

UNIVERSITY OF MUMBAI



Syllabus for Semester III and IV

Program: M.Sc.

Course: BOTANY

(Credit Based Semester and Grading System with
effect from the academic year 2013–2014)

M.Sc Botany Semester III

Outline of the Course: PSBO301 and PSBO302 are common papers for all specialisations

PSBO301: Techniques and Instrumentation

PSBO302: Cell and Molecular Biology

PSBO303 and PSBO304 are Optional Papers in any one of the following specialisations.

1. Mycology and Plant Pathology (MPP)
2. Plant Physiology and Biochemistry (PPB)
3. Angiosperms and Phytochemistry (ANP)
4. Molecular Biology, Cytogenetics and Biotechnology (MCB)
5. Environmental Botany (EB)

Semester III

Theory	PSBO301	:	4Credits
	PSBO302	:	4Credits
	PSBO303	:	4Credits
	PSBO304	:	4Credits
Practicals(based on all 4 courses)	PSBOP301,	:	16 Credits
	PSBOP302,		
	PSBOP303,		
	PSBOP304,		

SEMESTER III

Common Papers

Course Code	UNIT	TOPIC HEADINGS	Credits	L / Week
PSBO301	Title of the Paper: <u>TECHNIQUES AND INSTRUMENTATION</u>			
	I	Biostatistics	4	1
	II	Bioinformatics		1
	III	pH and buffers and Electrophoresis		1
	IV	Colorimeter, UV-visible spectrophotometer		1

PSBO302	Title of the Paper: <u>Molecular Biology</u>			
	I	DNA replication	4	1
	II	Transcription		1
	III	RNA processing		1
	IV	Translation		1

PSBOP301	Techniques and Instrumentation	2	4
PSBOP302	Molecular Biology	2	4

Specialization : Molecular Biology, Cytogenetics & Plant Biotechnology (MBC)

PSBOMCB303	Title of the Paper: <u>Plant Biotechnology</u>			
	I	Plant Tissue Culture	4	1
	II	Plant Tissue Culture		1
	III	Plant Tissue Culture		1
	IV	Plant Tissue Culture		1

PSBOMCB304	Title of the Paper: <u>Molecular Biology and Cytogenetics</u>			
	I	Cytology	4	1
	II	Cancer Biology		1
	III	Immune System		1
	IV	Genetic Disorders		1

PSBOMCBP303	Plant Biotechnology	2	4
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PSBOMCBP304	Cytogenetics	2	4
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Specialization : Plant Physiology and Biochemistry (PPB)

PSBOPPB303	Title of the Paper: <u>Plant Biochemistry and Phytochemistry</u>			
	I	Enzymes	4	1
	II	Vitamins and Coenzymes		1
	III	Plant Proteins		1
	IV	Nucleotide Metabolism		1

PSBOPPB304	Title of the Paper: <u>Plant Physiology</u>			
	I	Water relations of plants	4	1
	II	Post-harvest technology		1
	III	Stress Physiology: Drought		1
	IV	Stress Physiology: Salinity		1

PSBOPPB303	Plant Biochemistry and Phytochemistry	2	4
PSBOPPB304	Plant Physiology	2	4

Specialization : Mycology and Plant Pathology (MPP)

PSBOMPP303	Title of the Paper: <u>General Mycology</u>			
	I	History of Mycology	4	1
	II	Taxonomy and Life Histories		1
	III	Fungal Physiology		1
	IV	Fungal Cytology & Genetics		1

PSBOMPP304	Title of the Paper: <u>Applied Mycology & Plant Pathology</u>			
	I	Pathogenesis and Crop Protection	4	1
	II	Seed Pathology & Seed Mycoflora		1
	III	Culture Studies and Food Borne Fungi		1
	IV	Industrial Mycology		1

PSBOMPPP303	General Mycology	2	4
PSBOMPPP304	Applied Mycology & Plant Pathology	2	4

Specialization : Angiosperms and Phytochemistry (ANP)

PSBOANP303	Title of the Paper: <u>Angiosperms I</u>			
	I	History of Plant Taxonomy	4	1
	II	Progress & Advancement in Angiosperm Taxonomy in India		1
	III	Tools of Angiosperm Taxonomy		1
	IV	Plant Identification Strategies		1

PSBOANP304	Title of the Paper: <u>Angiosperms II</u>			
	I	Approaches to Angiosperm Taxonomy	4	1
	II	Anatomy		1
	III	Embryology and Palynology		1
	IV	Methods in Evaluating Crude Drugs		1

PSBOANPP303	Angiosperms -I	2	4
PSBOANPP304	Angiosperms - II	2	4

Specialization : Environmental Botany (EB)

PSBOEB303	Title of the Paper: <u>Ecology</u>			
	I	Basic Ecological Concept	4	1
	II	Ecosystem		1
	III	Biogeochemical Cycles		1
	IV	Natural Resources		1

PSBOEB304	Title of the Paper: <u>Recent Trends & Applied Environmental Botany</u>			
	I	Conservation Ecology I	4	1
	II	Conservation Ecology II		1
	III	Biodiversity Studies		1
	IV	Renewable and Non-renewable Sources of Energy		1

PSBOEBP303	Ecology and Environmental Botany	2	4
PSBOEBP304	Recent Trends & Applied Environmental Botany	2	4

SEMESTER IV

Common Papers

Course Code	UNIT	TOPIC HEADINGS	Credits	L / Week
PSBO401	Title of the Paper: <u>TECHNIQUES AND INSTRUMENTATION</u>			
	I	Microscopy	4	1
	II	Centrifugation		1
	III	Chromatography		1
	IV	Tracer Technique		1

PSBO402	Title of the Paper: <u>Molecular Biology</u>			
	I	Gene Regulation	4	1
	II	Gene Regulation		1
	III	Gene Regulation		1
	IV	Gene Regulation		1

PSBOP301	Project	2	4
PSBOP302	Molecular Biology	2	4

Specialization : Molecular Biology, Cytogenetics & Biotechnology (MCB)

PSBOMCB4 03	Title of the Paper: <u>Plant Biotechnology</u>			
	I	Environmental Biotechnology	4	1
	II	IPR		1
	III	Nanotechnology		1
	IV	Food Biotechnology		1

PSBOMCB404	Title of the Paper: <u>Molecular Biology and Cytogenetics</u>			
	I	Plant Breeding	4	1
	II	Plant Breeding		1
	III	Genetic Engineering		1
	IV	Molecular Markers		1

PSBOMCBP403	Plant Biotechnology	2	4
PSBOMCBP404	Molecular Biology & Cytogenetics	2	4

Specialization : Plant Physiology and Biochemistry (PPB)

PSBOPPB403	Title of the Paper: <u>Biochemistry and Phytochemistry</u>		
	I	Biochemical Regulation	4
	II	Secondary Metabolism	
	III	Cytosolic Carbon Metabolism	
	IV	Mitochondrial Metabolism	
			1
			1
			1
			1

PSBOPPB404	Title of the Paper: <u>Plant Physiology</u>		
	I	PGRs	4
	II	Phytoremediation	
	III	Phytochrome and Photomorphogenesis	
	IV	Senescence	
			1
			1
			1
			1

PSBOPBPP403	Biochemistry and Phytochemistry	2	4
PSBOPBPP404	Plant Physiology	2	4

Specialization : Mycology and Plant Pathology (MPP)

PSBOMPP403	Title of the Paper: <u>General Mycology</u>		
	I	History of Mycology	4
	II	Taxonomy and Life Histories	
	III	Fungal Physiology	
	IV	Fungal Cytology, Genetics & Ecology	
			1
			1
			1
			1

PSBOMPP404	Title of the Paper: <u>Applied Mycology & Plant Pathology</u>		
	I	Pathogenesis and Crop Protection	4
	II	Seed Pathology & Seed Mycoflora	
	III	Culture Studies & Food Borne Fungi	
			1
			1
			1

	IV	Industrial Mycology		1
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PSBOMPPP403	General Mycology	2	4
PSBOMPPP404	Applied Mycology & Plant Pathology	2	4

Specialization : Angiosperms (ANP)

PSBOANP403	Title of the Paper: <u>Angiosperms I</u>			
	I	History of Plant Taxonomy	4	1
	II	Progress & Advancement in Angiosperm Taxonomy in India		1
	III	Tools of Angiosperm Taxonomy		1
	IV	Plant Identification Strategies		1

