocot root.		
2	Primary structure of dicot and monocot stem.		
3	Study of dicot and monocot stomata.		
4	Epidermal outgrowths: with the help of mountings Unicellular: *Gossypium/*Radish Multicellular: *Lantana/*Sunflower Glandular: *Drosera* and Stinging: *Urtica* – only identification with the help of permanent slides. Peltate: *Thespesia* Stellate: *Erythrina*/*Sida acuta*/*Solanum/Helecteris* T-shaped: *Avicennia*		
5	Separation of chlorophyll pigments by strip paper chromatography.		
6	Separation of amino acids by paper chromatography.		
7	Change in colour because of change in pH: Anthocyanin: black grapes/Purple cabbage		
8	Test for tannins: Tea powder *and Eugenia caryophyllata, Acacia catechu*		
9	Identification of plants or plant parts for grandma's pouch as per theory *Oscimum sanctum* *Adathoda vasica* *Zinziber officinale* *Curcuma longa* *Terminallia chebula* *Terminalia belarica*		

	Emblica officinalis *Azadiracta indica*		
10	Excursion Report		

F.Y.B.Sc. (Botany)
Programme Structure
Semester I

Course Code	Unit	Topics	Credits	L/week
PCUSBOI21-111	**Botany Paper 1:Plant Diversity I**			
	I	Algae	**2**	**1**
	II	Fungi		**1**
	II	Bryophyta		**1**
PCUSBOI21-112	**Botany Paper 2:Forms and Function I**			
	I	Cell Biology	**2**	**1**
	II	Ecology		**1**
	III	Genetics and Biostatistics		**1**
PCUSBOI21-P111		Plant Diversity I Practical	**1**	**6**
PCUSBOI21-P112		Forms and Function I Practical	**1**	

Semester II

Course Code	Unit	Topics	Credits	L/week
PCUSBOI21-211	**Botany Paper1:Plant Diversity II**			
	I	Pteridophytes	**2**	**1**
	II	Gymnosperms		**1**
	II	Angiosperms		**1**
PCUSBOI21-212	**Botany Paper2: Forms and Function II**			
	I	Anatomy	**2**	**1**
	II	Physiology		**1**
	III	Medicinal Botany		**1**
PCUSBOI21-P211		Plant Diversity II Practical	**1**	**6**
PCUSBOI21-P212		Forms and Function II Practical	**1**	

Proposed Evaluation Pattern

Type of evaluation	Types of questions	Weightage
Theory : Internal 40%	One class test (Multiple choice questions)	15 Marks
	Assignment with presentation	15 Marks
	Herbarium preparation (any one)	10 Marks
Theory : External 60%	Multiple Choice Questions and Short Answer Questions	12 Marks
	Medium length answer questions	12 Marks
	Long answer questions	36 Marks
Practicals (2 Papers each semester)	Preparation, Presentations, Performing Observations, Calculations, Conclusions, Results, Viva, Field report and Journal	50 Marks/Paper

References:

1. College Botany Volume I and II Gangulee, Das and Dutta latest edition. Central Education enterprises
2. Cryptogamic Botany Volume I and II by G M Smith McGraw Hill.
3. Genetics by Russel. Wesley Longman inc publishers. (7th edition)
4. Plant Physiology by Taiz and Zeiger Sinauer Associates inc. publishers
5. Fundamentals of Ecology by E P Odum and G W Barrett. Thompson Asia Pvt Ltd. Singapore. 6. Cell Biology by De Robertis
6. Introduction to Biostatistics by P K Banerjee, Chand Publication.
7. Plant Biotechnology by K. Ramawat
8. Taxonomy of Angiosperms by Verma and Agarwal
9. Biostatistics by Mahajan
10. Classical Botany (volume series) by P.C. Vasistha

Academic Council dated 10th February 2022 as per Item Number: 3.03

Dombivli Shikshan Prasarak Mandal's
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Dombivli (E), Thane 421203

FACULTY OF SCIENCE

DEPARTMENT OF BOTANY
PROGRAMME: BACHLOR OF SCIENCE (B.Sc.)

S. Y.B.Sc.

Semester III and IV (Paper I, II and III)

Syllabus w.e.f Academic Year 2022-23

Syllabus w.e.f. Academic Year 2022-23 (CBCS)

S.Y.B.Sc. Semester- III
Botany-I
Course Code: **PCUSBOIII22-311 Credit: 02**.

Unit	PLANT DIVERSITY	Lectures (45)
I	**ALGAE AND BRYOPHYTA**	**15**
1.1	General Characters of Division Phaeophyta: Distribution, Cell structure, range of thallus, Economic Importance.	
1.2	Structure, life cycle and systematic position of ***Sargassum***	
1.3	General Account of Class Anthocerotae and Musci	
1.4	Structure, life cycle and systematic position of ***Anthoceros*** and ***Funaria***	
II	**ANGIOSPERMS**	**15**
2.1	Systematics: Objectives and Goals of Plant systematic 1. Plant Nomenclature 2. Introduction to APG IV system of classification	
2.2	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: 1. Capparaceae 2. Rosaceae 3. Asteraceae 4. Amaranthaceae 5. Poaceae	
III	**MODERN TECHNIQUES TO PLANT DIVERSITY**	**15**
3.1	Preservation Methods: Wet and Dry method	
3.2	Microscopy – Principle and working of Light Microscope	
3.3	Chromatography- Principle and techniques in paper and thin layer chromatography	
3.4	Principles and techniques of Horizontal and Vertical electrophoresis.	

S.Y.B.Sc	Semester III Theory
Paper I **Plant Diversity**	**Course Outcome** 1. Algae: Phaeophyta general structure and *Sargassum* a type genus to study the various stages of the life cycle. 2. Bryophytes: Anthocerotae and Musci with *Anthoceros* and *Funaria* as type genera. 3. Detailed study of classification of Psiliophyta and Lepidophyta 4. Study of *Selaginella*- Systematic position, Life cycle and Alternation of Generations. *5.* Introduction to APG IV system of classification *6.* Study of families with reference to vegetative, floral characters and plants of economic importance. *7.* Various instrumentation techniques such as Microscopy, Chromatography and Electrophoresis **Learner's space:** ➢ Detailed study of diversity in algae, bryophyte and its future applications in industry and environment. ➢ Learning the diversity in Pteridophyta. ➢ Students will be aware about new system of plant classification ➢ Students will be well versed with modern techniques to study diversity in plants with reference to various parameters

Botany-II
Course Code: **PCUSBOIII22-312 Credit: 02**

Unit	FORM AND FUNCTION	Lectures (45)
I	**CELL BIOLOGY**	**15**
1.1	Ultra Structure and functions of the following cell organelles: Endoplasmic reticulum: (Smooth and rough) Peroxisomes and Glyoxysomes and Golgi complex	
1.2	Cell Division and its significance Cell Cycle, structure of Interphase Nucleus (nuclear envelop, chromatin network, nucleolus and Nucleoplasm) Concept of Meiosis and its various stages Difference between mitosis and meiosis	
II	**CYTOGENETICS**	**15**
2.1	Variation in Chromosome structure (Chromosomal Aberrations) Definition, Origin, Cytological and Genetic Effects of the following:Deletions, Duplications, Inversions and Translocations.	
2.2	Concept of Mutation, Hugo de Vries theory (Mutation theory) Types of mutations: Spontaneous Mutations and Induced Mutations Point Mutations and its types i.e. Missense, Nonsense, Silent and Neutral	
2.3	Extranuclear Genetics Streptomycin resistance in *Chlamydomonas* Male sterility in maize and Plastid Inheritance in *Mirabilis jalapa*	
III	**MOLECULAR BIOLOGY**	**15**
3.1	DNA replication : Modes of Replication Meselson and Stahl Experiment	
3.2	DNA replication in prokaryotes and eukaryotes: enzymes involvedand molecular mechanism of replication	
3.3	Protein Synthesis: Central dogma of Protein synthesis Transcription in prokaryotes and eukaryotes: promoter sites, Initiation, Elongation and Termination.	

S.Y.B.Sc	Semester III Theory
Paper II **Form and Function**	**Course Outcomes:** 1. Cell Biology Ultrastructure of cell organelles : Endoplasmic reticulum, Golgi complex, peroxisomes and glyoxysomes 2. Concept of cell division with reference to Meiosis 3. Differentiate between mitosis and meiosis 4. Chromosomal aberrations: Structural and numerical 5. Concept of mutation with suitable examples 6. Replication in prokaryotes and eukaryotes 7. Transcription in prokaryotes and eukaryotes **Learner's space**: ➢ Will learn about cell organelles and their functions ➢ Understand the concept of meiosis with comparative account with that of mitosis ➢ Will be aware about chromosomal aberrations and their effects ➢ Introduction to mutation and its types ➢ Male sterility and plastid inheritance in *Mirabilis jalapa* ➢ With comparison they will learn about replication in prokaryotes and eukaryotes as well as process of transcription in prokaryotes and eukaryotes

Botany-III
Course Code: **PCUSBOIII22-313 Credit: 02**.

