



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 2019-2020)

SEMESTER II

Course Code	UNIT	TOPIC HEADINGS	Credits	L / Week
RJSPGBOT201	Title of paper: Plant Diversity: Cryptogams II (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: Environmental Botany and Physiology			
	I	Environmental Botany I	4	1
	II	Environmental Botany II		1
	III	Quantitative studies in Environmental science		1
	IV	Regulation of Photosynthesis in Eukaryotes and Photosynthesis in Prokaryotes		1

RJSPGBOT204	Title of paper: Medicinal Botany, Cytogenetics and Population genetics			
	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, Cytogenetics and Population genetics	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>		1
<ul style="list-style-type: none"> Classification of Bryophyta, upto orders, according to the system proposed by G.M.Smith. Life cycle of <i>Plagiochasma</i> and <i>Notothylas</i> Alternation of generation in Bryophyta 		
<u>Unit II: Bryophyta II</u>		1
<ul style="list-style-type: none"> Origin and evolution of Bryophyta with reference to habitat and form Evolution of the Sporophyte in Bryophyta 		
<u>Unit III: Pteridophyta I</u>		1
<ul style="list-style-type: none"> Classification of Pteridophyta, upto orders, according to the system proposed by G.M.Smith Study of life cycle of <i>Marselia</i> Evolution of Sori in Pteridophytes 		
<u>Unit IV: Pteridophyta II</u>		1
<ul style="list-style-type: none"> The geological time scale and a study of fossil Pteridophytes (<i>Rhynia</i>, <i>Horneophyton</i>, <i>Lepidodendron</i>, <i>Calamites</i>, <i>Cladoxylon</i>, <i>Sphenophyllales</i>, <i>Coenopteridales</i>) Economic importance of Pteridophytes Cultivation and maintenance of ornamental Ferns. 		

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 Bryophytes and Pteridophytes for getting motivated for entrepreneurship nursery practices for growing ornamental ferns.

Course Code	Title	Credits
RJSPGBOT202	Plant Diversity- Spermatophyta II (Anatomy, Developmental Botany and Palynology)	4
Unit I: <u>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
Unit II: <u>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; ABC model of flower development, floral evocation and factors responsible for floral evocation, overall pathway of flowering. 		1
Unit III: <u>Developmental Botany</u> <ul style="list-style-type: none"> Somatic embryogenesis and its applications, Pollen embryogenesis and development of androgenic haploids, Uses and Limitation of haploids. Fertilization: Pollination, pollen-pistil interaction, role of synergids, double fertilization and post fertilization changes. Endosperm: Types, endosperm cell fate and differentiation. 		1
Unit IV: <u>Palynology</u> <ul style="list-style-type: none"> Special relationships of pollen grain in pollen tetrads Pollen wall morphogenesis, ultrastructure, primexine formation. Pollen proteins and allergens 		1

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. Somatic embryogenesis, pollination, pollen-pistil interaction and fertilization, Mechanism of Pollination and Fertilization, endosperm and its types.
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.

Course Code	Title	Credits
RJSPGBOT203	Environmental Botany and Physiology	4
<u>Unit I: 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, interdemic extinctions, age structured population. 		
<u>Unit II: 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. 		
<u>Unit III: Quantitative studies in Environmental Botany</u>		1
<ul style="list-style-type: none"> Methods of studying Plant Community – Quadrats, Transects and Bisects Density, Frequency, Cover, Biomass, Species dominance Vegetation mapping using GPS and Remote sensing 		
<u>Unit IV: Regulation of C₃, C₄ and CAM Photosynthesis</u>		1
<ul style="list-style-type: none"> Role of Light Regulation of RUBISCO, PEPcase, NADP-MDH and PPDK CAM regulation through transport of metabolites Pentose phosphate pathway and its importance Photosynthesis in Prokaryotes – Light and Dark reactions 		

M.Sc	Semester II Theory
RJSPGBOT203 Paper-III Plant Physiology and Environmental Botany	<p>Course Outcomes 203</p> <ol style="list-style-type: none">1. Ecological study of environment, habitat and niche and population ecology.2. Detailed study of species interactions, biogeography and environmental botany.3. Study of regulation of photosynthetic pathways in plants <p>Learning outcomes :</p> <ul style="list-style-type: none">➤ Learning ecological concept of plant, biogeography and environmental botany.➤ Learning the adaptive values of plants by regulating photosynthesis