PSBOANP404	Title of the Paper: Molecular Biology and <u>Cytogenetics</u>			
	I	Approaches to Angiosperm Taxonomy	4	1
	II	Anatomy		1
	III	Embryology and Palynology		1
	IV	Methods in Evaluating Crude Drugs		1

PSBOANP P403	Angiosperms -I	2	4
PSBOANP P404	Angiosperms - II	2	4

Specialization : Environmental Botany (EB)

PSBOEB403	Title of the Paper: <u>Ecology</u>			
	I	Pollution	4	1
	II	Climate Change		1
	III	Plant Population Dynamics		1
	IV	Coastal Zone Management of India		1

PSBOEB404	Title of the Paper: <u>Recent Trends & Applied Environmental Botany</u>			
	I	Restoration of Ecosystem I	4	1
	II	Restoration of Ecosystem II		1
	III	Restoration of Land		1
	IV	Water shed Management		1

PSBOEBP403	Ecology	2	4
PSBOEBP404	Recent Trends & Applied Environmental Botany	2	4

**Detailed Syllabus SEMESTER III
General Papers**

Course Code	Title	Credits
PSBO301	Techniques and Instrumentation	4
Unit I: <u>Biostatistics</u> 1. Chi square test, contingency table. 2. Hypothesis testing: Theory of errors – Type I and Type II errors, Null Hypothesis, P values-one v/s two tail P values, <i>t</i> -test (paired and unpaired), <i>z</i> -test, Test of significance. 3. Introduction to ANOVA, One-way ANOVA. 4. Correlation and Regression: Calculation of Coefficient and correlation, linear regression.		1
Unit II: <u>Bioinformatics</u> 1. Organization of biological data, databases (raw and processed), Queering in data bases. 2. Gene finding, motif finding and multiple sequence alignment. 3. Protein sequence analysis (theory and algorithms). 4. Exploration of databases, retrieval of desired data, BLAST etc.		1
Unit III: <u>pH and Buffers and Electrophoresis</u> 1. pH and buffer solutions, acids and bases, hydrogen ion concentration, dissociation of acids and bases, measurement of pH, titration curves. Buffer solutions and pH life. 2. Electrophoresis		1
Unit IV: <u>Spectrophotometry</u> 1. Colorimeter, UV-visible spectrophotometer.		1

Course Code	Topic	Credits:
PSBO302	Molecular Biology	4
Unit I: DNA Replication <ul style="list-style-type: none"> • Molecular details of DNA replication in prokaryotes and eukaryotes. 		1

<ul style="list-style-type: none"> • Assembly of raw DNA into nucleosomes. • DNA recombination, holliday model for recombination. 	
UnitII: Transcription <ol style="list-style-type: none"> 1. Transcription, RNA synthesis, classes of RNA and the genes that code for them. 2. Transcription of protein coding genes, prokaryotes and eukaryotes, mRNA molecule. 3. Transcription of other genes, ribosomal RNA, and ribosomes, tRNA. 	
	1
Unit III:RNA processing <ul style="list-style-type: none"> • Capping, polyadenylation, splicing, introns and exons. 	1
Unit IV: Translation <ol style="list-style-type: none"> 1. Protein structure, nature of genetic code, translation of genetic message. 	1

Practical

PSBOP301	<u>Instrumentation and Techniques</u>	2	4
Biostatistics: <ul style="list-style-type: none"> • Hypothesis testing, Normal deviate test. • Test of significance of means, paired and unpaired t test. • Application of analysis of variance (ANOVA) Bioinformatics: <ul style="list-style-type: none"> • Multiple alignments – phylogenetic tree. • BLAST • Motif finding pH and buffers: <ul style="list-style-type: none"> • Determination of pKa 			
PSBO302	<u>Molecular Biology</u>	2	4
<ul style="list-style-type: none"> • Aseptic techniques, safe handling of microorganisms, establishing pure cultures, streak plate method, Maintenance of cultures - Paraffin embedding, Lyophilisation. • Preparation of culture medium, stock solutions and growth curve, determination of viable cells, determination of cell number. 			

<ul style="list-style-type: none"> • Separation of seed proteins using PAGE. • Viscosity studies of proteins: standard BSA and varying concentrations of urea. 	
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Special Papers

Specialisation: Molecular Biology, Cytogenetics and Biotechnology(MCB)

Course Code	Topic	Credits: 4
PSBOMCB303	Plant Biotechnology	
Unit I: Plant Tissue Culture		
<ul style="list-style-type: none"> • Plant improvement through somaclonal variations, anther culture. • Plant cell cultures as chemical factories: Cell suspension, enhancement of product formation using biotic and abiotic elicitors, immobilization, permeabilization and product recovery. 		1
UnitII: Plant Tissue Culture		
<ul style="list-style-type: none"> • Biotransformation using cell cultures for e.g. Vanillin production from <i>Capsicum</i> cell cultures. 		1
Unit III: Plant Tissue Culture		
<ul style="list-style-type: none"> • <i>In vitro</i> storage of germplasm, cryopreservation. • Studies on Agrobacterium mediated transformed root cultures. 		1
Unit IV: Plant Tissue Culture		
<ul style="list-style-type: none"> • The quest for commercial production from plant cell scaling up of cell cultures, important factors for bioreactor design, pneumatically agitated bioreactors, comparison of bioreactors, operating mode, batch, fed-batch, semicontinuous, two stage operation, continuous cultivation, example: Shikonin production by <i>Lithospemumerythrorhizon</i> cell cultures. 		1

Course Code	Topic	Credits: 4
PSBOMCB304	Molecular Biology and Cytogenetics	
Unit I: Cytology		
<ul style="list-style-type: none"> • . Cell membrane and permeability: Molecular models of cell membrane, cell permeability. Differentiation of cell membrane, intercellular 		1

<p>communications and gap junctions. Cell coat and cell recognition, cell surface.</p> <ul style="list-style-type: none"> • Ultrastructure of mitochondrion and chloroplast. 	
<p>UnitII: Cancer Biology</p> <ul style="list-style-type: none"> • Cancer cells: Characteristics, division, spread, treatment. Course of cancer cell formation, • Carcinogens: radiations, chemicals, oncogenic virus. • Cancer and mutations, reproductive properties of transformed animal cell in culture, oncogenes, protooncogenes and their conversion. Oncogenes and growth factors. 	1
<p>Unit III: Immune System</p> <ul style="list-style-type: none"> • Phylogeny of immune system, innate and acquired immunity, nature and biology of antigens, major histocompatibility complex cells of immune system, regulation of immune responses. Production of antibodies by plant cells and organs. 	1
<p>Unit IV: Genetic Disorders</p> <ul style="list-style-type: none"> • Genetic disorders, genetic counseling and gene therapy: Biochemical disorders, sex linked disorders, cardiovascular disorders. 	1

PRACTICAL

PSBOMCBP303	<u>Plant Biotechnology</u>	2	4
<ul style="list-style-type: none"> • Various sterilization techniques, preparation of stock solutions, preparation of MS medium. • Seed sterilization, callus induction and regeneration, hardening and field transfer of any suitable material. • Encapsulation of axillary buds. • Establishment of callus of any suitable material and estimation of biomass accumulation and any one measurable product as a function of time. • Visit to industry/research lab to see various types of fermenters 			
PSBOMCBP304	<u>Molecular Biology & Cytogenetics</u>	2	4
<ul style="list-style-type: none"> • Effect of PDB on cytological changes in the cells (Onion root tips), preparation of permanent slides. • Study of meiosis in using suitable flower buds • Study of mitotic index. 			