Unit	CURRENT TRENDS IN PLANT SCIENCES I	Lectures (45)
I	**PHARMACOGNOSY AND NUTRACEUTICAL SCIENCES**	**15**
1.1	Introduction to Indian pharmacopeia	
1.2	Study of monographs from Indian pharmacopeia	
1.3	Study of following Secondary Metabolites Alkaloids, Tannins, Flavonoids and Glycosides with respect to their Sources, Properties and Uses	
1.4	Concept of adulterants with reference to their medicinal uses in following plants, *Terminalia arjuna and Terminalia cattapa* *Bacopa monnieri* and *Centella asiatica* *Polyalthia longifolia* and *Saraca asoka*	
1.5	Botanical Nutraceuticals: *Spirulina, Vanillin, Garcinia indica and Chlorella*	
II	**FORESTRY**	**15**
2.1	Concept of forests in India Classification of forests based on average rain fall and flora found in those forests	
2.2	Impact of Reforestation and Deforestation	
2.3	Agro-forestry, Urban forestry, Social forestry	
III	**INDUSTRY BASED PLANT PRODUCTS**	**15**
3.1	Economic botany: Fibers: Jute and Cotton Current trends in fibre industeries Spices and Condiments: Saffron and Cardamom, Clove Commercial Markets of spices Paper industry: Bamboo, *Eucalyptus*	
3.2	Plants based enzymes industry: α amylase, Pectinase, Proteases	
3.3	Concept of Biofuels, types of biofuels and its applications	
3.4	Introduction to Aromatherapy, its types and applications	

S.Y.B.Sc	Semester III Theory
Paper III **Current Trends in Plant Sciences**	**Course Outcome** 1. Analytical techniques learning (microscopy, colorimeter andchromatography. 2. Economic importance of plants with the help of examples ofplants yield in terms of fibres, paper and spices. 3. Basic molecular biology concept with respect to DNA, RNA,chromosome and DNA replication. **Learner's space:** ➢ Learning of principles and working of microscopy, colorimetric,Spectrophotometry and Chromatography. Research orientation ➢ Identification and understanding the economic importance offorest products and Spices and condiments. Develop Entrepreneurial skills among the learners ➢ Basic molecular biology concept learning. Research orientation

Sr. No.	SEMESTER III	L	Cr
	PRACTICAL PAPER I: PLANT DIVERSITY PCUSBOIII22-P311	**30**	**1**
1	Study of stages in the life cycle of *Sargassum* from fresh/ preserved sample and permanent slides		
2	Economic importance and range of thallus in Phaeophyta		
3	Study of stages in the life cycle of *Anthoceros* and *Funaria* from fresh/ preserved sample and permanent slides		
4	Study of stages in the life cycle of *Funaria* from fresh/ preserved sample and permanent slides		
7	Study of one plant from each family prescribed for theory: Morphological peculiarities and economic importance of the members of the family		
8	Chromatography: Separation of amino acids by Paper Chromatography		
9	Separation of carotenoids by thin layer chromatography		
10	Electrophoresis: Agarose Gel Electrophoresis demonstration		
	PRACTICAL PAPER II- FORM AND FUNCTION PCUSBOIII22-P312	**30**	**1**
1	Study of ultra structure of cell organelles prescribed for theory using photographs		
2	Study of Meiosis from suitable plant material		
3	Estimation of DNA from suitable plant material (One blank and one unknown) Std. value to be provided		
4	Estimation of RNA from suitable plant material (One blank and one unknown) Std. value to be provided		
5	Study of cytological consequences of chromosomal aberrations: Chromosomal laggards, Chromosomal bridge & chromosomal ring		
6	Types of mutations and problems based on mutations		
7	Determining the sequence of amino acids in the protein molecule synthesized from given mRNA stand (Prokaryotic and Eukaryotic)		

Sr. No.	**SEMESTER III**	**L**	**Cr**
	PRACTICAL PAPER III: CURRENT TRENDS IN PLANT SCIENCES **PCUSBOIII22-P313**	**30**	**1**
1	Study of macroscopic, microscopic characters and Qualitative analysis of phytoconstituents of the following: 1. *Terminalia arjuna and Terminalia cattapa* 2. *Bacopa monnieri* and *Centella asiatica* 3. *Polyalthia longifolia and Saraca asoka*		
2	Identification of botanical Nutraceuticals with the help of photographs(prescribed in theory)		
3	Study of plant diversity (Botanical excursion)		
4	Study of forests types in India (using map)		
5	Plants used in fibre, paper industry and as spices and condiments		

S.Y.B.Sc	Semester III Practical
Practical I **Plant Diversity**	**Course Outcomes:** They aim at enhancing the skills of the studentslearning by doing 1. Experiential learning to mount the specimens of *Sargassum, Anthoceros* and *Funaria* andlearn about the details of the life cycles. 2. Students will study families along with T.S of ovary and L.S. of flower as well as floral formula for the specimen. 3. Separation of DNA using agarose gel electrophoresis **Learner's space:** ➢ Learning the diversity in algae, bryophytes and their future applications ➢ Preparation of herbarium ➢ Well acquainted with electrophoresis technique
Practical II **Form and** **Function**	**Course Outcome:** 1. Study of the ultra-structure of cell organelles 2. Learning different stages of meiosis. Staining techniques 3. Study of chromosomal aberrations 4. Study of mutations and its types 5. Study of inheritance pattern in *Mirabilis jalapa* **Learner's space:** ➢ Understanding the ultra-structure of cell organelles ➢ Learn preparation of smear for meiosis experiment ➢ Will be able to identify type of mutation ➢ Learn to estimate DNA and RNA content using plant sample ➢ Identify prokaryotic and eukaryotic mRNA
Practical III **Current Trends** **in Plant Sciences**	**Course outcome:** 1. Macro, microscopic characters as well as quantitative estimation of phytoconstituents 2. Nutraceuticals study 3. Botanical excursion to observe, study and learn plants belonging to various families 4. Different geographical locations in India on the basis of average rain fall 5. Fibers, paper and spices and condiments identification and uses **Learner's space:** ➢ They will learn to identify adulterants ➢ Applications of neutraceuticals ➢ Explore to various plants belonging to different families ➢ Making them aware about different geographical locations in India

S.Y.B.Sc. Semester- IV
Botany-I
Course Code: **PCUSBOIV22-411 Credit: 02**.

Unit	PLANT DIVERSITY	Lectures (45)
I	**MYCOLOGY AND PLANT PATHOLOGY**	**15**
1.1	General characters of Ascomycetae	
1.2	Structure, life cycle and systematic position of *Erysiphe* and *Xylaria*	
1.3	Plant pathology: Symptoms, causal organism, disease cycle and control measures of apple scab and leaf spot of turmeric	
II	**ANGIOSPERMS AND GYMNOSPERMS**	**15**
2.1	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: 1. Umbelliferae 2. Apocynaceae: sub family: Asclepiadaceae 3. Euphorbiaceae 4. Musaceae	
2.2	Structure and life cycle and systematic position of *Pinus*	
III	**PTERIDOPHYTA**	**15**
3.1	Salient features and classification up to orders (with examples of each) of Psiliophyta and Lepidophyta (G.M. Smith's system of classification)	
3.2	Structure and life cycle and systematic position of *Selaginella*	

S.Y.B.Sc	Semester IV Theory
Paper I **Plant Diversity**	**Course Outcome** 1. Fungi: Students to learn the classification of Ascomycetae. Life cycle study of *Erysiphe* and *Xyleria.* Symbiotic relationships lichen and theirecological significance. 2. Study of fungal diseases 3. Taxonomy of selected plant families along with their plants of economic importance 4. .Detailed study of *Pinus.* 5. Study of life cycle and systematic position of *Selaginella* **Learner's space:** ➢ Learning the diversity in ascomycetes and fungal diseases ➢ Identification of plants on the basis of their morphological characters ➢ Study of gymnosperm, *Pinus* ➢ Life cycle of *Selaginella*

Botany-II
Course Code: **PCUSBOIV22-412 Credit: 02**

Unit	PLANT DIVERSITY	Lectures (45)
I	**ANATOMY**	**15**
1.1	Tissues providing mechanical strength and support and their disposition	
1.2	Concept of I-girdles in aerial and underground organs	
1.3	Vascular bundles, its types with suitable examples	
1.4	Concept of normal secondary growth in Dicot stem and dicot root and Mechanical Tissue System	
II	**PLANT PHYSIOLOGY**	**15**
2.1	Respiration Aerobic: Glycolysis, TCA cycle and ETS Anaerobic respiration	
2.2	Photorespiration	
2.3	Photoperiodism: Phytochrome response and Vernalization with reference to flowering in higher plants Physico-chemical properties of phytochromes, role of phytochromes in flowering plants of SDPs and LDPs	
2.4	Vernalization: Mechanism and applications	
III	**ECOLOGY AND ENVIRONMENTAL BOTANY**	**15**
3.1	Biogeochemical cycles: Carbon, Phosphorus, Sulphur and Water	
3.2	Ecological factors: Concept of environmental factors. Soil as an Edaphic factor, Soil Composition, types of soil formation and soil profile	
3.3	Soil Pollutants- Pesticides and synthetic fertilizers.	

S.Y.B.Sc	Semester IV Theory
Paper II **Form and Function**	**Course Outcome** 1. Understanding the secondary growth structure and types ofvascular bundles of dicot and monocot stem and root. 2. Mechanical tissue system 3. Concept of vascular bundle and its types 4. Physiological cycles such as Glycolysis, ETS and TCA 5. Concept of vernalization 6. Study of biogeochemical cycles such as Carbon, Phosphorus, Sulpur and Water 7. Concept of ecological factors 8. Soil pollutants with reference to synthetic fertilizers **Learner's space:** ➢ Knowing the process and need of secondary growth in plant,mechanical tissue system and vascular bundles functions in plants ➢ Understand various physiological and biogeochemical cycles ➢ Understand ecological factors and their applications ➢ Use of soil pollutants in relation with pesticides

Botany-III
Course Code: **PCUSBOIV22-413 Credit: 02**.

