



Hindi Vidya Prachar Samiti's
Ramniranjan Jhunjhunwala College
of Arts, Science & Commerce
(Autonomous College)

Affiliated to
UNIVERSITY OF MUMBAI

Syllabus for the M.Sc.
Program: M.Sc. BOTANY
Program Code: RJSPGBOT

(CBCS 2018-19)

M.Sc. Semester II Botany Syllabus**SEMESTER II**

Course Code	UNIT	TOPIC HEADINGS	Credits	L / Week	
RJSPGBOT201	Title of paper: Plant Diversity: Cryptogams (Bryophyta And Pteridophyta)				
	I	Bryophyta I	4	1	
	II	Bryophyta II		1	
	III	Pteridophyta I		1	
	IV	Pteridophyta II		1	

RJSPGBOT202	Title of paper: Plant Diversity: Spermatophyta II (Anatomy, Developmental Botany and Palynology)				
	I	Anatomy I	4	1	
	II	Anatomy II		1	
	III	Developmental biology		1	
	IV	Palynology		1	

RJSPGBOT203	Title of paper: Plant Physiology and Environmental Botany				
	I	Seed Physiology I	4	1	
	II	Stress Physiology II		1	
	III	Environmental Botany I		1	
	IV	Environmental Botany II		1	

RJSPGBOT204	Title of paper: Medicinal Botany and Dietetics				
	I	Medicinal Botany	4	1	
	II	Molecular Evolution and Population Genetics		1	
	III	Transposable Elements in Prokaryotes		1	
	IV	Extra nuclear Genetics		1	

RJSPGBOTP201	Plant Diversity : Cryptogams II (Bryophyta and Pteridophyta)		2	4
RJSPGBOTP202	Plant Diversity: Spermatophyta II (Anatomy, Developmental Botany and Palynology)		2	4
RJSPGBOTP203	Plant Physiology and Environmental botany		2	4
RJSPGBOTP204	Medicinal Botany and Dietetics		2	4

Theory Semester II Detail Syllabus

Course Code	Title	Credits
RJSPGBOT201	Plant Diversity - Cryptogams II (Bryophyta and Pteridophyta)	4
<u>Unit I: Bryophyta I</u> <ul style="list-style-type: none">• Classification of Bryophyta, upto orders, according to the system proposed by G.M.Smith.• Alternation of generation in Bryophyta		1
<u>Unit II: Bryophyta II</u> <ul style="list-style-type: none">• Origin and evolution of Bryophyta with reference to habitat and form• Evolution of the Sporophyte in Bryophyta		1
<u>Unit III: Pteridophyta I</u> <ul style="list-style-type: none">• Classification of Pteridophyta, upto orders, according to the system proposed by G.M.Smith		1
<u>Unit IV: Pteridophyta II</u> <ul style="list-style-type: none">• The geological time scale and a study of fossil Pteridophytes (<i>Rhinia, Horneophyton, Lepidodendron, Calamites, Cladoxylon, Sphenophyllales, Coenopteridales</i>)• Economic importance of Pteridophytes• Cultivation and maintenance of ornamental Ferns.		1

M.Sc	Semester II Theory
<p>RJSPGBOT201</p> <p>Paper 1</p> <p>Plant Diversity - Cryptogams II (Bryophyta and Pteridophyta)</p>	<p>Course Outcomes 2.1:</p> <ol style="list-style-type: none"> 1. Detailed study of classification of G.M.Smith for Bryophyta and Pteridophyta. 2. Study of Bryophytes and Pteridophytes in aspect of evolution ecology, economic importance, ecological indicators and evolution of sporophyte and gametophyte. 3. Economic importance of Pteridophytes and cultivation and maintenance of ornamental Ferns. <p>Learning outcomes :</p> <ul style="list-style-type: none"> ➤ Understanding past environment and role of bryophyta and Pteridophytes with reference to adaptation to Land habitat. ➤ Recognising the benefits of gymnosperms and Pteridophytes for getting motivated for entrepreneurship nursery practices for growing ornamental ferns and gymnosperms. Important products from Gymnosperms like turpentine, resin, pine nuts starch, etc