<ul style="list-style-type: none"> • Culturing of <i>Drosophila</i> and study of genetic traits. • Blood group testing. • Identification of genetic diseases by chemical tests. • Karyotypes of genetic disorders. 	
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Specialization: Plant Physiology and Biochemistry (PPB)

Course Code	Topic	Credits:
PSBOPPB303	Biochemistry	4
Unit I: Enzymes		1
<ul style="list-style-type: none"> • Enzyme isolation and purification, measurement of enzyme activity, specific activity, turnover number, isozymes, industrial application of enzymes. 		
UnitII: Vitamins and Coenzymes		1
<ul style="list-style-type: none"> • Structure, occurrence of all water soluble and fat soluble vitamins and coenzyme activity. 		
Unit III: Plant Proteins		1
<ul style="list-style-type: none"> • Lectins and storage proteins in plants, transamination, oxidative deamination and urea cycle. 		
Unit IV: Nucleotide Metabolism		1
<ul style="list-style-type: none"> • Purine and pyrimidine biosynthesis and regulation 		

Course Code	Topic	Credits:
PSBOPPB304	Plant Physiology	4
Unit I: Water Relations of Plants		1
<ul style="list-style-type: none"> • The concept of chemical potential and water potential, transpiration, antitranspirants, modern methods of improving crop productivity. 		
UnitII: Post Harvest Technology		1
<ul style="list-style-type: none"> • Physiological changes during ripening, fruit preservation, role of ethylene in post-harvest technology. 		
Unit III: Stress Physiology: Drought		1
<ul style="list-style-type: none"> • Types of drought, morphological and cellular adaptations, mechanism of 		

drought tolerance, drought tolerant crops, role of betaines, proline and other metabolites in stress resistance.	
Unit IV: Stress Physiology: Salinity <ul style="list-style-type: none"> Salt accumulation and exclusion (salt avoidance and tolerance/resistance) in halophytes and halobacteria. Chloride and sulphate halophytes, salt tolerant, effect of salt on metabolic processes, proton pumps, Na⁺ and K⁺ATPases and regulation of iron transport. 	1

PRACTICAL

PSBOPBP303	<u>Plant Physiology & Biochemistry -I</u>	2	4
<ul style="list-style-type: none"> Electrophoretic separation of proteins (Native/SDS). Estimation of vitamin C. Isolation and estimation of DNA. Estimation of RNA by Orcinol method. Study of NiR activity <i>in vivo</i> 			
PSBOPBP304	<u>Plant Physiology & Biochemistry -II</u>	2	4
<ul style="list-style-type: none"> Activity of ATPases in green plant material. Morphological character key in identification of type of halophyte. Proline content estimation in garden and salt stressed plants. Extraction and estimation of pectin and sugars from fruits. 			

Specialization: Specialization: Mycology and Plant Pathology (MPP)

Course Code	Topic	Credits:
		4
PSBOMPP303	<u>General Mycology</u>	
Unit I: History of Mycology and Plant Pathology in India & Soil Mycology <ul style="list-style-type: none"> History of Mycology and Plant Pathology in India and contribution of Mycologists and Plant Pathologists: i) C J. Alexopoulos ii) E. A. Bessey iii) K. S. Bilgrami iv) E. A. Butler v) K. S. Thind vi) M. N. Kamat vii) R. N. Tandon 		1

<ul style="list-style-type: none"> • Soil Mycology: i) Various techniques to determine the fungal population in soil. ii) Various interactions amongst the soil fungi and other organisms. 	
<p>Unit III: Fungal Taxonomy & Life history and Systematic position of fungi</p> <ul style="list-style-type: none"> • Fungal Taxonomy: A comparative account of various systems of classification of fungi proposed by Bessey and Ainsworth. • Life history and Systematic position of the following fungi: <ul style="list-style-type: none"> ○ Myxomycetes: <i>Physarumpolycephalum</i> ○ Ascomycetes: <i>Clavicepspurpurea</i> 	1
<p>Unit III: Fungal Physiology</p> <ul style="list-style-type: none"> • Nutrition in fungi with reference to: i) Carbon ii) Sulphur iii) Potassium iv) Magnesium v) Nicotinic acid vi) Riboflavin • Fungal Metabolites: Acetate and Nitrogenous metabolites 	1
<p>Unit IV: Fungal Cytology, Genetics and Ecology</p> <ul style="list-style-type: none"> • Fungal Cytology: Microscopic structure, Chemical composition and functional attributes of fungus cell walls • Fungal Ecology: <ul style="list-style-type: none"> ○ Environmental factors influencing fungal growth: i) Humidity ii) Temperature ○ Fungal Diversity: Anamorphic fungi- i) Nematophagous fungi ii) Aquatic hyphomycetous fungi iii) Aero-aquatic fungi 	1

Course Code	Topic	Credits:
		4
PSBOMPP304	<u>Applied Mycology and Plant Pathology</u>	
<p>Unit I: Pathogenesis and Crop Pathogeny</p> <ul style="list-style-type: none"> • Pathogenesis: i) Penetration and entry by plant pathogens ii) Pre-penetration iii) Entry through natural openings • Crop Pathology: Study of the following diseases; i) Wart of potato ii) Downy mildew of grapes iii) Bunt of rice iv) Citrus canker 	1	
<p>Unit II: Seed Mycoflora & Seed Pathology</p> <ul style="list-style-type: none"> • Seed Mycoflora: Fungi on seeds- A) Field Fungi B) Storage Fungi – i) Characteristics of major storage fungi ii) Effect of storage fungi iii) 	1	

Control of storage fungi	
<ul style="list-style-type: none"> • Seed Pathology: Pathological Effects of Seed borne diseases- i) Seed abortion ii) Shrunken seeds & Reduced seed size iii) Seed rot iii) Sclerotisation&Stromatisation iv) Seed discolouration v) Reduced or complete loss of germinability 	
Unit III: Cultural Studies and Food borne Fungi <ul style="list-style-type: none"> • Cultural Studies in Fungi: Culture Media and their types based on i) Empirical use ii) Physical states iii) Chemical composition • Food borne fungi: <ul style="list-style-type: none"> ○ Common contaminants of – i) Fresh food ii) Processed food iii) Stored food ○ Use of chemical preservatives to protect the food against contamination 	1
Unit IV: Industrial Mycology <ul style="list-style-type: none"> • Industrial application of fungal enzymes – i) Protease ii) Cellulase iii) Invertase • Uses of immobilization technique in fermentation by fungi 	1

PRACTICAL

PSBOMPPP303	<u>General Mycology</u>	2	4
<ul style="list-style-type: none"> • Isolation of soil fungi by Warcup method • Study of the following fungal types with reference to their systematic position, thallus and reproductive structures: <ul style="list-style-type: none"> ○ <i>Physarum</i> ○ <i>Arcyria</i> ○ <i>Taphrina</i> ○ <i>Chaetomium</i> ○ <i>Phyllachora</i> • Measurement of fungal growth by linear determination • Study of effect of incubation temperatures on fungal growth (15⁰C, 30⁰C & 60⁰C) • Isolation of nematophagus fungi from garden soil/agriculture soil 			

PSBOMPPP304	<u>Applied Mycology and Plant Pathology</u>	2	4
<ul style="list-style-type: none"> • Isolation of fungal pathogens from infected leaves • Study of the following diseases: i) Wart of potato ii) Downy mildew of grapes iii) Bunt of rice iv) Citrus canker • Isolation of seed borne fungi by 2-4 D method • Minimum inhibition concentration of salt on fungal growth • Quantitative estimation of cellulose by DNSA method 			

Specialization: Angiosperm and Phytochemistry (ANP)

Course Code	Topic	Credits:
PSBOANP303	<u>Angiosperms & Phjytochemistry -I</u>	4
Unit I: Evolution <ul style="list-style-type: none"> • The effects of evolutionary theory on systematic, monographic, and floristic development <ul style="list-style-type: none"> ○ Primitive versus advanced ○ Homology and Analogy ○ Parallelism and Convergence. 		1
UnitII: Cladistics <ul style="list-style-type: none"> • Use of cladistic in classification • Phylogenetic classification systems-Takhtajan,Cronquist,APGI,II,III • Understanding phylogeny, constructing phylogeny, Monophyly,Paraphyly and polyphyly • Patterns of variation and phylogenetic trees, Building Trees-Rooting 		1

technique, Distance methods, Maximum likely hood methods, Bootstrapping using trees. Phyllocode	
Unit III: Nomenclature <ul style="list-style-type: none"> • International code of Botanical Nomenclature 1830-Paris Code to 2011-Melbourne code • Major adaptations considered in these International Botanical Congress • Important Rules of ICBN, Typification, Type concept and Types of type, Basionym, Homonym, Tautonym, Taxonomic and nomenclature synonyms 	1
Unit IV: Keys and GB <ul style="list-style-type: none"> • Types of keys <ul style="list-style-type: none"> ○ single access and multi access keys, preparation of keys for Taxon based on exomorphic characters • Green -belt planning <ul style="list-style-type: none"> ○ Concept and recommendations ○ Utility of GBP ○ List of plants, ornamental, Flowering, shady ○ Imporance of Green Belt in the current environmental conditions in India 	1