Unit	CURRENT TRENDS IN PLANT SCIENCES I	Lectures (45)
I	**HORTICULTURE**	**15**
1.1	Locations in garden: Edges, Hedges, Lawn, Avenues, Flower beds, Water garden (with names of two plants for each category)	
1.2	Focal Point	
1.3	Types of gardens Formal garden Informal garden	
1.4	Sanjay Gandhi National Park Veer Mata Jijabai Udyan (Victoria Garden)	
II	**PLANT BIOTECHNOLOGY**	**15**
2.1	Agricultural Biotechnology: History and present status in India	
2.2	Recombinant DNA Technology: Concept of gene cloning Enzymes involved in gene cloning: Restriction Endonucleases Study of vectors: Plasmid vectors pBR-322,and pUC-18 Plant based vector: Ti- Plasmid	
2.3	Applications with reference to Crop Modification (Genetically Modified Crops), agro food, Commercialization, rules and regulations under government act Status of GM crops with respect to Indian scenario	
III	**BIOSTATISTICS AND BIOINFORMATICS**	**15**
3.1	Coefficient of correlation, its types and problems based on coefficient of correlation	
3.2	Concept of Chi-square test and problems based on Chi-square test	
3.3	Introduction to bioinformatics, goals, need, scope and limitations	
3.4	Introduction to NCBI with respect to BLAST and its types	

S.Y.B.Sc	Semester IV Theory
Paper III **Current Trends in Plant Sciences**	**Course Outcome:** 1. Concept of horticulture and its branches 2. Study of various garden locations with suitable examples 3. Indian scenario of agricultural biotechnology 4. Study of R-DNA technology 5. Applications of agricultural biotechnology with reference to GM crops 6. Biostatistics -Testing of hypothesis - Chi Square Test 7. Coefficient ofcorrelation. Theory and Problems based on these concepts 8. Study of Bioinformatics with respect to Internet, Databases, Software tools, Concept of BLAST **Learner's space:** ➢ Role of horticulture in various fields ➢ Understanding of R-DNA technology ➢ Identification of common vectors ➢ Use of bioinformatics to study BLAST

Sr. No.	SEMESTER IV	L	Cr
	PRACTICAL PAPER I: PLANT DIVERSITY I PCUSBOIV22-P411	**30**	**1**
1	Study of stages in the life cycle of *Erysiphe* from fresh/ preserved material and permanent slides		
2	Study of stages in the life cycle of *Xylaria* from fresh/ preserved material and permanent slides		
3	Study of fungal diseases prescribed in theory		
4	Study of stages in the life cycle of *Selaginella* from fresh/ preserved material and permanent slides		
5	Study of stages in the life cycle of *Pinus* from fresh/ preserved material and permanent slides		
6	Study of one plant from each family prescribed for theory: Morphological peculiarities and economic importance of the members of the family		
	PRACTICAL PAPER II- FORM AND FUNCTION I PCUSBOIV22-P412	**30**	**1**
1	Study of normal secondary growth in the stem and root of dicot plant (*Helianthus annus*)		
2	Types of mechanical tissues, mechanical tissue system in aerial, underground organs.		
3	Study of conducting tissues- Xylem and phloem elements in Gymnosperms and Angiosperms as seen in L.S. and through maceration technique.		
4	Study of different types of vascular bundles with the help of permanent slides or photographs		
5	Q_{10} – germinating seeds using Phenol red indicator		
6	Comparative account of chlorophyll content in young & adult leaves		
7	Study of working of following ecological instruments 1. Soil thermometer 2. pH meter 3. Soil testing kit 4. Wind anemometer		
8	Quantitative estimation of organic matter of the soil by Walkley and Blacks Rapid titration method.		
9	Mechanical analysis of soil by the sieve method		
10	Study of water holding capacity of different soil samples.		

Sr. No.	SEMESTER IV		Cr
	PRACTICAL PAPER III: CURRENT TRENDS IN PLANT SCIENCES I PCUSBOIV22-P413	**30**	**1**
1	Study of three to five examples of plants for each of the garden locations as prescribedfor theory.		
2	Preparation of garden plans – Formal and Informal gardens		
3	Bottle and dish garden preparation		
4	Isolation of pure culture by streaking method		
5	Measurement of microbial growth by turbidometry methods.		
6	Effect of temperature, pH and carbon and nitrogen sources on microbial growth.		
7	Identification of the cloning vectors with the help of photographs pBR322, pUC 18 and Ti-plasmid		
8	Problems based on Coefficient of correlation		
9	Problems based on Chi-Square Test		
10	Demonstration of BLAST		

S.Y.B.Sc	Semester IV Practical
Practical I **Plant** **Diversity**	**Course Outcomes:** Skill development plant identification in field 1. Slide preparation of *Xyleria* and *Erysiphe* 2. Slide preparation of *Selaginella, Pinus.* 3. Study of inflorescence, flower morphology and functional modifications of floral whorls. 4. Study of families and plants of economic importance **Learner's space:** ➢ Learning the diversity and stages of life cycle in Fungi, Pteridophyta and Gymnosperms ➢ Study of plant diseases ➢ Detailed study of morphology of flowers and some angiosperms. families.
Practical II **Form and** **Function**	**Course outcome:** 1. Exploring the normal secondary growth in the dicot stem and root 2. Study of different types of vascular bundles and conducting tissues- Xylem and phloem elements in Gymnosperms and Angiosperms. 3. Analysis of soil by the sieve method & pH of soil and water holding capacity of different soil samples. 4. Quantitative estimation of organic matter of the soil by Walkleyand Black's Rapid titration method. (Industrial application) 5. Study of vegetation by the list quadrant method. 6. Study of different ecological instruments. 7. Study of water holding capacity of soil **Learner's space:** ➢ Knowing the reason of secondary growth, mechanical tissue system and vascular bundles functions in plant. ➢ Study of Ecological factors and assessment of soil pH, water holding capacity of the soil
Practical III **Current Trends in Plant Sciences**	➢ Applications of various ecological instruments **Course outcome:** Skill Development: 1. Preparation of Bottle and dish garden and study of five examples of plants for each of the garden locations

	2. Study of pBR322, pUC 18, Ti plasmid 3. Learn concept of aseptic techniques, streak plate method 4. Quantitative estimation of microbial growth 5. Data analysis using Chi square test 6. Coefficient of correlation between two variables 7. Concept of BLAST **Learner's space:** ➢ Designing of gardens and application of horticulture (Entrepreneurship). ➢ Identification of the cloning vectors – pBR322, pUC 18, Tiplasmid. ➢ Understanding the various methods used in microbiology ➢ Use of BLAST for data retrieval

EVALUATION PATTERN

Type of evaluation	Type of questions	Weightage
Theory: Internal (40%)	One class test (Multiple choice questions)	20 marks
	Assignment with oral presentation	20 marks
Theory: External (60%)	Long answer questions (Unit wise)	45 marks
	Short notes	15 marks
Practicals	Preparation, Presentations, Performing Observations, Calculations, Conclusions, Results, Viva, Field report and Journal	50 marks (each paper)

Proposed Evaluation Scheme (In detail)
S.Y.B.Sc. Botany (Theory)

1.	**INTERNAL ASSESSMENT**		**40 Marks**
1.1	One class test (Objective/ Multiple choice questions)		20 Marks
1.2	Assignment with oral presentation		20 Marks
2.	**EXTERNAL ASSESSMENT (Semester End Examination)**		**60 Marks**
	N.B. 1. All questions are compulsory 2. All questions carry equal marks. 3. Draw neat and labelled diagrams wherever necessary		
	Q1.	Attempt **any two** of the following a b c d	15 Marks
	Q2.	Attempt **any two** of the following a b c d	15 Marks
	Q3.	Attempt **any two** of the following a b c d	15 Marks
	Q4.	Attempt **any three** of the following a b c d e f	15 Marks

Evaluation Pattern
F.Y.B.Sc. Botany Practical Examination (Both semesters)

1.	**Practical Paper I (Experiments + Viva + Journal)**	**50 Marks**
2.	**Practical Paper II (Experiments + Viva + Journal + Field report)**	**50 Marks**

University of Mumbai

No. UG/ 36 of 2019-20

CIRCULAR:-

Attention of the Principals of the Affiliated Colleges and Directors of the recognized Institutions in Science & Technology Faculty is invited to this office Circular No. UG/95 of 2015-16, dated 5th October, 2015 relating to the revised syllabus as per (CBSGS) for the T.Y.B..Sc. Botany (Sem. V & VI).

They are hereby informed that the recommendations made by the Board of Studies in Botany at its meeting held on 18th March, 2019 have been accepted by the Academic Council at its meeting held on 10th May, 2019 **vide** item No. 4.26 and that in accordance therewith, the revised syllabus as per the (CBCS) for the T. Y .B.Sc. Botany in (Sem. V & VI) has been brought into force with effect from the academic year 2019-20, accordingly. (The same is available on the University's website www.mu.ac.in).

(Dr. Ajay Deshmukh)
REGISTRAR

MUMBAI – 400 032
03rd July, 2019

To

The Principals of the affiliated Colleges and Directors of the recognized Institutions in Science & Technology Faculty. (Circular No. UG/334 of 2017-18 dated 9th January, 2018.)