Course Code	Title	Credits
RJSPGBOT204	Medicinal Botany, Cytogenetics and Population genetics	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>Cinnamomum</i> and <i>Holarrhena</i> (bark) and <i>Acorus</i> (rhizome) and <i>Tinospora</i> root. Essential oils (<i>Cinnamomum</i>, <i>Eucalyptus</i> and <i>Citronella</i>) Fatty oil (Sesam, Safflower and Coconut) Vegetable fat (Kokum butter and Mahua butter) Preparation of a Monograph : <i>Murraya koneigi</i> 		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 theory
<p>RJSPGBOT204</p> <p>Paper-IV</p> <p>Medicinal Botany, Cytogenetics and Population genetics</p>	<p>Course outcomes 2.4 :</p> <ol style="list-style-type: none"> 1. Detailed study of medicinal botany as Biological source, geographical distribution and physicochemical analysis 2. 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 and dynamics of population genetics. <p>Learning outcomes :</p> <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. ➤ Methods and analysis skills required for the study of population genetics.

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</i>, <i>Plagiochasma</i>, <i>Fimbraria</i>, <i>Pellia</i> and <i>Pogonatum</i>.</p> <p>2. Study of vegetative and reproductive structures in : <i>Isoetes</i>, <i>Ophioglossum</i>, <i>Pteris</i>, <i>Angiopteris</i>, <i>Lygodium</i> and <i>Azolla</i></p> <p>3. Study of fossils: <i>Sigillaria</i>, <i>Calamites</i>, <i>Rhynia</i>, <i>Sphenophyllum</i>, <i>Zygopteris</i>, <i>Botryopteris</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</i>, <i>Plagiochasma</i>, <i>Fimbraria</i>, <i>Pellia</i> and <i>Pogonatum</i>.</p> <p>2. Slide preparation/ permanent slides study of vegetative and reproductive structures in: <i>Isoetes</i>, <i>Ophioglossum</i>, <i>Pteris</i>, <i>Angiopteris</i>, <i>Lygodium</i> and <i>Azolla</i>.</p> <p>3. Detailed study of fossils: <i>Sigillaria</i>, <i>Calamites</i>, <i>Rhynia</i>, <i>Sphenophyllum</i>, <i>Zygopteris</i>, <i>Botryopteris</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

Practical Title	Practical Title (Skill enhancement)	Credits
RJSPGBOTP202	Plant Diversity- Spermatophyta II (Anatomy, Developmental Botany and Palynology)	2
<ol style="list-style-type: none"> Study of wood elements in <i>Annona</i>, <i>Michelia</i>, <i>Sterculia</i> and <i>Thuja</i>, using the maceration technique. 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>. Photosynthetic system in <i>Pinus</i> (arm palisade): <i>Cyperus</i>, <i>Ficus</i>, and <i>Oxalis</i>. <i>In vitro</i> germination of pollen grains, effect of temperature on pollen viability and short term storage. 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)	Course Outcomes: <ol style="list-style-type: none"> Study of wood elements using the maceration technique. Detailed anatomical sectional study of leaves with respect to leaf surface characters (wax, cuticle, epidermis, stomata, and epidermal outgrowth). Study of photosynthetic systems in leaves Learning outcome : <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

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> <ol style="list-style-type: none"> 1. Quantitative study of diurnal fluctuation in titratable acid number (TAN) on CAM plants. 2. Study of instruments used to measure microclimatic variables; soil thermometer, anemometer, whirling psychrometer, rain gauge, lux meter. Visit to meterological station and report writing 3. Field visit to study costal ecosystem/mangrove vegetation and make a key to identify mangroves bases on morphological characters. 4. Quantitative analysis of herbaceous vegetation for frequency and comparison with Raunkiaer's frequency distribution law. 5. Assessment of % frequency, density and abundance of a community using quadrat. 6. Prepare a list of plants occurring in a grassland and prepare chart along line transect 7. Submission of project reports of every field study. 		

M.Sc	Semester II Practical
RJSPGBOTP203 Practical III Plant Physiology and Environmental Botany	Course Outcomes: <ol style="list-style-type: none"> 1. Study of instruments used to measure ecological parameters 2. Quantitative analysis of herbaceous vegetation using Raunkiaer's frequency Learning outcomes :

	➤ Learning the working of ecological impact assessment develop entrepreneurship.
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Course Code	Practical Title (Skill enhancement)	Credits
RJSPGBOTP204	Medicinal Botany, Cytogenetics and Population genetics	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 soxhlet 4. Estimation of free fatty acids 5. Estimation of saponification value of the oil sample 6. 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)
<p>RJSPGBOT20P4</p> <p>Practical IV</p> <p>Medicinal Botany, Cytogenetics and Population genetics</p>	<p>Course outcome 2.4 :</p> <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 <p>Learning outcome :</p> <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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