Course Code	Topic	Credits:
PSBOPPB304	<u>Angiosperms & Phytochemistry -II</u>	4
Unit I: Families <ul style="list-style-type: none"> • Approaches to Angiosperm Taxonomy Study the following families with reference to its systematic position, distribution, salient features, flioral formula, floral diagram, morphological peculiarities and enlist economic important plants and their uses. Nympheaceae ,Onagraceae, Vitaceae, Nyctaginaceae, ,Balsaminaceae, and commelinaceae. • A detailed study of the present status, affinities, phylogeny and interrelationships of the above families. 	1	

<p>UnitII: Anatomy</p> <ul style="list-style-type: none"> • Study of cambium with reference to its origin, position, structure, distribution, behaviour and its importance in vascular plants. • Study of Leaf architecture Patterns in dicotyledonous plants and its significance. • A study on basic features on Node-petiole and Nodal anatomy. 	1
<p>Unit III: Embryology and Palynology</p> <ul style="list-style-type: none"> • Types,Technique,factors affecting somatic embryogenesis and importance of embryogenesis. • Embryology in relation to taxonomy. • In vivo growth of pollen,pollenrecognition and pollen rejection in angiosperms. • 	1
<p>Unit IV: Crude Drugs</p> <ul style="list-style-type: none"> • Fumitories and Masticatories • Mild stimulants –Tea,Coffee and cocoa • Methods in evaluation of crude drugs: <ol style="list-style-type: none"> a. Organoleptic b. Microscopic: <ol style="list-style-type: none"> i. leafconstanants: palisade ratio and vein islet number. ii. trichomes and Trichome density iii. stomata:structure and types. iv. cell inclusions v. sclereids vi. Wood elements:structure and organization c. Physico-chemical: <ol style="list-style-type: none"> i. Ash content ii. Extactive values iii. Qualitative chemical analysis • Quantitative chemical analysis 	1

PRACTICAL

PSBOMCBP303	<u>Angiosperms & Phjytochemistry -I</u>	2	4
<ol style="list-style-type: none"> 1. Study of exomorphic characters: study of stem, root, leaf, inflorescence, flower, fruit and seed of any five plants. 2. Study of endomorphic characters. <ol style="list-style-type: none"> a. Study of anatomical characters of Taxonomic importance: <ol style="list-style-type: none"> i. Epidermal characters: Study of following epidermal characters with respect to families Graminae and Cruciferae <ol style="list-style-type: none"> 1. Epidermal cells <ol style="list-style-type: none"> a. Cell size and shape b. Cell wall materials and thickness of wall c. Cell wall surface and extra cellular deposits. d. Cell inclusions 2. Study of stomata: <ol style="list-style-type: none"> a. Types of stomata b. Size and shape of guard cells and other cells in association. 3. Epidermal outgrowths: Study of trichomes in crotons. b. Study of cell inclusions: <ol style="list-style-type: none"> i. Reserve food material: Use of differences in starch grain types in detection of varieties in Diffenbachiaseguine. ii. Secretory products: Analysis of Nectar from any five plants. iii. Other metabolic end products: <ol style="list-style-type: none"> 1. Latex cells in Apocynaceae, Euphorbiaceae. 2. Resin cystolith in Begoniaceae 3. Raphides in Onagraceae c. Study of Vascular bundles: <ol style="list-style-type: none"> i. Cortical vascular bundles in Casuarinaceae ii. Medullary vascular bundles in Nyctaginaceae 			
PSBOANPP304	<u>Angiosperms & Phytochemistry -II</u>	2	4
<ul style="list-style-type: none"> • Study of Angiosperm families mentioned for theory with reference to morphological peculiarities and economic 			

importance of its members with the help of locally available plants.

- Study of floral diagrams with respect to the families prescribed.
- Study of Cambium primary, secondary and cork cambia.
- Study of leaf architecture. Prepare permanent leaflet of Tamarind leaf architecture (submission).
- Study of Node petiole anatomy.
- Study of *in vivo* growth of pollen grains.
- Embryo mounting –dicot and monocot and polyembryony
- Study of trichomes, types of stomata, palisade as microscopic evaluation of crude drugs.
- Study Fumitories and Masticatories.

Specialisation: Environmental Botany

Course Code	Topic	Credits: 4
PSBOEB303	<u>Ecology and Environmental Botany</u>	
Unit I: Basic Ecological Concept <ul style="list-style-type: none"> • Habitat ecology, systems ecology, synecology, autecology; Ecosystem concept; Structure and functions of biotic and abiotic components; Energy in ecosystems and environment; Energy exchange and productivity-food chains and food webs-ecological pyramids 		1
UnitII: Ecosystem <ul style="list-style-type: none"> • Type of habitats marine & fresh water, estuaries, biota of marine, fresh water and estuarine ecosystem, ecology of marine and coastal and estuarine ecosystems. • Ecosystems studies with special reference to primary productivity and phyto-planktonic studies. Aquatic weeds its uses, maintenance and control 		1
Unit III: Bio-geochemical Cycle <ul style="list-style-type: none"> • Nitrogen Cycle: Role of nitrogen in plant metabolism and in biosphere. Normal nitrogen cycle and as tampered by man – agricultural nitrogen fixation, industrial emissions, transportations etc. Impact in terms of eutrophication of environment and health. • Sulphur Cycle: forms of sulphur in biosphere and geosphere in fossil fuels and its release with industrialization sulphur cycling in soil bacterial metabolism. Impact of plants on life. • Carbon Cycle: Forms and places of occurrence of carbon. Photosynthetic sequestration of carbon. Carbon in biomass in forest ecosystems. Cycling of carbon in biosphere and in oceans. Global warming problem and its possible implications. • Oxygen Cycle: Origin of molecular oxygen on earth, its increase in atmosphere through geological eras. Inventory, role in plants, in biosphere and in oceans. Causes of disturbance of the cycle, effects. Role of plants in oxygen balance, oxygen emission by plants and forests. The problem of ozone layer around the earth. 		1

<p>Unit IV: natural Resources</p> <ol style="list-style-type: none"> 1. Forest resources: use and over-exploitation, 2. Deforestation, timber extraction, mining, dams and their effects on forests and tribal people. 3. Water resources: use and utilization of surfaces and ground water, floods drought, dams-benefits and problems. <ul style="list-style-type: none"> • Land resources: Land as a resource, Land degradation, man induced landslides, soil erosion and desertification 	1
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Course Code	Topic	Credits: 4
PSBOEB304	<u>Recent Trends & Applied Environmental Botany</u>	
<p>Unit I: Conservation Ecology –I</p> <ul style="list-style-type: none"> • Soil conservation - definition, causes for erosion; types - wind and water erosion; conservation and management of eroded soils/areas, wind breaks, shelter belts; sand dunes; reclamation of saline and alkaline soils, water logged and other waste lands. • Role of national and international organisations in conservation and some relevant terms IUCN, UNDP, WWF, World Bank, European Union, MoEF, DST,DBT, CSIR, UGC, CPCB, PCBs, Municipal corporation Agenda 21, NGOss, capacity building, GEMS, GEO, WRR, GIS, IBGP, TRIPS, etc, legislation aiming at conservation. 		1
<p>UnitII: Conservation Ecology II</p> <ul style="list-style-type: none"> • Environmental impact assessment for physical, chemical, biological and socio-economic factors; Legislative implications of EIA, environmental impacts assessment and environmental auditing; • Economics assessment of watershed development vis-a-vis ecological and environmental protection. • Role or contribution of Botanist in EIA and EMP 		1
<p>Unit III: Biodiversity Studies</p> <ul style="list-style-type: none"> • Biodiversity: Concepts and levels, NATIONAL & GLOBAL STATUS, role of biodiversity in ecosystem function and stability, Speciation and extinction, IUCN categories of threats, distribution and global pattern, biodiversity hotspots, inventory. 		1