A.C./4.26/10/05/2019

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No. UG/ 36 -A of 2019 MUMBAI-400 032 3rd July, 2019

Copy forwarded with Compliments for information to:-

1) The I/c Dean, Faculty of Science & Technology,
2) The Chairman, Board of Studies in Botany,
3) The Director, Board of Examinations and Evaluation,
4) The Professor-cum-Director, Institute of Distance and Open Learning (IDOL),
5) The Director, Board of Students Development,
6) The Co-ordinator, University Computerization Centre,s

(Dr. Ajay Deshmukh)
REGISTRAR

University of Mumbai

UNIVERSITY OF MUMBAI

Syllabus for the T.Y.B.Sc.
Program: B.Sc. Course: BOTANY

(Credit Based Semester and Grading System with effect from the academic year 2019–2020)

T.Y.B.Sc. Botany Syllabus
Restructured for Credit Based and Grading System
To be implemented from the Academic year 2019-2020

SEMESTER V

Course Code	UNIT	TOPICS	Credit	L / Weeks
USBO501	PLANT DIVERSITY III			
	I	Microbiology	2.5	1
	II	Algae		1
	III	Fungi		1
	IV	Plant Pathology		1
USBO502	PLANT DIVERSITY IV			
	I	Paleobotany	2.5	1
	II	Angiosperms I		1
	III	Anatomy I		1
	IV	Palynology		1
USBO503	FORM AND FUNCTION III			
	I	Cytology and Molecular Biology	2.5	1
	II	Plant Physiology I		1
	III	Environmental Botany		1
	IV	Plant Tissue Culture		1
USBO504	CURRENT TRENDS IN PLANT SCIENCES II			
	I	Ethnobotany and Mushroom Industry	2.5	1
	II	Plant Biotechnology I		1
	III	Instrumentation		1
	IV	Pharmacognosy and medicinal botany		1
USBOP5	Practicals based on Two Courses in Theory (501 & 502) – For 6 Units		3	8
USBOP6	Practicals based on Two Courses in Theory (503 &504) – For 6 Units		3	8
USBOP7	Practicals based on Two Courses in Theory (502 & 503) – For 3 Units		3	8
			16	32 + 8 (3 Units)

SEMESTER VI

Course Code	UNIT	TOPICS	Credit	L / Weeks
USBO601	**PLANT DIVERSITY III**			
	I	**Bryophyta**	**2.5**	**1**
	II	**Pteridophyta**		**1**
	III	**Bryophyta and Pteridophyta: Applied Aspects**		**1**
	IV	**Gymnosperms**		**1**
USBO602	**PLANT DIVERSITY IV**			
	I	**Angiosperms II**	**2.5**	**1**
	II	**Anatomy II**		**1**
	III	**Embryology**		**1**
	IV	**Plant Geography**		**1**
USBO603	**FORM AND FUNCTION III**			
	I	**Plant Biochemistry**	**2.5**	**1**
	II	**Plant Physiology II**		**1**
	III	**Genetics**		**1**
	IV	**Biostatistics**		**1**
USBO604	**CURRENT TRENDS IN PLANT SCIENCES II**			
	I	**Plant Biotechnology II**	**2.5**	**1**
	II	**Bioinformatics**		**1**
	III	**Economic Botany**		**1**
	IV	**Post Harvest Technology**		**1**
USBOP8	**Practicals based on Two Courses in theory (601 & 602) – For 6 Units**		**3**	**8**
USBOP9	**Practicals based on Two Courses in theory (603 & 604) – For 6 Units**		**3**	**8**
USBOP10	**Practicals based on Two Courses in theory (602 & 603) – For 3 Units**		**3**	**8**
			16	**32 + 8 (3 Units)**

BSc BOTANY: PROGRAM OUTCOMES

Specific core discipline knowledge

- Students can recall details and information about the evolution, anatomy, morphology, systematics, genetics, physiology, ecology, and conservation of plants and all other forms of life.
- Students can recall details of the unique ecological and evolutionary features of the local and Indian flora.

Communication skills

- Students can communicate effectively using oral and written communication skills

Problem solving and research skills

- Students can generate and test hypotheses, make observations, collect data, analyze and interpret results, derive conclusions, and evaluate their significance within a broad scientific context

BSc BOTANY: PROGRAM SPECIFIC OUTCOMES

- To recognize and identify major groups of non-vascular and vascular plants and their phylogenetic relationships.
- To understand the phylogeny of plants and study various systems of classification.
- To explore the morphological, anatomical, embryological 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 be able to carry out phytochemical analysis of plant extracts and application of the isolated compounds for treatment of diseases.
- To be able to deal with all microbes and the technologies for their effective uses in industry and mitigation of environmental concerns.
- 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 understand patterns of heredity and variation among individuals, species and populations and apply principles for improvement of quality and yield.
- To be able to apply statistical tools to gain insights into significantly different data from different sources.
- To acquire recently published knowledge in molecular biology, such as rDNA technology; PTC and bioinformatics and their applications.

SEMESTER V
THEORY

Course Code	Title	Credits
USBO501	**PLANT DIVERSITY – III**	**2.5 Credits (60 Lectures)**

Course outcomes:

The students would be able :

- To gain knowledge about microbial diversity and techniques for culturing and visualization.
- To understand the salient features of three major groups of algae, their life cycle patterns with a suitable example; to be able to identify them.
- To learn the general characteristics and classification of two major groups of fungi along with life cycles of each group; to be able to identify them.
- To understand the scope and importance of Plant Pathology and apply the concepts of various control measures of commonly widespread plant diseases.

Unit I: Microbiology • **Types of Microbes:** Viruses, Bacteria, Algae, Fungi, Protozoa, Mycoplasma and Actinomycetes. • **Culturing:** Sterilization, media, staining, colony characters. • Pure cultures	**(15 lectures)**
Unit –II: Algae (G.M. Smith Classification System to be followed) • Division Rhodophyta: Classification and General Characters: Distribution, Cell structure, pigments, reserve food, range of thallus, reproduction: asexual and sexual, Alternation of Generations, Economic Importance. • Structure, life cycle and systematic position of *Polysiphonia, Batrachospermum.* • Classification and General Characters of Xanthophyta: Distribution, Cell structure, pigments, reserve food, range of thallus, Reproduction: asexual and sexual, Alternation of Generations, Economic Importance. • Structure, life cycle and systematic position of *Vaucheria.* • Classification and General Characters of Bacillariophyta: Distribution, Cell structure, pigments, reserve food, range of thallus, Reproduction: asexual and sexual, Alternation of Generations, Economic Importance. • Structure, life cycle and systematic position of *Pinnularia.*	**(15 lectures)**
Unit III: Fungi (G.M. Smith Classification System to be followed) • Basidiomycetes: Classification and General characters ➢ Life cycle of *Agaricus* ➢ Life cycle of *Puccinia* • Deuteromycetae: Classification and General Characters • Life cycle of *Alternaria*	**(15 lectures)**

Unit IV: Plant Pathology • **Study of plant diseases:** Causative organism, symptoms, predisposing factors, disease cycle and control measures of the following. ➢ White Rust –*Albugo candida* ➢ Tikka disease of ground nut: *Cercospora* ➢ Damping off disease: *Pythium* ➢ Citrus canker –*Xanthomonas axonopodis* pv. citri ➢ Leaf curl – leaf curl virus in *Papaya.* • Study of Physical, chemical and biological control methods of plant diseases.	**(15 lectures)**

Course Code	Title	Credits
USBO502	**PLANT DIVERSITY – IV**	**2.5 Credits (60 lectures)**

Course outcomes:

The students would be able :

- To acquire knowledge of different fossil forms and understand their role in evolution.
- To provide plant description, describe the morphological and reproductive structures of seven families and also identify and classify according to Bentham and Hooker's system.
- To gain proficiency in the use of keys and identification manuals for identifying any unknown plants to species level.
- To relate anomalies in internal stem structure with function and appreciate the salient features of the root stem transition zone.
- To get exposure to pollen study and learn to apply it in various fields.

Unit I: Paleobotany • *Lepidodendron*– All form genera root, stem, bark, leaf, male and female fructification. • *Lyginopteris*– All form genera root, stem, leaf, male and female fructification. • *Pentoxylon*– All form genera. • Contribution of Birbal Sahni, Birbal Sahni Institute of Paleobotany, Lucknow	**(15 lectures)**
Unit II: Angiosperms I • Morphology of flower – All Parts of Flower. • Complete classification of Bentham and Hooker (only for prescribed families), Merits and demerits • 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. (Special stress on fruit morphology to be given) ➢ Capparidaceae ➢ Umbelliferae ➢ Cucurbitaceae ➢ Rubiaceae ➢ Solanaceae ➢ Commelinaceae ➢ Graminae	**(15 lectures)**
Unit III: Anatomy I • **Anomalous secondary growth** in the Stems of *Bignonia*, *Salvadora*, *Achyranthes*, *Dracaena*. Storage roots of Beet, Radish • **Root stem transition** • **Types of Stomata**– Anomocytic, Anisocytic, Diacytic, Paracytic, and Graminaceous	**(15 lectures)**

Unit IV: Palynology ● **Pollen Morphology** ● **Pollen viability**–storage ● Germination and growth of pollen ● Application of Palynology in honey industry, coal and oil exploration, Aerobiology and pollen allergies, forensic science	**(15 lectures)**

Course Code	Title	Credits
USBO503	**FORM AND FUNCTIONS- II**	**2.5 Credits (60 Lectures)**

Course outcomes:

The students would be able :

- To acquire knowledge about two important organelles and molecular mechanisms of translation
- To understand water relations of plants, inorganic and organic solute transport, and apply the knowledge to manage mineral nutrition and survival in challenging abiotic stresses.
- To understand succession in plant communities and study remediation technologies in order to apply knowledge acquired for cleanup of polluted sites.
- To get exposure to principles and techniques of plant tissue culture and apply these studies for improving agriculture and horticulture and to become an entrepreneur.