M.Sc. Semester II Botany Syllabus

Course Code	Title	Credits
RJSPGBOT202	Plant Diversity- Spermatophyta II (Anatomy, Developmental Botany and Palynology)	4
<u>Unit I: Anatomy I</u> <ul style="list-style-type: none"> Meristems: Definition type of meristems, apical cell theory, histogen theory and Tunica corpus theory Sensory and tactile tissue system: Tactile sense organs, gravitational and optical sense organs 		1
<u>Unit II: Anatomy II</u> <ul style="list-style-type: none"> Morphogenesis and organogenesis in plants: Organization of shoot and root apical meristems; shoot and root development, leaf development and phyllotaxy; transition of flowering, floral meristems and floral development in <i>Arabidopsis</i> and <i>Antirrhinum</i> 		1
<u>Unit III: Developmental Botany</u> <ul style="list-style-type: none"> Male gametophyte: Pollen development and gene expression male sterility sperm dimorphism and hybrid seed production; pollen tube growth and guidance; pollen storage; pollen embryos Female gametophyte; Types of embryo sacs; structure of embryo sac cells. Pollination, pollen-pistil interaction and fertilization: floral characteristics. Mechanism of Pollination and Fertilization: vectors involved in pollination; breeding system; commercial considerations, structure of the pistil; pollen-stigma interactions, sporophytic and gametophytic self-incompatibility (cytological, biochemical and molecular aspects); double fertilization; <i>in vitro</i> fertilization. Seed development and fruit growth; endosperm development during Early, Maturation and Desiccation stages; embryogenesis, ultrastructure and nucellar cytology; cell lineage during late embryo development; storage proteins of endosperm and embryo; apomixis; embryo culture; dynamics of fruit growth; biochemistry and molecular biology of fruit maturation 		1
<u>Unit IV: Palynology</u> <ul style="list-style-type: none"> Special relationships of pollen grain in pollen tetrads Pollen wall morphogenesis, ultrastructure, primexin formation. Pollen proteins and allergens 		1

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M.Sc	Semester II Theory
RJSPGBOT202	Course Outcomes 2.2 :
Paper 2	1. Detailed study of anatomical Meristems tissues, Sensory and tactile tissue system, Morphogenesis and organogenesis in plants.
Plant	2. Development study of male and female gametophyte, Pollination, pollen-pistil interaction and fertilization, Mechanism of Pollination and Fertilization and Seed development and fruit growth
Diversity- Spermatophyta	3. Detailed study of palynology.
II (Anatomy, Developmental Botany and Palynology)	Learning outcomes : <ul style="list-style-type: none">➤ Understanding the mechanism of various type of tissues➤ Detailed study of angiosperms plant development➤ Application of palynology in various industries, allergies identifies pollen and correlate with seasonal allergies.

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Course Code	Title	Credits
RJSPGBOT203	Plant Physiology and Environmental Botany	4
<u>Unit I: Seed physiology</u>		1
<ul style="list-style-type: none"> • Physiology and biochemistry of seed germination mobilization of food reserves, germination and growth factors, seed dormancy, control and release of dormancy 		
<u>Unit II: Stress Physiology</u>		1
<ul style="list-style-type: none"> • Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses; mechanism of resistance to biotic stress and tolerance to abiotic stress 		
<u>Unit III: Environmental Botany I</u>		1
<ul style="list-style-type: none"> • The Environment: Physical environment; biotic environment; biotic and abiotic interactions. • Habitat and Niche: concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement. • Population Ecology: Characteristics of a population; population growth curves; population regulation; life history strategies (r and K selection); concept of metapopulation – demes and dispersal, interdemec extinctions, age structured population. 		
<u>Unit IV: Environmental Botany II</u>		1
<ul style="list-style-type: none"> • Species interactions: types of interactions, interspecific competition, herbivory, carnivory, pollination and symbiosis. • Biogeography: Major terrestrial biomes, theory of island biogeography; biogeographical zones of India. • Environmental Botany- Present concern: Conservation of genetic resources, gene pools land races, Global warming and costal ecosystems. Depletion of forest cover, threats to mangroves. Urbanization and plant cover. 		