<ul style="list-style-type: none"> • Biodiversity management approaches. • Measures of maintaining biodiversity, need for preservation of biodiversity with special reference to tropical forest biodiversity • centres of origin of crops, species concept; Significance of biodiversity; Plant genetic resources, exploration and collection; Crop domestication, plant introductions; Migration and utilization; IUCN clauses and concept of threatened and endangered species; • Different approaches for Biodiversity conservation-In-situ conservation: sanctuaries, biosphere reserves, national parks, nature reserves, preservation plots. • 	
<p>Unit IV: Renewable and Non-renewable Sources of Energy</p> <ul style="list-style-type: none"> • Concept and demand of energy, Growing energy needs, Renewable and non-renewable sources, use of alternate energy sources, Wind energy, Solar energy, Water as source of energy, Biofuels production, use and sustainability, use and over exploitation of energy sources and associated problems. 	1

PRACTICAL

PSBOEBP303	<u>Ecology and environmental Botany</u>	2	4
<ul style="list-style-type: none"> • Measurement of primary productivity by i) chlorophyll method, ii) harvest method and iii) light and dark bottle method. • Determination of pH, electrical conductivity and water holding capacity of different types of soil. • Determination of total organic matter of the soil. • Determination of total nitrogen value of soil by Kjeldahl's method. • Determination of SAR value of soil (Sodium Absorption Ratio). 			
PSBOEBP304	Recent Trends & Applied Environmental Botany	2	4
<ul style="list-style-type: none"> • Prepare a document of endemic and exotic species of plants for a selected protected area network (PAN). • Preparation of life form spectrum of a plant community (Field Exercise). 			

- Interpretation of satellite imagery, using recent images of familiar areas.
- Preparation of maps of Biosphere Reservations of India.
- Preparation of location maps of National Parks and Sanctuaries in Maharashtra.
- Identification of some important plants along with their locations, for their importance viz. Conservation status (are, endangered, threatened, protected, ethnic significance etc).

M.Sc Botany Semester IV

Outline of the Course: PS401 and 402 are common papers for all specialisations

PSBO401: Techniques and Instrumentation

PSBO 402: Cell and Molecular Biology

PSBO403 and PSBO404 are Optional Papers in any one of the following specialisations.

1. Mycology and Plant Pathology
2. Plant Physiology and Biochemistry
3. Angiosperms and Phytochemistry
4. Molecular Biology, Cytogenetics and Biotechnology
5. Environmental Botany

Semester IV

Theory	PSBO401	:	4Credits
	PSBO402	:	4Credits
	PSBO403	:	4Credits
	PSBO404	:	4Credits
Practicals (based on all 4 courses)	PSBOP401	:	16 Credits
	PSBOP402		
	PSBOP403		
	PSBOP404		

**Detailed Syllabus SEMESTER IV
General Papers**

Course Code	Title	Credits
PSBO401	Techniques and Instrumentation	4
Unit I: <u>Microscopy</u> <ul style="list-style-type: none"> • Principles, working and application of light, phase contrast and fluorescence • Electron microscopy - Biological sample preparation, scanning and transmission electron microscopy, application of electron microscopy 		1
Unit II: <u>Centrifugation</u> <ol style="list-style-type: none"> 1. Rotor types 2. Density gradient centrifugation 5. Types of centrifugation and their application 		1
Unit III: <u>Chromatography</u> <ul style="list-style-type: none"> • Principles and application of chromatography • Principle and application of gel filtration 		1
Unit IV: <u>Tracer techniques</u> <ol style="list-style-type: none"> 1. Principle and application of tracer techniques in biology 2. Radioactive isotopes and autoradiography 2. Geiger Muller and Liquid Scintillation CounterColorimeter, UV-visible spectrophotometer. 		1

Course Code	Topic	Credits:
PSBO402	Molecular Biology	4
Unit I: Gene Regulation- I <ul style="list-style-type: none"> • Regulations of gene expression in bacteria – <i>trp</i> operon. 		1
Unit II: Gene Regulation- II <ol style="list-style-type: none"> 4. Regulation of gene expression in bacteriophage λ. 		
Unit III: Gene Regulation- III		1

<ul style="list-style-type: none"> Control of gene expression in eukaryotes, Transcriptional control, RNA processing control, mRNA translocation control, mRNA degradation control, protein degradation control 	
Unit IV: Gene Regulation <ul style="list-style-type: none"> Genetic regulation of development in <i>Drosophila</i> Developmental stages in <i>Drosophila</i> – embryonic development, imaginal discs, homeotic genes Protein structure, nature of genetic code, translation of genetic message. 	1

Practical

PSBOP401	<u>Project</u>	2	4
<p>‘Project Work’ - based on specialization , prepare a report and presentation of the same.</p> <ol style="list-style-type: none"> Projects should be: <ul style="list-style-type: none"> Well planned and executed meticulously. Related to an environmental problem in a nearby / familiar area An attempt at multi-disciplinary approach Consist of references to literature of relevance In the nature of ‘problem solving’ Hypothesis should be clearly spelt out, Objectives should be unambiguous Material and methods should be precise Collected data must be treated statistically and presented in a graphical manner Results should highlight the achievements of the project executed and identify the scope for further work in the subject. 			
PSBO402	<u>Molecular Biology</u>	2	4
<ol style="list-style-type: none"> Isolation of plasmid DNA Quantification of plasmid DNA Agarose gel electrophoresis separation of plasmid DNA Restriction enzyme digestion and separation of fragments 			

5. Southern blot transfer technique	
6. Transformation of <i>E. coli</i> cell by plasmid DNA	
7. β -galactosidase expression and assay.	

Special Papers

Specialisation: Molecular Biology, Cytogenetics and Biotechnology(MCB)

Course Code	Topic	Credits:
PSBOMCB403	Plant Biotechnology	4
Unit I: Environmental Biotechnology		
1. Environmental pollution – types, methods of measurement of pollution, pollution indicators and biosensors 2. Solid waste treatment <ul style="list-style-type: none"> • Hazardous waste management – degradation by xenobiotics and pesticides 		1
UnitII: IPR		
<ul style="list-style-type: none"> • Biotechnology and the law – objective, evolution, basic structure of gene techniques, applications, commercial potential of biotech inventions, rational for IPR protection • Protection of traditional knowledge – objective, concept of traditional knowledge, holders, issue concerning, bio-prospecting and bio-piracy. Biotransformation using cell cultures for e.g. Vanillin production from <i>Capsicum</i> cell cultures. 		1
Unit III: Nanotechnology		
<ul style="list-style-type: none"> • Introduction, synthesis of nanomaterials, biological methods, use of microbial system & plant extracts, use of proteins & templates like DNA • Application of nanomaterials in food, cosmetics, agriculture, environment management and medicine. 		1

<p>Unit IV: Food Biotechnology</p> <ul style="list-style-type: none"> • Factors affecting spoilage • Quality control of food <p>The quest for commercial production from plant cell scaling up of cell cultures, important factors for bioreactor design, pneumatically agitated bioreactors, comparison of bioreactors, operating mode, batch, fed-batch, semicontinuous, two stage operation, continuous cultivation, example: Shikonin production by <i>Lithospemumerythrorhizon</i> cell cultures.</p>	1
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Course Code	Topic	Credits:
PSBOMCB404	Cytogenetics and Molecular Biology	4
<p>Unit I: Plant Breeding</p> <ol style="list-style-type: none"> 1. Aims and objectives, plant introductions and acclimatization 2. Selection – mass, pure line and clonal <ul style="list-style-type: none"> • Hybridization techniques, hybridization in self pollinated and cross pollinated plants <p>Cell membrane and permeability: Molecular models of cell membrane, cell permeability. Differentiation of cell membrane, intercellular communications and gap junctions. Cell coat and cell recognition, cell surface.</p> <ul style="list-style-type: none"> • Ultrastructure of mitochondrion and chloroplast. 		1
<p>Unit II: Plant Breeding</p> <ul style="list-style-type: none"> • Distant hybridization: In nature. In plant breeding – Barriers to the production of distant hybrids; Unreduced gametes in distant hybridization; Sterility in distant hybrids; Consequences of segregation in distant hybrids; Applications and Achievements of distant hybridization in crop improvement; Limitations of distant hybrids. 		1
<p>Unit III: Genetic Engineering</p> <ul style="list-style-type: none"> • Transgenic plants – Artificial (Direct DNA uptake by protoplast, electrotransportation, liposome mediated and particle gun transformation) and natural method of gene transfer (<i>Agrobacterium</i> and virus) 		1