Unit I: Cytology and Molecular Biology • Structure and function of nucleus • Structure and function of vacuole • Structure and function of giant chromosomes • The genetic code: Characteristics of the genetic code • Translation in Prokaryotes and Eukaryotes.	**(15 lectures)**
Unit II: Plant Physiology I • **Water relations:** Potential, osmosis, transpiration, imbibition, • **Solute transport:** Transport of ions across cell membranes, active and passive transport, carriers, channels and pumps. • **Translocation of solutes:** Composition of phloem sap, girdling experiment. • **Pressure flow model (Munch's hypothesis):**Phloem loading and unloading, anatomy of sieve tube elements and mechanisms of sieve tube translocation. • **Mineral Nutrition:** Role of Macro and Micro nutrients, physiological functions and deficiency symptoms.	**(15 lectures)**
Unit III: Environmental Botany • **Bioremediation:** Principles, factors responsible and microbial population in bioremediation. • **Phytoremediation**: Metals, Organic pollutants • **Plant succession**: Hydrosere and Xerosere – Formation of Barren Space, Succession on the Land Citing Different Seres leading up to the Climax, Succession in Water, Ecesis, Poly and Mono-climax theories.	**(15 lectures)**
Unit IV: Plant Tissue Culture • **Aspects of Micro-propagation with reference to Floriculture:** Detailed study of Orchid Cultivation • **Plant cell suspension cultures for the production of secondary metabolites:** With special reference to Shikonin production. • Somatic Embryogenesis and Artificial Seeds. • **Protoplast Fusion and Somatic Hybridization:** i) Concept, Definition, and various methods of Protoplast Fusion ii) Applications of Somatic Hybridization in Agriculture	**(15 lectures)**

Course Code	Title	Credits
USBO504	**CURRENT TRENDS IN PLANT SCIENCES – II**	**2.5 Credits (60 Lectures)**

Course outcomes:

The students would be able :

- To get exposure to the technique of mushroom cultivation and explore the possibility of entrepreneurship in the same.
- To learn ethnobotanical principles, applications and utilize indigenous plant knowledge for the cure of common human diseases and improvement of agriculture.
- To gain knowledge about the latest molecular biology techniques for isolation and characterization of genes.
- To learn principles and application of commonly used techniques in instrumentation.
- To gain proficiency in the monograph study and pharmacognostic analysis of six medicinal plants.

Unit I: Ethnobotany and Mushroom Industry • **Ethnobotany**- Definition, history, sources of data and methods of study. • **Applications of ethnobotany:** ➢ Ethno-medicines. ➢ Agriculture. ➢ Edible plants. • **Traditional medicines** used by tribals in Maharashtra towards ➢ Skin ailments: *Rubia cordfolia, Sandalwood* ➢ Liver ailments: *Phyllanthus, Andrographis* ➢ Wound healing and ageing: *Centella, Typha, Terminalia, Tridax.* ➢ Fever: *Vitex negundo*, *Tinospora cordifolia* leaves ➢ Diabetes: *Momordica charantia, Syzygium cuminii* • **Mushroom industry:** ➢ Detail general account of production of mushrooms with respect to methods of Composting, spawning, casing, harvesting of mushroom. Cultivation of *Pleurotus, Agaricus, Volvariella* mushroom. ➢ General account of mushrooms: Nutritional value, picking and packaging, economic importance.	**(15 lectures)**
Unit II: Plant Biotechnology I • Construction of genomic DNA libraries, Chromosome libraries and c- DNA libraries. • Identification of specific cloned sequences in c-DNA libraries and Genomic libraries • **Analysis of genes and gene transcripts –**Restriction enzyme, analysis of cloned DNA sequences. Hybridization(Southern Hybridization)	**(15 lectures)**
Unit III: Instrumentation • **Colorimetry and Spectrophotometry** (Visible, UV and IR) – Instrumentation, working, principle and applications. • **Chromatography:** General account of Column chromatography. Principle and bedding material involved in adsorption and partition chromatography, ion exchange chromatography, molecular sieve chromatography.	**(15 lectures)**

Unit IV: Pharmacognosy and Medicinal Botany • Monographs of drugs with reference to biological sources, geographical distribution, common varieties, macro and microscopic characters, chemical constituents, therapeutic uses, adulterants- *Strychnos* seeds, *Senna* leaves, Clove buds, *Allium sativum, Acorus calamus* and *Curcuma longa*	**(15 lectures)**

SEMESTER V
PRACTICAL

Minimum marks for passing: 20

Semester V USBOP5 – For 6 Units	**Cr**
PRACTICAL PAPER I–PLANT DIVERSITY III – USBOP 501 (For 6 Units)	**1.5**
Microbiology • Study of aeromicrobiota by petriplate exposed method: Fungal culture, Bacterial culture. • Determination of Minimum Inhibitory Concentration (MIC) of sucrose against selected microorganism. • Study of antimicrobial activity by the disc diffusion method.	
Algae (G.M. Smith Classification System to be followed) • Study of stages in the life cycle of the following Algae from fresh / preserved material and permanent slides. ➢ *Polysiphonia* ➢ *Batrachospermum* ➢ *Vaucheria* ➢ *Pinnularia*	
Fungi (G.M. Smith Classification System to be followed) • Study of stages in the life cycle of the following Fungi from fresh / preserved material and permanent slides ➢ *Agaricus* ➢ *Puccinia* ➢ *Alternaria*	
Plant Pathology • Study of the following fungal diseases: ➢ White rust in Cruciferae (Brassicaceae) ➢ Tikka disease in Groundnut ➢ Damping off disease ➢ Citrus canker ➢ Leaf curl in *Papaya Leaf*	
Semester V USBOP7 – For 3 Units	
PRACTICAL PAPER II–PLANT DIVERSITY IV USBOP 502 (For 3 & 6 Units)	**Cr**
Paleobotany • Study of the following form genera with the help of permanent slides/ photomicrographs. ➢ *Lepidodendron* ➢ *Lyginopteris* ➢ *Pentoxylon*	**1.5**
Angiosperms I • Morphology of Flower – All Parts of Flower • Study of one plant from each of the following Angiosperm families as per Bentham and Hooker's system of classification. ➢ Capparidaceae ➢ Umbelliferae ➢ Cucurbitaceae	

➢ Rubiaceae ➢ Solanaceae ➢ Commelinaceae ➢ Graminae • Morphological peculiarities and economic importance of the members of the above-mentioned Angiosperm families • Identifying the genus and species of a plant with the help of Flora	
Anatomy I • Study of anomalous secondary growth in the stems of the following plants using double staining technique. *1) Bignonia* *2) Salvadora* *3) Achyranthes* *4) Dracaena* • Study of anomalous secondary growth in the roots of 1) Beet 2) Radish • Types of Stomata 1) Anomocytic 2) Anisocytic 3) Diacytic 4) Paracytic 5) Graminaceous	
Palynology I • Study of pollen morphology (NPC Analysis) of the following by Chitale's Method ➢ *Hibiscus* ➢ *Datura* ➢ *Ocimum* ➢ *Crinum* ➢ *Pancratium* ➢ *Canna* • Determination of pollen viability • Pollen analysis from honey sample – unifloral and multifloral honey • Effect of varying concentration of sucrose on *In vitro* Pollen germination	
Total Credit	**3**

Semester V USBOP6 – For 6Units **Semester V USBOP7 – For 3Units**	**Cr**
PRACTICAL –PAPER III FORM AND FUNCTION II USBOP 503 (For 3 & 6 Units)	**1.5**
Cytology and Molecular Biology • Mounting of Giant chromosomes from *Chironomous* larva • Smear preparation from *Tradescantia* buds • Predicting the sequence of amino acids in the polypeptide chain that will be formed following translation(Eukaryotic)	
Plant Physiology I • Estimation of Phosphate phosphorus (Plant acid extract) • Estimation of Iron (Plant acid extract) Note: Preparation of a standard graph and determination of the multiplication factor for Phosphate / Iron estimation using a given standard phosphate / Standard Iron solution should be done in regular practical as this will also be put as a question in practical exam	
Environmental Botany • Estimation of the following in given water sample ➢ Dissolved oxygen demand ➢ Biological oxygen demand ➢ Hardness ➢ Salinity and Chlorinity	
Micropropogation • Plant Tissue culture: • Identification – Multiple shoot culture, hairy root culture, somatic embryogenesis • 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).	
Semester V USBOP6 – For 6 Units	
PRACTICAL – PAPER IV CURRENT TRENDS IN PLANT SCIENCES II USBOP 504 (For 6 Units)	**Cr**
Ethnobotany and mushroom industry • Study of plants mentioned in theory for Ethnobotany • Mushroom cultivation (To be demonstrated) • Identification of various stages involved in mushroom cultivation – spawn, pin head stage, mature/ harvest stage of *Agaricus, Pleurotus, Volvariella*	**1.5**
Biotechnology I • Growth curve of E. coli • Plasmid DNA isolation and Separation of DNA using AGE • Restriction mapping (problems), Southern blotting	
Instrumentation • Demonstration of Beer Lambert's Law • Experiment based on ion exchange chromatography for demonstration • Experiment based on separation of dyes/ plant pigments using silica gel column.	