M.Sc. Semester II Botany Syllabus

M.Sc	Semester II Theory
RJSPGBOT203 Paper-III Plant Physiology and Environmental Botany	<p>Course Outcomes 2.3 :</p> <ol style="list-style-type: none">1. Detailed study of seed physiology and biochemistry of seed germination2. Detailed study of stress physiology and Responses of plants to biotic and abiotic stresses.3. Ecological study of environment, habitat and niche and population ecology.4. Detailed study of species interactions, biogeography and environmental botany. <p>Learning outcomes :</p> <ul style="list-style-type: none">➤ Understanding the mechanism of hydrolytic enzymes in seed germination➤ Knowing the effect of biotic and abiotic stresses on plants➤ Learning ecological concept of plant, biogeography and environmental botany.

M.Sc. Semester II Botany Syllabus

Course Code	Title	Credits
RJSPGBOT204	Cytogenetics, Molecular Biology and Biotechnology	4
	<p>Unit I: Medicinal Botany</p> <ul style="list-style-type: none"> • Biological source, geographical distribution, physicochemical analysis of <i>Tylophora asthmatica</i> (leaf), Fennel and <i>Plantago</i> (fruit/seed), <i>Cinnamon</i> and <i>Holarrhena</i> (bark) and <i>Acorus</i> (rhizome) and <i>Tinospora</i> root. • Essential oils (<i>Cinnamon</i>, <i>Eucalyptus</i> and <i>Citronella</i>) • Fatty oil (Sesame, Safflower and coconut) • Vegetable fat (Kokum butter and Mahua butter) 	1
	<p>Unit II: Molecular Evolution and Population Genetics</p> <ul style="list-style-type: none"> • Concepts of molecular evolution, molecular divergence and molecular clocks; molecular tools in phylogeny, classification and identification; protein and nucleotide sequencing; origin of new genes and proteins; gene duplication and divergence • Population Genetics-Population, gene pool, gene frequency, Hardy-Weinberg Law, concepts and rate of change in gene frequency through natural selection, migration and random genetic drift, isolating mechanisms; Allopatricity and sympatricity, Convergent evolution and co evolution. 	1

<p>Unit III: Transposable Elements in Prokaryotes:</p> <ul style="list-style-type: none">• Insertion sequences, Transposons, IS elements and Transposons in Plasmids, Bacteriophage Mu.• Transposable Elements in Eukaryotes: Transposons in plants, <i>Ty</i> elements in yeasts, <i>Drosophila</i> Transposons	1
<p>Unit IV: Extra nuclear Genetics: Organization of Extra nuclear Genomes:</p> <ul style="list-style-type: none">• Mitochondrial Genome, Chloroplast Genome, RNA Editing, Origin of Mitochondria and Chloroplasts.• Extranuclear inheritance: Leaf variegation in <i>Mirabilis jalapa</i>, poky mutant in <i>Neurospora</i>, Yeast petite mutants, extra nuclear genetics in <i>Chlamydomonas</i>.	1

M.Sc. Semester II Botany Syllabus

M.Sc	Semester II theory
RJSPGBOT204 Paper-IV Cytogenetics, Molecular Biology and Biotechnology	Course outcomes 2.4 : <ol style="list-style-type: none">1. Detailed study of medicinal botany as Biological source, geographical distribution and physicochemical analysis2. Detailed study of Essential Oils, Fatty oils and Vegetable Fats.3. Molecular evolution, gene pool, gene frequencies, mobile genetic elements, role in plant breeding.4. Maternal inheritance Learning outcomes : <ul style="list-style-type: none">➤ Concept and application of Pharmacognosy and economic importance of plants➤ Understand the genetic basis of speciation, variations, genetic drift, mobile genetic elements, chloroplastic and mitochondrial genomes and their role in evolution.