Unit IV: Molecular Markers	
<ul style="list-style-type: none"> DNA-based molecular marker aided breeding: RAPD, RFLP, AFLP, STS, ISSR, Microsatellites 	1

PRACTICAL

PSBOMCBP403	<u>Plant Biotechnology</u>	2	4
<ol style="list-style-type: none"> Determine the biological oxygen demand of given water sample. Determine the chemical oxygen demand of a given water sample. Patent search and filing of a patent form. Carrying out a patent search for the given invention. Synthesis and analysis of Nanoparticles – UV Visible spectra analysis. Preparing compost from vegetable waste and estimating the pH, water holding and organic matter. Industry visit to see the instruments used for characterization of nanoparticles. 			
PSBOMCBP404	<u>Molecular Biology & Cytogenetics</u>	2	4
<ul style="list-style-type: none"> Effect of PDB on cytological changes in the cells (Onion root tips), preparation of permanent slides. Study of meiosis in using suitable flower buds Study of mitotic index. Culturing of <i>Drosophila</i> and study of genetic traits. Blood group testing. Identification of genetic diseases by chemical tests. Karyotypes of genetic disorders. 			

Specialization: Plant Physiology and Biochemistry (PPB)

Course Code	Topic	Credits:
		4
PSBOPPB403	Biochemistry	
Unit I: Biochemical Regulation		
<ul style="list-style-type: none"> Coarse metabolic controls, fine metabolic controls, regulation by variation 		1

in substrate and pH, pacemaker enzymes, allosteric regulation, covalent modification, subunit association and dissociation. Role of ATP, calmodulins, calcium.	
UnitII: Secondary Metabolism <ul style="list-style-type: none"> Shikimic acid pathway, Malonic acid pathway, Mevalonic acid pathway, 3PGA/pyruvate pathway-Biosynthesis and role of Phenols, Phenylpropanes, Coumarinns, lignins, flavonoids, alkaloids, tannins, sterols and terpenes. 	1
Unit III: Cytosolic carbon metabolism <ul style="list-style-type: none"> Central role of hexose phosphate, sucrose synthesis and breakdown, starch synthesis and breakdown, regulation of glycolysis, gluconeogenesis. 	1
Unit IV: Mitochondrial Metabolism <ul style="list-style-type: none"> Catabolic role of the TCA cycle: oxidation/reduction of carbohydrate, lipid, protein and amino acids, anabolic role of the TCA cycleintermediates, anapleuotic CO₂ fixation, provision of acetyl CoA for biosynthesis, control of TCA. 	1

Course Code	Topic	Credits:
PSBOPPB404	Plant Physiology	4
Unit I: PGRs <ul style="list-style-type: none"> Modulation of plant genomes by natural and synthetic PGRs. 	1	
UnitII: Phytoremediation <ul style="list-style-type: none"> Role of various enzymes in phytoremediation, super accumulators, Phytoextraction. 	1	
Unit III: Phytochrome & Photomorphogenesis <ul style="list-style-type: none"> Photochemical and biochemical properties of phytochrome, phytochrome induced whole plant response, cellular and molecular mode of action. Molecular basis of flower organization: MADS box genes and their expression. 	1	
Unit IV: Senescence <ul style="list-style-type: none"> Pigment Metabolism, protein metabolism and oxidative metabolism during senescence. Programmed cell death (PCD) an overview. 	1	

PRACTICAL

PSBOPPPBP403	<u>Plant Physiology & Biochemistry -I</u>	2	4
<ol style="list-style-type: none"> 1. Effect of substrate variation having allosteric concentration on the activity of enzyme. 2. Effect of inhibitors on the activity of enzymes. 3. Study of enzymes SDH and MDH. 4. Study the activity of enzyme invertase. 5. Progressive amylase activity in germinating seeds. 6. Pharmacological tests for secondary metabolites. 			
PSBOPPPBP404	<u>Plant Physiology & Biochemistry -II</u>	2	4
<ol style="list-style-type: none"> 1. Study of effect of various concentration of Indole butyric acid on rooting of stem cuttings of suitable tree species. 2. Estimation of polyphenols. 3. Problems based on ABC model for flower organization 4. Study of absorption spectrum of pigments at different stages of senescence. 			

Specialization: Specialization: Mycology and Plant Pathology (MPP)

Course Code	Topic	Credits:
PSBOMPP403	<u>General Mycology</u>	4
Unit I: History of Mycology and Plant Pathology in India & Soil Mycology <ul style="list-style-type: none"> • History of Mycology and Plant Pathology in India and contribution of Mycologists and Plant Pathologists: i) S. D. Garrett ii) K. C. Mehta iii) B. B. Mundkur iv) C. V. Subramaniam v) T. S. Sadashivan vi) M. J. Thirumalachar vii) John Webster • 2) Soil Mycology: Distribution of Mycoflora with relation to the soil factors - i) Texture ii) Moisture iii) Temperature iv) Aeration v) pH vi) Organic matter 		1
History of Mycology and Plant Pathology in India and contribution of Mycologists and Plant Pathologists: i) C J. Alexopoulos ii)		

<p>E. A. Bessey iii) K. S. Bilgrami iv) E. A. Butler v) K. S. Thind vi) M. N. Kamat vii) R. N. Tandon</p> <ul style="list-style-type: none"> • Soil Mycology: i) Various techniques to determine the fungal population in soil. ii) Various interactions amongst the soil fungi and other organisms. 	
<p>Unit II: Fungal Taxonomy & Life history and Systematic position of fungi</p> <ul style="list-style-type: none"> • Fungal Taxonomy: A comparative account of various systems of classification of fungi proposed by i) Smith ii) Martin • Life history and Systematic position of the following fungi: <ul style="list-style-type: none"> ○ Phycomycetes: <i>Saprolegnia</i> ○ Basidiomycetes: <i>Cyathus</i> ○ Deuteromycetes: <i>Helminthosporium</i> <p>A comparative account of various systems of classification of fungi proposed by Bessey and Ainsworth.</p> <ul style="list-style-type: none"> • Life history and Systematic position of the following fungi: <ul style="list-style-type: none"> ○ Myxomycetes: <i>Physarum polycephalum</i> ○ Ascomycetes: <i>Claviceps purpurea</i> 	1
<p>Unit III: Fungal Physiology</p> <ul style="list-style-type: none"> • Nutrition in fungi with reference to: i) Nitrogen ii) Phosphorus iii) Thiamine iv) Folic acid v) Pantothenic acid vi) Iron • Fungal Metabolites: Aflatoxins and Aromatic terpenes 	1
<p>Unit IV: Fungal Cytology, Genetics and Ecology</p> <p>1. Fungal Genetics: Study of fungal genetics with reference to –</p> <p>i) <i>Neurospora</i> ii) <i>Saccharomyces</i> iii) <i>Puccinia graminis</i> iv) <i>Ustilago</i></p> <p>2. Fungal Ecology:</p> <p>A) Physical Environmental factors influencing fungal growth:</p> <p>i) Light ii) Hydrostatic pressure iii) Radiations</p> <p>B) Fungal Diversity: i) Fresh water fungi ii) Marine fungi iii) Coprophilous fungi iv) Aero-fungi</p>	1

Course Code	Topic	Credits:
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PSBOMPP404	<u>Applied Mycology and Plant Pathology</u>	
Unit I: Pathogenesis and Crop Pathogeny 3. Symptomology: Various symptoms of plant diseases caused by fungi. <ul style="list-style-type: none"> • Crop Pathology: Study of the following diseases; i) Club root of cabbage ii) Coffee Rust iii) Brown spot of rice iv) Papaya mosaic 		1
UnitII: Seed Mycoflora & Seed Pathology <ul style="list-style-type: none"> • Seed Mycoflora: Detection of Seed borne pathogens by- i) Washing test ii) Incubation method: a) Blotter method b) Agar plate method • Seed Pathology: Management of Seed borne diseases - i) Chemicals ii) Antibiotics iii) Biological control agents iv) Host – Resistance in disease management 		1
Unit III: Cultural Studies and Fungal Toxins <ul style="list-style-type: none"> • Cultural Studies in Fungi: Preservation techniques of fungal cultures – i) Sub-culturing ii) Storage under mineral oil iii) Storage in distilled water iv) Storage by drying v) Storage by freezing • Fungal Toxins: Mycotoxins and their types i) <i>Alternaria</i> Toxins ii) Citrinin iii) Ochratoxins iv) Patolin v) Penicillic Acid vii) Sterigmatocystin viii) Zearalenone 		1
Unit IV: Industrial Mycology <ul style="list-style-type: none"> • Fungal bio-conversions of Lignocellulose materials i) Lignocellulose ii) Potential bio-products and their applications 		1