Pharmacognosy • Macroscopic/ Microscopic characters and Chemical tests for active constituents of the following plants. ➢ *Allium sativum* ➢ *Acorus calamus* ➢ *Curcuma longa* ➢ *Senna angustifolia* ➢ *Strychnos nux-vomica* ➢ *Eugenia caryophyllata*	
Total Credit	**3**

Course Code	Title	Credits
USBO601	**PLANT DIVERSITY – III**	**2.5 Credits (60 Lectures)**

Course outcomes:

The students would be able :

- To identify, describe and study in detail the life cycles of three Bryophytes.
- To and study in detail classification and general characters of three classes of Pteridophytes and identify as well as describe the life cycles of one example from each class.
- To study evolutionary aspects and economic utilization of Bryophytes and Pteridophytes.
- To identify, describe and study in detail the life cycles of three Gymnosperms.

Unit I: Bryophyta (G. M. Smith Classification system to be followed) • Life cycle of *Marchantia* • Life cycle of *Pelia* • Life cycle of *Sphagnum*	**(15 lectures)**
Unit II: Pteridophyta (G. M. Smith Classification System to be followed) • Lepidophyta – Classification, general characters; Life cycle of • *Lycopodium* • Calamophyta – Classification, general characters; Life cycle of • *Equisetum* • Pterophyta - Classification, general characters; Life cycle of *Adiantum* and *Marselia*	**(15 lectures)**
Unit III: Bryophytes and Pteridophytes: Applied aspects • Ecology of Bryophytes. • Economic importance of Bryophytes. • Bryophytes as Indicators. • Evolution of Sporophyte and Gametophyte in Bryophytes. • Economic importance of Pteridophytes • Diversity and distribution of Indian Pteridophytes • Types of Sori and Evolution of Sori in Pteridophytes.	**(15 lectures)**
Unit IV: Gymnosperms (Chamberlain's Classification System to be followed) • Life cycle of *Thuja*, • Life cycle of *Gnetum* • Life cycle of *Ephedra*. • Economic importance of Gymnosperms	**(15 lectures)**

Course Code	Title	Credits
USBO602	**PLANT DIVERSITY – IV**	**2.5 Credits (60 Lectures)**

Course outcomes:

The students would be able :

- To study contribution of Botanical gardens, BSI to Angiosperm study and provide plant description, describe the morphological and reproductive structures of seven families.
- To gain exposure to a phylognetic system of classification.
- To gain insight into the anatomical adaptations of different ecological plant groups.
- To understand development plant of male and female gametophytes, embryonic structure and development.
- To understand the different aspects and importance of Biodiversity and utilize them for conservation of species so as to prevent further loss or extinction of Biodiversity and preserve the existing for future generations.

Unit I: Angiosperms II — **(15 lectures)**

- **Major Botanic gardens of India**– Indian Botanic Garden, Howrah; National Botanic Garden (NBRI) Lucknow; Lloyd Botanic Garden, Darjeeling; Lalbaugh Botanic Garden, Bangaluru.
- Botanical survey of India and regional branches of India
- Bentham and Hooker's system of classification for flowering plants up to family with respect to the following prescribed families and economic importance, medicinal importance and fruit morphology for members of the families
  - Rhamnaceae
  - Combretaceae
  - Asclepiadaceae
  - Labiatae
  - Euphorbiaceae
  - Cannaceae
- Hutchinson's classification system of Angiosperms Brief Introduction, Merits and Demerits of Hutchinson's Classification System

Unit II: Anatomy II — **(15 lectures)**

- **Ecological anatomy**
  - Hydrophytes – submerged, floating, rooted
  - Hygrophytes -*Typha*
  - Mesophytes
  - Sciophytes
  - Halophytes
  - Epiphytes
  - Xerophytes

Unit III: Embryology — **(15 lectures)**

- **Microsporogenesis**
- **Megasporogenesis**- Development of monosporic type, examples of all embryo sacs
- Types of ovules
- Double fertilization
- Development of embryo–*Capsella*

Unit IV: Plant Geography (Shifted from Paper – IV) • **Phytogeographical regions of India**. • **Biodiversity**: ➢ Definition, diversity of flora found in various forest types of India ➢ Levels of biodiversity ➢ Importance and status of biodiversity ➢ Loss of biodiversity ➢ Conservation of biodiversity ➢ Genetic diversity- Molecular characteristics	**(15 lectures)**

Course Code	Title	Credits
USBO603	**FORMS AND FUNCTION – III**	**2.5 Credits 60 Lectures)**

Course outcomes:

The students would be able :

- To study various plant biomolecular structures and appreciate the structures, role, functions and applications of enzymes.
- To gain insight into the Nitrogen and plant hormone metabolism with applications of the same in agriculture and horticulture.
- To understand principles of genetic mapping , mutations and solve problems based on them, gain knowledge of various metabolic disorders and their implications.
- To generate and test hypotheses, make observations, collect data, analyze and interpret results, derive conclusions, and evaluate their significance within a broad scientific context, using suitable statistical techniques.

Unit I: Plant Biochemistry • **Structure of biomolecules:** Carbohydrates (sugars, starch, cellulose, pectin, lipids (fatty acids and glycerol), proteins (amino acids) • **Enzymes:** Nomenclature, classification, mode of action, Enzyme kinetics, Michaelis-Menten equation, competitive, non-competitive and un-competitive inhibitors.	**(15 lectures)**
Unit II: Plant Physiology II • **Nitrogen Metabolism:** Nitrogen cycle, root nodule formation, and leghaemoglobin, nitrogenase activity, assimilation of nitrates, (NR, NiR activity), assimilation of ammonia, (amination and transamination reactions), nitrogen assimilation and carbohydrate utilization. • Physiological effects and commercial applications of Auxins, Gibberillins, Cytokinins and Abscisic acid	**(15 lectures)**
Unit III: Genetics • **Genetic mapping in eukaryotes:** discovery of genetic linkage, gene recombination, construction of genetic maps, three- point crosses and mapping chromosomes, problems based on the same • **Gene mutations:** definition, types of mutations, causes of mutations, induced mutations, the Ame's test • **Metabolic disorders**– enzymatic and non-enzymatic: Gene control of enzyme structure Garrod's hypothesis of inborn errors of metabolism, Phenyl ketone urea.	**(15 lectures)**
Unit IV: Biostatistics (Shifted from Paper – II) • Test of significance student's *t*-test – Paired and Unpaired. • Regression. • ANOVA (one way).	**(15 lectures)**

Course Code	Title	Credits
USBO604	**Current Trends in Plant Science – II**	**2.5 Credits (60 Lectures)**

Course outcomes:

The students would be able :

- To gain insight into recent molecular biology techniques for DNA analysis and amplification and Barcoding techniques and applications therein.
- To understand and apply tools of Bioinformatics for data retrieval and phylogenetic analysis.
- To learn about the sources of economically important plants in the field of fats and oils and apply it for extraction, dealing with entrepreneurship in the field.
- To gain knowledge and proficiency in preservation of post harvest produce and explore the possibility of entrepreneurship in the field.

Unit I: Plant Biotechnology II • **DNA sequence analysis**– Maxam – Gilbert Method and Sanger's method, Pyro Sequencing. • Polymerase Chain Reaction (PCR). • **DNA barcoding:** Basic features, nuclear genome sequence, chloroplast genome sequence, *rbc*L gene sequence, *mat* K gene sequence, present status of barcoding in plants.	**(15 lectures)**
Unit IV: Bioinformatics (Shifted from Paper – III) • Organization of biological data, databases • Exploration of data bases, retrieval of desired data, BLAST. • Protein structure analysis and application • Multiple sequence analysis and phylogenetic analysis	**(15 lectures)**
Unit III: Economic Botany • **Essential Oils:** Extraction, perfumes, perfume oils, oil of Rose, Sandalwood, *Patchouli*, *Champaca*, grass oils: *Citronella*, Vetiver. • **Fatty oils:** Drying oil (Linseed and Soyabean oil), semidrying oils (Cotton seed, Sesame oil) and non-drying oils (Olive oil and Peanut oil), • **Vegetable Fats**: Coconut and Palm oil	**(15 lectures)**
Unit IV : Post Harvest Technology • **Storage of Plant Produce –**Preservation of Fruits and Vegetables ➢ Drying (Dehydration) – Natural conditions – Sun drying, Artificial Drying – Hot Air Drying, Vacuum Drying, Osmotically Dried Fruits, Crystallized or Candied Fruits, Fruit Leather, Freeze Drying) ➢ Freezing (Cold Air Blast System, Liquid Immersion method, Plate Freezers, Cryogenic Freezing, Dehydro-Freezing, Freeze Drying), ➢ Canning ➢ Pickling (in Brine, in Vinegar, Indian Pickles) ➢ Sugar Concentrates (Jams, Jellies, Fruit juices) ➢ Food Preservatives ➢ Use of Antioxidants in Preservation	**(15 lectures)**