M.Sc. Semester II Botany Syllabus

Course Code	Practical Title (Skill enhancement, research orientation)	Credits
RJSPGBOTP201	Plant Diversity - Cryptogams II (Bryophyta and Pteridophyta)	2
<p>1. Study of vegetative and reproductive structures in <i>Targionia Plagiochasma Fimbraria, Peltia</i> and <i>Pogonatum</i>.</p> <p>2. Study of vegetative and reproductive structures in : <i>Isoetes, Ophioglossum Pteris, Angiopteris, Lygodium</i> and <i>Azolla</i></p> <p>3. Study of fossils: <i>Sigillaria, Calamites, Rhynia, Sphenophyllum</i> and <i>Glossopteris</i>.</p>		

M.Sc	Semester II Practical
RJSPGBOTP201	Course Outcomes: Skill development, experiential learning , plant diversity
Practical I	
Plant Diversity - Cryptogams II (Bryophyta and Pteridophyta)	<p>1. Slide preparation/ permanent slides study of vegetative and reproductive structures in <i>Targionia Plagiochasma Fimbraria, Peltia</i> and <i>Pogonatum</i>.</p> <p>2. Slide preparation/ permanent slides study of vegetative and reproductive structures in: <i>Isoetes, Ophioglossum Pteris, Angiopteris, Lygodium</i> and <i>Azolla</i>.</p> <p>3. Detailed study of fossils: <i>Sigillaria, Calamites, Rhynia, Sphenophyllum</i> and <i>Glossopteris</i>.</p> <p>Learning outcomes :</p> <ul style="list-style-type: none"> ➤ Understanding the detailed study of vegetative and reproductive structures of plant diversity ➤ Recognising the evolution of plants through fossils study

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Practical Title	Practical Title (Skill enhancement)	Credits
RJSPGBOTP202	Plant Diversity- Spermatophyta II (Anatomy, Developmental Botany and Palynology)	2
<ol style="list-style-type: none"> 1. Study of wood elements in <i>Annona</i>, <i>Michelia</i>, <i>Sterculia</i> and <i>Thuja</i>, using the maceration technique. 2. Study of the following leaves with respect to leaf surface characters (wax, cuticle, epidermis, stomata, epidermal outgrowth): <i>Pistia</i>, <i>Ficus</i>, <i>Avicennia</i> and <i>Peperomia</i>. 3. Photosynthetic system in <i>Pinus</i> (arm palisade): <i>Cyperus</i>, <i>Ficus</i>, and <i>Oxalis</i>. 4. A study of microsporogenesis and megasporogenesis with the help of permanent slides 5. <i>In vitro</i> germination of pollen grains, effect of temperature on pollen viability and short term storage. 6. Study of the morphology of the pollen (using Chitale's and acetolysis method) from the families; Malvaceae, Asteraceae, Convolvulaceae, Labiatae and Graminae. 		

M.Sc	Semester II Practical (Skill Enhancement)
RJSPGBOTP202 Practical II Plant Diversity- Spermatophyta II (Anatomy, Developmental Botany and Palynology)	<p>Course Outcomes:</p> <ol style="list-style-type: none"> 1. Study of wood elements using the maceration technique. 2. Detailed anatomical sectional study of leaves with respect to leaf surface characters (wax, cuticle, epidermis, stomata, and epidermal outgrowth). 3. Study of photosynthesis system, various stages of microsporogenesis and megasporogenesis, embryo and morphology of the pollen <p>Learning outcome :</p> <ul style="list-style-type: none"> ➤ Detailed study of some wood elements can be helpful to check purity of plant materials product ➤ Knowing the adaptations of plant with the study of leaf outgrowths ➤ Study of plant development stages ➤ Application of palynology for honey industry