PRACTICAL

PSBOMPPP403	<u>General Mycology</u>	2	4
<ol style="list-style-type: none"> 1. Study of the following fungal types with reference to their systematic position, thallus and reproductive structures: i) <i>Achlya</i> ii) <i>Allomyces</i> iii) <i>Cyathus</i> iii) <i>Uromyces</i> iv) <i>Curvularia</i> 2. To study effect of different nitrogen sources on fungal growth in term of biomass 3. Light as physical factor influencing fungal growth & sporulation 4. Isolation of fresh water fungi by baiting technique. 			

5. Study of effect of relative humidity on fungal growth (CaSO ₄ .5H ₂ O -98%, KCl-85% & CaNO ₃ .4H ₂ O -52%)			
PSBOMPPP404	<u>Applied Mycology and Plant Pathology</u>	2	4
1. Study of different symptoms of plant diseases: i) Wilting ii) Leaf spot iii) Canker iv) Leaf mosaic 2. Study of Seed Surface Mycoflora by Dry Seed Agar Plate technique 3. Qualitative estimation of Mycotoxins by Paper Chromatographic method 4. Sub-culturing of fungal culture from pour plate culture 5. Study of wood rotting fungi: i) <i>Pleurotus</i> ii) <i>Schyzophyllum</i> iii) <i>Auriculariav</i>) <i>Hexagonia</i>			

Specialization: Angiosperm and Phytochemistry (ANP)

Course Code	Topic	Credits: 4
PSBOANP403	<u>Angiosperms & Phjytochemistry -I</u>	
Unit I: Evolution 1. The effects of evolutionary theory on systematic, monographic, and floristic development i. Phylogeny, phylogenetic and phynetic ontogeny ii. Monophyly and Polyphyly • Character weighing The effects of evolutionary theory on systematic,		1

<p>monographic, and floristic development</p> <ul style="list-style-type: none"> ○ Primitive versus advanced ○ Homology and Analogy ○ Parallelism and Convergence. 	
<p>UnitII: Progressive taxonomy</p> <ul style="list-style-type: none"> • a. Internet a. Taxonomic databases <p>b. Present status and future scope of Taxonomy in India</p> <ul style="list-style-type: none"> i. Vegetationsurvey ii. Floristics iii. Revisionary and monographic studies iv. Ethnobiological studies v. Development and establishment of new herbaria <ul style="list-style-type: none"> • Global Positioning System in vegetation studiesUse of cladistic in classification • Phylogenetic classification systems-Takhtajan,Cronquist,APGI,II,III • Understanding phylogeny, constructing phylogeny, Monophyly,Paraphyly and polyphyly • Patterns of variation and phylogenetic trees, Building Trees-Rooting technique, Distance methods, Maximum likely hood methods, Bootstrapping using trees. Phyllocode 	1
<p>Unit III: Tools</p> <p>1. Library</p> <ul style="list-style-type: none"> a. Literture:definition,origin,History and Evolution of Literature of Taxonomy in India. b. Classification of Taxonomic Literature:Checklist,Catalogue,Floras,Monographs,Revisions,Encyclopedias,Indices,Dictionaries,Journal. <p>2. Museum(Herbarium)</p> <p>Definition, Steps involved in development of a herbarium, Maintenance of Herbarium, General account of Herbaria in India. Role of B.S.I in Herbaria, Private herbaria, Herbarium of KEW, Utility and importance of Herbaria in Taxonomy.</p>	1

<p>3. Garden</p> <ul style="list-style-type: none"> a. Origin, History and Development of gardens in India b. Types of Gardens c. Role of gardens in taxonomic studies d. Preservation of germ -plasm techniques and its importance in taxonomy. <p>4. Naming of plants</p> <ul style="list-style-type: none"> a. Plant nomenclature-definition, ICBN • Principles, Articles, recommendations, Rules and exercises on plant nomenclature and Typification. 	
<p>Unit IV: Applies Taxonomy</p> <ul style="list-style-type: none"> • Types of keys A. Remote Sensing <ul style="list-style-type: none"> i. History, Principles and types of Remote sensing ii. Advantages and limitations of remote sensing iii. Applications of Remote Sensing in Vegetation Classification and Forest resource Management. iv. Remote sensing of soil and water B. Plant quarantine <ul style="list-style-type: none"> i. Purpose ii. Historical account iii. Plant protection organisation iv. Exclusive quarantine v. Regular quarantine vi. Domestic quarantine vii. Certification of plant materials • Green -belt planning <ul style="list-style-type: none"> ○ Concept and recommendations ○ Utility of GBP ○ List of plants, ornamental, Flowering, shady ○ Imporance of Green Belt in the current environmental conditions in India 	<p>1</p>

Course Code	Topic	Credits: 4
PSBOPP404	<u>Angiosperms & Phytochemistry -II</u>	
<p>Unit I: Families</p> <ul style="list-style-type: none"> • Approaches to Angiosperm Taxonomy Study the following families with reference to its systematic position, distribution, salient features, floral formula, floral diagram, morphological peculiarities .Enlist economic important plants and their uses. Oleaceae ,Plumbaginaceae, sapotaceae, Bignonaceae, Caryophyllaceae ,Loranthaceae,Urticaceae, Araceae and Orchidaceae.. • A detailed study of the present status, affinities, phylogeny and interrelationships of the above families. 		1
<p>UnitII: Anatomy</p> <p>i. Ontogeny of stomatal development. Study of abscission zone in Plants.</p> <p>iii. Floral anatomy in hypogynous, perigynous and epigynous flowers and its significance.</p>		1
<p>Unit III: Embryology and Palynology</p> <p>1. Embryology and Palynology</p> <ol style="list-style-type: none"> a. Role of embryology in plant breeding. b. Pollen-Pistil interaction and its importance. c. Evolution of pollen aperture types in angiosperms. 		1

<p>Unit IV: Crude Drugs</p> <p>2. Medicinal Botany</p> <p>i. History, origin, characteristics, uses, present status and varieties of Ginger and Eucalyptus.</p> <ul style="list-style-type: none"> • Psychoactive drugs: Narcotics, Hypnotics and Hallucinogens • Methods in evaluation of crude drugs: <ul style="list-style-type: none"> a) Biological <ul style="list-style-type: none"> i. Hepatoprotective ii. Anti-fertility iii. Anti-inflammatory iv. Anti-ulcer v. Neuro-pharmacological b) Evaluation of powdered drugs c) Detection and adulterants and quality testing of crude drugs. 	<p>1</p>
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PRACTICAL

PSBOMCBP403	<u>Angiosperms & Phytochemistry -I</u>	2	4
<ul style="list-style-type: none"> • Study of anomalous secondary growth: Pattern of anomalous secondary growth in Nyctaginaceae and Amaranthaceae. <p>2. Study of wood anatomy: a) Wood elements in members of Nymphaeaceae and Araceae</p> <p style="padding-left: 150px;">b) Distribution of wood parenchyma</p> <p style="padding-left: 150px;">c) Type of wood fibres</p> <p>3. Study of sclereids :Sclereids in Nymphaea leaf, Sapota fruit and Bean testa.</p> <p>4. Study of cytological characters of Taxonomic value: Study of karyotypes of <i>Allium cepa</i> and <i>Aloe vera</i> with respect to:</p> <ul style="list-style-type: none"> i) Chromosomal number ii) Length of individual chromosomes iii) Arm ratio iv) Type of karyotype (symmetric/ asymmetric) <p>5. Study of Palynological characters of Taxonomic value:</p> <ul style="list-style-type: none"> i) Eurypalynous type in Acanthaceae 			

- ii) Stenopalynous type in Casuarinaceae
- 6. Study of Biochemical characters in Taxonomic value:
 - i) Extraction and qualitative testing of Solanaceous alkaloids.
 - ii) Study of modifications in the phenotype using and suitable material.
 - iii) Preparation of artificial key using minimum five plants belonging to a family
 - v) Exercises on Nomenclature based on literature.