SEMEST ER VI
PRACTICAL

Minimum marks for passing: 20

SEMESTER VI USBOP8 – FOR 6 UNITS	**Cr**
PRACTICAL PAPER I–PLANT DIVERSITY III – USBOP 601(For 6 Units)	**1.5**
Bryophyta (G.M. Smith Classification System to be followed) • Study of stages in the life cycle of the following Bryophyta from fresh / preserved material and permanent slides ➢ *Marchantia* ➢ *Pelia* ➢ *Sphagnum*	
Pteridophyta (G.M. Smith Classification System to be followed) • Study of stages in the life cycles of the following Pteridophytes from fresh / preserved material and permanent slides ➢ *Lycopodium* ➢ *Equisetum* ➢ *Adiantum* ➢ *Marselia*	
Bryophytes and Pteridophytes: Applied aspects • Economic importance of Bryophyta • Economic importance of Pteridophyta • Types of Sporophytes in Bryophyta (from Permanent slides) • Types of Sori and Soral Arrangement in Pteridophytes	
Gymnosperms (Chamberlain's Classification System to be followed) • Study of stages in the life cycles of the following Gymnosperms from fresh / preserved material and permanent slides ➢ *Thuja* ➢ *Gnetum* ➢ *Ephedra* • Economic importance of Gymnosperms	
USBOP10 – FOR 3 UNITS	
PRACTICAL PAPER II–PLANT DIVERSITY IV USBOP602 (For 3 & 6 Units)	**1.5**
Angiosperms II • Study of one plant from each of the following Angiosperm families as per Bentham and Hooker's system of classification. ➢ Rhamnaceae ➢ Combretaceae ➢ Asclepiadaceae ➢ Labiatae ➢ Euphorbiaceae ➢ Cannaceae • Morphological peculiarities and economic importance of the members of the above-mentioned Angiosperm families • Identify the genus and species with the help of flora	

Anatomy II • Study of Ecological Anatomy of ➢ Hydrophytes: *Hydrilla* stem, *Nymphaea* petiole, *Eichhornia* offset ➢ Epiphytes: Orchid ➢ Sciophytes: *Peperomia* leaf ➢ Xerophytes: *Nerium* leaf, *Opuntia phylloclade* ➢ Halophytes: *Avicennia* leaf and pneumatophore, *Sesuvium* / *Sueda* leaf ➢ Mesophytes: *Vinca* leaf	
Embryology • Study of various stages of Microsporogenesis, Megasporogenesis and Embryo Development with the help of permanent slides / photomicrographs • Mounting of Monocot (Maize) and Dicot (Castor and Gram)embryo • *In vivo* growth of pollen tube in *Portulaca /Vinca*	
Plant Geography • Study of phytogeographic regions of India • Preparation of vegetation map using Garmin's GPS Instrument • Problems based on Simpson's diversity Index	
Total Credit	**3**
SEMESTER VI USBOP9 – FOR 6 UNITS	**Cr**
SEMESTER VI USBOP10 – FOR 3 UNITS	
PRACTICAL PAPER III–FORM AND FUNCTION III USBOP603 (For 3 & 6 Units)	**1.5**
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	
Plant Physiology II • Determination of alpha-amino nitrogen • Effect of GA on seed germination • Estimation of reducing sugars by DNSA method	
Genetics • 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*	
Biostatistics • *t*-test (paired and unpaired) • Problems based on regression analysis • ANOVA (One Way)	
PRACTICAL PAPER IV CURRENT TRENDS IN PLANT SCIENCES USBOP 604 (For 6 Units)	
Plant Biotechnology II • DNA sequencing by Sanger's Method and Pyro Sequencing Method • DNA barcoding of plant material by using suitable data	

Bioinformatics • BLAST: nBLAST, pBLAST • Multiple sequence alignment • Phylogenetic analysis • RASMOL/SPDBV	
Economic Botany • Demonstration: Extraction of essential oil using Clevenger • Thin layer chromatography of essential oil of *Patchouli* and *Citronella* • Saponification value of Palm oil	
Post-Harvest Technology • Preparation of ➢ Squash ➢ Jam ➢ Jelly ➢ Pickle	
Total Credit	**3**

Scheme of Examinations:

Theory Course: Semester End Assessment	**100 Marks Each Theory Paper**
Practical Course	**50 Marks Each Practical Paper**

- **Students offering Double major (3 Units) will study Paper II and III**

Semester End Theory Examination Question Paper Pattern:

Q.1 – Four (4) Long Answer Questions on Unit – I out of which Two (2) to be solved.	**10 Marks Each**
Q.2 – Four (4) Long Answer Questions on Unit – II out of which Two (2) to be solved.	**10 Marks Each**
Q.3 – Four (4) Long Answer Questions on Unit – III out of which Two (2) to be solved.	**10 Marks Each**
Q.4 – Four (4) Long Answer Questions on Unit – IV out of which Two (2) to be solved.	**10 Marks Each**
Q.5 – Six (6) Short Answer Questions on all four (4) Units out of which Four (4) to be solved.	**05 Marks Each**

Note:

1. Minimum Marks of 20 are required in Every Practical Paper Examination in each semester.
2. A minimum of four field excursions (with at least one beyond the limits of Mumbai / Local area) for habitat studies are compulsory. Field work of not less than eight hours duration is equivalent to one period per week for a batch of fifteen students.
3. A candidate will be allowed to appear for the practical examinations only if he/she submits a certified journal of T.Y.B.Sc. Botany and the Field Report or a certificate from the Head of the Department/Institute to the effect that the candidate has completed the practical course of T.Y.B.Sc. Botany as per the minimum requirements. In case of loss of journal, a candidate must produce a certificate from the Head of the Department/ Institute that the practical for the academic year were completed by the student. However, such a candidate will be allowed to appear for the practical examination but the marks allotted for the journal will not be granted.

UNIVERSITY OF MUMBAI

T.Y.B.SC. BOTANY SEMESTER V (USBOP5)

Plant Diversity III (USBOP501)

Practical Paper – I

Duration: 9:00 am to 01:00 pm Max. Marks:50

Q.1	Perform the given Microbiological Experiment **'A'**	12
Q.2	Identify, Classify and Describe Specimens **B, C** and **D**. Sketch neat and labeled diagrams of Morphological / Microscopical structures seen in the specimens.	24
Q.3	Identify and describe slides / specimens **E, F** and **G**.	09
Q.4	Journal	05

KEY:

A– Any one experiment out of four as prescribed in syllabus.

B & **C**– Algae.

D– Fungi.

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

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T.Y.B.SC. BOTANY SEMESTER V (USBOP5)

Plant Diversity IV (USBOP502)

Practical Paper – II

Duration: 9:00 am to 01:00 pm Max. Marks:50

Q. 1A. Classify specimen **'A'** up to their families giving reasons. Give floral formula. Sketch neat and labeled L. S. of flower and T.S. ovary. 10

Q. 1B. Identify genus and species of specimen **'B'** using flora. 05

Q.2 Make a temporary double stained preparation of T.S. specimen **'C'** and comment on the type of secondary growth. 06

Q.3 Perform the Palynology experiment **'D'** allotted to you. 07

Q.4 Identify and describe slide/ specimen **'E', 'F', 'G'** & **'H'**. 12

Q.5 Field report 05

Q.6 Viva voce (based on Paper I and Paper II). 05

KEY

A– Families of T.Y.B.Sc only

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

C– Anatomy Anomalous Secondary Growth

D– As per slip

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

UNIVERSITY OF MUMBAI

T.Y.B.SC. BOTANY SEMESTER V (USBOP6)

FORMS AND FUNCTION III (USBOP503)

Practical Paper – III

Duration: 9:00 am to 01:00 pm Max. Marks:50

Q.1	Make a smear preparation of material **'A'** and show the slide to the Examiner. Comment on your observation / Expose the giant chromosomes from the salivary glands of *Chironomous* larva.	08
Q. 2	Perform the experiment **'B'** allotted to you (Physiology).	12
Q. 3	Perform the experiment **'C'** allotted to you (Ecology).	12
Q. 4.	Calculate the_____of the given solution **'D'** to prepare the required solution.	07
Q. 5.	Identify and describe slide/specimen **'E'** & **'F'**.	06
Q.6.	Journal.	05

KEY

B– Physiology experiment.

C– Ecology experiment.

D– Plant Tissue Culture.

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

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T.Y.B.SC. BOTANY SEMESTER V (USBOP6)

CURRENT TRENDS IN PLANT SCIENCE II (USBOP504)

Practical Paper – IV

Duration: 9:00 am to 01:00 pm Max. Marks:50

Q.1.	Perform the experiment **A**– growth curve of *E.coli* / Isolate plasmid DNA and separate using AGE.	12
Q.2.	Perform the experiment **'B'** allotted to you.	10
Q.3.	Describe macroscopical /microscopical character with the help of neat and labelled sketches of specimens **'C'** and **'D'**. Perform the chemical test / TLC to identify the active constituents.	14
Q. 4	Identify and explain the specimens/ photographs **'E', 'F'** and **'G'**.	09
Q. 5.	Journal.	05

KEY

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

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

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

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T.Y.B.SC. BOTANY SEMESTER V (USBOP7)

Plant Diversity IV (USBOP502) (For 3 Units)

Practical Paper – II

Duration: 9:00 am to 01:00 pm Max. Marks:50

Q. 1A.	Classify specimen **'A'** up to their families giving reasons. Give floral formula. Sketch neat and labelled L.S. of flower and T.S. of ovary.	10
Q. 1B.	Identify genus and species of specimen **'B'** using flora.	05
Q.2	Make a temporary double stained preparation of T.S. specimen **'C'** and comment on the type of secondary growth.	06
Q.3	Perform the Palynology experiment **'D'** allotted to you.	07
Q.4	Identify and describe slide/ specimen **'E', 'F', 'G' & 'H'**.	12
Q.5	Field report	05
Q.6	Journal.	05

KEY

A– Families of T.Y.B.Sc only

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

C– Anatomy Anomalous Secondary Growth

D– As per slip

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

UNIVERSITY OF MUMBAI

T.Y.B.SC. BOTANY SEMESTER V (USBOP7)

FORMS AND FUNCTION III (USBOP503) (For 3 Units)

Practical Paper – III

Duration: 9:00 am to 01:00 pm Max. Marks:50

Q.1	Make a smear preparation of material **'A'** and show the slide to the Examiner. Comment on your observation / Expose the giant Chromosomes from the salivary glands of *Chironomous* larva.	08
Q. 2	Perform the experiment **'B'** allotted to you (Physiology).	12
Q. 3	Perform the experiment **'C'** allotted to you (Ecology).	12
Q. 4	Calculate the_____of the given solution **'D'** to prepare the required solution.	07
Q. 5	Identify and describe slide/specimen **'E'**& **'F'**.	06
Q.6.	Viva voce (based on Paper II and Paper III).	05

KEY

B– Physiology experiment.