Course Code	Practical Title (Skill enhancement)	Credits
RJSPGBOTP203	Plant Physiology and Environmental Botany	2
<p>Practical exercises are planned for better understanding of the state of environment, rather than 5-hour units. Field exercises are expected to be completed during excursion and field diaries maintained for submission during tests. Other practical work can be carried out in the laboratory with help of plant and soil samples collected from the field.</p>		
<p>Plant Physiology experiment</p> <ol style="list-style-type: none">1. Estimation of reducing sugar, starch in any cereal grain during stages of germination 24, 36, 48 and 72 hrs after germination. Preparation of standard graph for glucose and starch.2. Estimation of protein content during stages of germination- any pulse 0,24,36,14 and 72hrs after germination. Preparation of standard graph for protein3. Estimation of α-amino nitrogen content from germinating seeds. Standard graph of leucine.4. Estimation of proline content in glycophyte, mesophyte, xerophyte and halophyte. Standard graph of proline5. To study the activity of lipases in germinating oil seeds to demonstrate mobilization of lipids during germination		
<p>Environmental Botany Practical</p> <ol style="list-style-type: none">1. Study of instruments used to measure microclimatic variables; soil thermometer, anemometer, whirling psychrometer, rain gauge, lux meter. Visit to meteorological station2. Determination of dissolved oxygen of water sample from polluted and unpolluted sources.3. Determination of epidermal architecture of leaves, stomatal index of leaves.4. Assessment of pollution in ambient air on the basis of injured leaf area.5. Field visit to study costal ecosystem/mangrove vegetation.6. Quantitative analysis of herbaceous vegetation for frequency and comparison with Raunkiaer's frequency distribution law.		

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M.Sc	Semester II Practical
<p>RJSPGBOTP203</p> <p>Practical III</p> <p>Plant Physiology and Environmental Botany</p>	<p>Course Outcomes:</p> <ol style="list-style-type: none"> 1. Estimation of reducing sugars and proteins from sample. 2. Study the effect of temperature, pH and substrate variation on the activity of amylase. 3. Estimation of alpha-amino nitrogen and effect of GA on seed germination. 4. Assessment of plant under stress with estimation of proline 5. Study of instruments used to measure ecological parameters 6. Assessment of pollution of water and air by BOD and injured leaf area 7. Quantitative analysis of herbaceous vegetation using Raunkiaer's frequency <p>Learning outcomes :</p> <ul style="list-style-type: none"> ➤ Understanding the mechanism of enzymes and knowing protein content during stages of germination ➤ Knowing the effect of biotic and abiotic stresses on plants through proline accumulation in cell ➤ Learning the working of ecological impact assessment develop entrepreneurship

Course Code	Practical Title	Credits
RJSPGBOTP204	Cytogenetic, Molecular Biology and Biotechnology	2
<ol style="list-style-type: none">1. A study of the macroscopic and microscopic characters and identification of active ingredients of drugs mentioned in the syllabus for theory by means of chemical tests/TLC.2. Preparation of monograph for any one medicinal plant.3. Estimation of oil from oil seeds: Solvent extraction using soxhlet4. Estimation of free fatty acids5. Estimation of saponification value of the oil sample6. Interpretation of genetic phenomenon in Maize, <i>Mirabilis jalapa</i>7. Calculation of genotypic frequencies.8. Calculation of allelic frequencies from the frequencies of particular genotypes.		

M.Sc	Semester II Practical (Skill enhancement)
RJSPGBOT20P4 Practical IV Cytogenetics, Molecular Biology and Biotechnology	Course outcome 2.4 : <ol style="list-style-type: none">1. Detailed study of medicinal botany with the macroscopic and microscopic characters and identification of active ingredients of drugs.2. Economic importance and application of fatty oils.3. Mobile genetic elements, population genetics and evolutionary aspects Learning outcome : <ul style="list-style-type: none">➤ Concept and application of medicinal botany➤ Understanding the genuinely of plant materials for drugs➤ Commercial value and applications of fatty oil➤ Interpretations of genetic phenomenon

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