PSBOANPP404	<u>Angiosperms & Phytochemistry -II</u>	2	4
<ol style="list-style-type: none"> 1. Study of Angiosperm families mentioned for theory with reference to morphological peculiarities and economic importance of its members with the help of locally available plants. 2. Study of floral diagrams with respect to the families prescribed. 3. Study of Abscission zone with the help of permanent slide. 4. Study of floral anatomy as per the syllabus. 5. Study of pollen aperture types and pollinia types of Asclepiadaceae and orchidaceae. 6. Study of pericarp structure of Lady finger/pleumania/Alstonea. 7. Study of pericarp structure of Indehiscent fruit-Lotus, Physalis and Maize. 8. Study of seed coat structure in cotton, Ludvigia, Bauhinea, Caster, Pumpkin, Canna. 9. Types of ovules and Emryo sacs. 10. Organoleptic, microscopic and physico-chemical evaluation of drugs Ginger rhizome, Vasaka leaf, Fennel fruit, survey of formulations containing above drugs. 11. Detection of adulterants in the following samples on the basis of organoleptic, microscopic and physico-chemical evaluation. 			

<ul style="list-style-type: none">i. Tobacco leaves (adulterant diospyrose leaf)ii. Clove buds (adulterant cinnamomum buds)iii. Pepper fruits (adulterant lantana fruits/papaya seeds) <p>12. Visit to a Plant Quarantine centre and make a report of it.</p>	
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Specialisation: Environmental Botany

Course Code	Topic	Credits:
PSBOEB403	<u>Ecology and Environment Botany</u>	4
<p>Unit I: Pollution</p> <ol style="list-style-type: none"> 1. Air Pollution: Classification, sources of air pollutants, mode of their deposition, Effect of air pollution on plants and ecosystem. Process of acidification and its impacts on aquatic and terrestrial ecosystem. 2. Acid rain, physiological and biochemical effects of SO₂, HF, PAN and O₃ on vegetation, toxicity symptoms on vegetation, defence mechanism against air pollutants in plants, sensitive and tolerant plant species to air pollutants 3. Air pollution tolerant plants, ATPI Index (air pollution tolerant index) 4. Water Pollution – Types of water pollution, sources of major pollutants, BOD, COD, eutrophication 5. Eutrophication - natural & manmade eutrophication, causes and effects and control measures. indicators of water pollution 6. Types of pollutants, various industrial effluents such as pulp and paper mills, oil exploration and refinery, petrochemicals, iron and steel industries, domestic wastes, organic debris, agricultural wastes, pesticides 7. Oil pollution and marine ecology, sources of oil pollution, factors effecting fate of oil after spillage movement, spreading, evaporation, emulsification, dispersion, remote sensing in water quality monitoring. Habitat ecology, systems ecology, synecology, autecology; Ecosystem concept; Structure and functions of biotic and abiotic components; Energy in ecosystems and environment; Energy exchange and productivity-food chains and food webs-ecological pyramids 		1
<p>UnitII: Climatic Change</p> <ol style="list-style-type: none"> 1. Global Climate Change: Concept, Green house gases, their major sources, Ozone layer, Ozone hole. Consequences of climate change (CO₂ level, global warming, UV radiation). <ul style="list-style-type: none"> • Kyoto protocol: major recommendations, Concept of carbon footprint, 		1

Carbon credits, importance of carbon foot printing.	
Unit III: Plant Population Dynamics 1. Population - characteristics and measurement; Communities - habitats, niches, population dynamics, species and individual in the ecosystem.	1
Unit IV: Coastal Zone Management in India <ul style="list-style-type: none"> • Coastal zone management in India- coastal environment India, coastal issues, land use and changes, coastal zone management, initiatives in India, prohibited and regulated activities in coastal areas, State coastal zone management authorities. • Mangrove: habitat and characteristics, mangrove, plantation-establishment and rehabilitation of degraded mangrove formations; silvicultural systems for mangrove; protection of habitats against natural disasters. 	1

Course Code	Topic	Credits:
PSBOEB404	<u>Recent Trends & Applied Environmental Botany</u>	4
Unit I: Restoration of Ecosystems I <ul style="list-style-type: none"> • Plant and their role in improvement of urban environment, criteria for selection of plant species for plantation in different types of land uses in urban areas, Urban forests. Study of urban health through surveys of urban trees. A holistic approach to study- industrial areas, population and their habitats, water and other supplies and waste disposal, Transportation, infrastructure, education, health, sport and entertainment. Amenities and cultural issues- and relationship of all these with plants 		1
UnitII: Restoration of Ecosystems II <ul style="list-style-type: none"> • Restoration of mangrove ecosystem- selection and treatment of coastal area with reference to tidal situation and physical properties, choice of species, collection of seeds and seedling material, storage and plantation. Problems of seed dormancy, tidal forces predation nutrient supply etc. and methods to overcome the same. 		1
Unit III: Restoration of Land <ul style="list-style-type: none"> • Soil conservation - definition, causes for erosion; types - wind and water erosion; conservation and management of eroded soils/areas, wind breaks, 		1

shelter belts; sand dunes; reclamation of saline and alkaline soils, water logged and other waste lands, Restoration of waste lands and lakes..	
Unit IV: Water Shed management <ul style="list-style-type: none"> • Concepts of watershed; role of mini-forests and forest trees in overall resource management, forest hydrology, watershed development in respect of torrent control, river channel stabilization, avalanche and landslide controls, rehabilitation of degraded areas; hilly and mountain areas; watershed management and environmental functions of forests; water-harvesting and conservation; ground water recharge and watershed management; role of integrating forest trees, horticultural crops, field crops, grass and fodders 	1

PRACTICAL

PSBOEBP403	<u>Ecology and Environmental Botany</u>	2	4
<ol style="list-style-type: none"> 1. Determination of particulate matter from the industrial area by High Volume Sampler/Settling Method. 2. Determination of physical parameters of i) well water, ii) industrial effluent iii) river water and iv) sea water. 3. Determination of Dissolved oxygen from sea water by Winkler's method. 4. Determination of Chemical Oxygen demand value for industrial waste effluent. 5. To study qualitative and quantitative characters of plant community by quadrat method. 6. Determination of tolerance index of a plant species, towards polluted water, containing toxic material. 			
PSBOEBP404	Recent Trends & Applied Environmental Botany	2	4
<ol style="list-style-type: none"> 1. Study of ecological Instruments (Maximum minimum thermometer, Whirling hygrometer, Anemometer, Rain gauge, Wet and dry bulb thermometer) 2. Determination of diversity indices in plant communities. 3. Determination of energy content of primary production in an ecosystem by bomb calorimetry. 			

4. Study of mangroves in any one given area (Godrej mangrove park, Mumbra creek, Vasai creek)
5. Preparation of an inventory of water in an ecosystem.
6. Sodium and potassium content from soil of different location using flame photometer.

SEMESTER IV

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Environmental Botany

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3	Biostatistics- The Bare Essentials (Second Edition 2000)	NosmanStreiner	B. C. Decker Inc.
4	Bioinformatics : Sequence and Genome Analysis (Second Edition 2004)	David W. Mount	ColdspringHarbor Laboratory Press
5	Bioinformatics and Functional Genomics (2003)	Jonathan Pevsner	John Wiley & Sons Publications

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2	Nano forms of carbon and its applications (2007)	Prof.Maheshwar Sharon and Dr.Madhuri Sharon	Manad Nanotech Pvt. Ltd.
3	Biotechnanotechnology lessons from Nature (2004)	David Goodsell	Wiley-Liss A John Wiley and sons
4	Nanotechnology- Basic science and emerging technologies (2005)	WillsonKannangava, Smith, Simmons, Raguse	Oversease Press
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6	Nanotechnology- Principles and practices	S. K. Kulkarni	Capital Publishing Co.