C– Ecology experiment.

D– Plant Tissue Culture.

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

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T.Y.B.SC. BOTANY SEMESTER VI

(USBOP8)

Plant Diversity III (USBOP601)

Practical Paper – I

Duration: 9:00 am to 01:00 pm Max. Marks:50

1	Identify, classify and describe specimen **'A'** and **'B'**. Sketch neat and labelled diagrams of Morphological/Microscopical structures seen in the specimens.	12
2	Identify, classify and describe specimen **'C'** and **'D'**. Sketch neat and labeled diagrams of Morphological/Microscopical structures seen in the specimens.	12
Q.3	Identify, classify and describe specimen **'E'**. Sketch neat and labeled diagrams of Morphological/Microscopical structures seen in the specimens.	06
Q.4	Identify and describe slides/specimen **'F', 'G' 'H', 'I'** & **'J'**.	15
Q.5	Journal.	05

KEY

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

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

E– Gymnosperm: *Thuja, Gnetum & Ephedra*

F, G, H, I & **J**– Economic importance of Bryophytes, Economic importance of Pteridophytes Types of Sporophytes in Bryophyta, Types of Sori in Pteridophytes, Soral arrangement in Pteridophytes, Economic importance of Gymnosperms. (In random order)

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T.Y.B.SC. BOTANY SEMESTER VI

(USBOP8)

Plant Diversity IV (USBOP602)

Practical Paper – II

Duration: 9:00 am to 01:00 pm Max. Marks:50

Q. 1 A.	Classify specimen **'A'** up to its family giving reasons. Give floral formula. Sketch neat and labeled L.S. of flower and T.S. ovary.	08
Q. 1.B.	Identify genus and species of specimen **'B'** using flora.	04
Q. 2	Make a stained preparation of specimen **'C'** and comment on its ecological anatomy.	06
Q.3.A	Calculate Simpson's Diversity Index from the given data **'D'**.	08
Q.3.B	Mark the Phytogeographic region **'E'** in the map of India and Comment on the same.	05
Q.4	Identify and describe slide/specimen **'F', 'G' & 'H'**.	09
Q.5	Field Report.	05
Q.6	Viva voce (based on Paper I and Paper II)	05

KEY

A– Families of T.Y.B.Sc Sem – VI only

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

C– Ecological anatomy.

F, G & **H**– Economic importance of specimen from prescribe families (Sem VI only)**,** Morphological Peculiarities of prescribed families (Sem – VI only), Embryology. (In random order)

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T.Y.B.Sc. BOTANY SEMESTER VI (USBOP9)

FORM AND FUNCTION III (USBOP603)

PRACTICAL III

Duration: 9:00 am to 01:00 pm Max. Marks:50

Q.1	Perform the experiment **'A'** allotted to you.	10
Q.2	Perform the experiment **'B'** allotted to you.	10
Q.3	Make a squash preparation to show the stage of mitosis from the pre-treated root tips **'C'**.	05
Q.4	Construct a chromosome map from the given data **'D'** / Identify the type of mutation and comment on them (any two types of mutations)	10
Q.5	From the given data/ material **'E'** determine test of significance using students t-test/ Regression Analysis /ANOVA	10
Q.6	Journal.	05

KEY

A– Plant Biochemistry Experiment.

B– Plant Physiology Experiment.

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T.Y.B.Sc. BOTANY SEMESTER VI (USBOP9)

CURRENT TRENDS IN PLANT SCIENCE II (USBOP604)

PRACTICAL IV

Duration: 9:00 am to 01:00 pm Max. Marks:50

Q.1	Perform the DNA barcoding of plant material using given data **'A'**.	12
	OR	
	Perform DNA sequencing by Sanger's method of the given sequence **'A'**.	12
Q.3	Perform the experiment **'B'** allotted to you.	12
Q.4	Perform the given analysis of data **'C'** using computer(Bioinformatics).	08
Q.5	Prepare the squash/Jam/jelly/pickle from the given material **'D'**.	12
Q.6	Viva voce. (Based on Paper III and Paper IV)	06

KEY

B– TLC of *Patchouli* or *Citronella* / Saponification value

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

UNIVERSITY OF MUMBAI

T.Y.B.SC. BOTANY SEMESTER V (USBOP10)

Plant Diversity IV (USBOP602) (For 3 Units)

Practical Paper – II

Duration: 9:00 am to 01:00 pm Max. Marks:50

Q. 1A.	Classify specimen **'A'** up to its family giving reasons. Give floral formula. Sketch neat and labeled L.S. of flower and T.S. ovary.	08
Q. 1.B.	Identify genus and species of specimen **'B'** using flora.	04
Q. 2	Make a stained preparation of specimen **'C'** and comment on its ecological anatomy.	06
Q.3.A	Calculate Simpson's Diversity Index from the given data **'D'**.	08
Q.3.B	Mark the Phytogeographic region **'E'** in the map of India and Comment on the same.	05
Q.4	Identify and describe slide/specimen **'F', 'G'** & **'H'.**	09
Q.5	Field Report.	05
Q.6	Journal	05

KEY

A– Families of T.Y.B.Sc Sem – VI only

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

C– Ecological anatomy.

F, G & **H**– Economic importance of specimen from prescribe families (Sem VI only), Morphological Peculiarities of prescribed families (Sem – VI only), Embryology. (In random order)

UNIVERSITY OF MUMBAI

T.Y.B.Sc. BOTANY SEMESTER VI(USBOP10)

FORM AND FUNCTION III (USBOP603) (For 3 units)

PRACTICAL III

Duration: 9:00 am to 01:00 pm Max. Marks:50

Q.1	Perform the experiment **'A'** allotted to you.	10
Q.2	Perform the experiment **'B'** allotted to you.	10
Q.3	Make a squash preparation to show the stage of mitosis from the pre-treated root tips **'C'**.	06
Q.4	Construct a chromosome map from the given data **'D'**/ Identify the type of mutation and comment on them (any two types of mutations)	10
Q.5	From the given data/ material **'E'** determine test of significance using students t-test/ Regression Analysis /ANOVA	09
Q.6	Viva-voce. (based on Paper II and Paper III)	05

KEY

A– Plant Biochemistry Experiment.

B– Plant Physiology Experiment.

ReferenceBooks

1. A handbook of Ethnobotany by S.K. Jain, V. Mudgal
2. Plants in folk religion and mythology (Contribution to Ethnobotany by S.K.Jain3rd Rev.Ed).
3. Introduction to Plant Physiology by Noggle and Fritz, Prentice Hall Publishers(2002)
4. Plant Physiology by Salisbury and Ross CBS Publishers
5. Plant Physiology by Taiz and Zeiger Sinauer Associates Inc. Publishers,2002
6. Genetics by Russel Peter Adison Wesley Longman Inc. (5th edition)
7. An introduction to Genetic analysis Griffith Freeman and Company(2000)
8. Fundamentals of Biostatics by Rastogi, Ane Books Pvt. Ltd.(2009).
9. College Botany Vol I and II by Gangulee Das and Dutta Central Education enterprises.
10. Cryptogamic Botany Vol I and II by G M Smith, Mcg raw Hill
11. Industrial Microbiology by Cassida, New Age International, New Delhi
12. Industrial Microbiology Mac Millan Publications, New Delhi
13. Physiological Plant Anatomy by Haberlandt, Mac Millan and Company
14. Ayurveda Ahar by P H Kulkarni
15. Pharmacognosy by Kokate, Purohit and Gokhale, Nirali Publications
16. Bioinformatics by Sunder Rajan
17. Instant Notes on Bioinformatics by Westhead (2002), Taylor Francis Publications.
18. Bioinformatics by Ignasimuthu
19. DNA barcoding plants: taxonomy in a new perspective 2010. K Vijayan and C H Tsou, Current Science, 1530 –1541.
20. Introduction to Biostatistics by P K Banerjee, Chand Publication.
21. Plant Biotechnology by K. Ramawat
22. Practical Biochemistry by David Plummer, McGraw Hill Publ.
23. Economic Botany by A F Hill, TATA McGRAW-HILL Publishing Co. Ltd.
24. Post-Harvest Technology by Verma and Joshi, Indus Publication
25. Embryology of Plants by Bhojwani and Bhatnagar
26. Pollen Morphology and Plant Taxonomy by G. Erdtman, Hafner Publ. Co., N.Y.
27. A text Book of Palynology by K Bhattacharya, New Central Book Agency Pvt. Ltd., London
28. An introduction to Embryology of Angiosperms by P Maheshwari, McGraw Hill Book Co.
29. Plant Systematics by Gurcharan Singh, Oxford and IBH Publ.
30. Taxonomy of Vascular Plants by Lawrence George, H M, Oxford and IBH Publ.