



Hindi Vidya PracharSamiti's
RamniranjanJhunjhunwala 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 2020-2021)

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 Plant Physiology)			
	I	Anatomy I	4	1
	II	Anatomy II		1
	III	Developmental Biology and Palynology		1
	IV	Regulation of Photosynthesis in Eukaryotes and Photosynthesis in Prokaryotes		1

RJSPGBOT203	Title of paper: Environmental Botany and Statistical tools			
	I	Environmental Botany I	4	1
	II	Environmental Botany II		1
	III	Quantitative studies in Environmental science		1
	IV	Statistical tools and data analysis		1

M.Sc. Semester II Botany Syllabus

RJSPGBOT204	Title of paper: Medicinal Botany, Cytogenetics and Research Methodology			
	I	Medicinal Botany	4	1
	II	Molecular Evolution and Population Genetics		1
	III	Transposable Elements in Prokaryotes and Extra nuclear genetics		1
	IV	Research methodology		1

RJSPGBOTP201	Plant Diversity: Cryptogams II (Bryophyta and Pteridophyta)	2
RJSPGBOTP202	Plant Diversity: Spermatophyta II (Anatomy, Developmental Botany and Plant Physiology)	2
RJSPGBOTP203	Environmental botany and Statistical tools	2
RJSPGBOTP204	Medicinal Botany, Cytogenetics and Research Methodology	2

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. • Life cycle of <i>Plagiochasma</i> and <i>Notothylas</i> • 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 • Study of life cycle of <i>Marselia</i> • Evolution of Sori in Pteridophytes 		1
<u>Unit IV: Pteridophyta II</u> <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. 		1

M.Sc. Semester II Botany Syllabus

M.Sc	Semester II Theory
RJSPGBOT201 Paper 1 Plant Diversity - Cryptogams II (Bryophyta and Pteridophyta)	<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.

M.Sc. Semester II Botany Syllabus

Course Code	Title	Credits
RJSPGBOT202	Plant Diversity- Spermatophyta II (Anatomy, Developmental Botany and Plant Physiology)	4
<u>Unit I: Anatomy I</u> <ul style="list-style-type: none"> Meristems: Definition type of meristems, apical cell theory, histogentheory 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; ABC model of flower development, floral evocation and factors responsible for floral evocation, overall pathway of flowering. 		1
<u>Unit III: Developmental Botany</u> <ul style="list-style-type: none"> Special relationships of pollen grain in pollen tetrads Pollen wall morphogenesis, ultra structure, primexine formation. Pollen proteins and allergens 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
<u>Unit IV: Regulation of C₃, C₄ and CAM Photosynthesis</u> <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 		1

M.Sc	Semester II Theory
<p>RJSPGBOT202</p> <p>Paper 2</p> <p>Plant Diversity- Spermatophyta II (Anatomy, Developmental Botany and Palynology)</p>	<p>Course Outcomes 2.2 :</p> <ol style="list-style-type: none"> 1. Detailed study of anatomical meristem, tissues, sensory and tactile tissue system, Morphogenesis and organogenesis in plants. 2. Somatic embryogenesis, pollination, pollen-pistil interaction and fertilization, Mechanism of Pollination and Fertilization, endosperm and its types. 3. Detailed study of palynology. 4. Study of photosynthetic pathways and its regulation in plants <p>Learning outcomes:</p> <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. ➤ Learning the adaptive values of plants by regulating photosynthesis

M.Sc. Semester II Botany Syllabus

Course Code	Title	Credits
RJSPGBOT203	Environmental Botany and Statistical tools	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 meta population – demes and dispersal, interdemec 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: Statistical Tools</u>		1
<ul style="list-style-type: none"> Statistical tools and data analysis: Central tendency, variance, testing of hypothesis, coefficient of correlation, ANOVA and regression, Randomised block design and Latin square. 		

M.Sc. Semester II Botany Syllabus

M.Sc	Semester II Theory
<p>RJSPGBOT203</p> <p>Paper-III</p> <p>Plant Physiology and Environmental Botany</p>	<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. Statistical tools for application in various studies <p>Learning outcomes:</p> <ul style="list-style-type: none"> ➤ Learning ecological concept of plant, biogeography and environmental botany. ➤ Design of experiments which are statistically sound and data interpretation.

Course Code	Title	Credits
RJSPGBOT204	Medicinal Botany, Cytogenetics and Research Methodology	4
Unit I: Medicinal Botany		1
<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> 		
Unit II: Molecular Evolution and Population Genetics		1
<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. 		
Unit III: Transposable Elements in Prokaryotes and Extra nuclear Genetics		1
<ul style="list-style-type: none"> Insertion sequences, Transposons, IS elements and Transposons in Plasmids, Bacteriophage <i>Mu</i>. Transposable Elements in Eukaryotes: Transposons in plants, <i>Ty</i> elements in yeasts, <i>Drosophila</i> Transposons Mitochondrial Genome, Chloroplast Genome, RNA Editing, Origin of Mitochondria and Chloroplasts. Extra nuclear inheritance: Leaf variegation in <i>Mirabilis jalapa</i>, poky mutant in <i>Neurospora</i>, Yeast petite mutants, extra nuclear genetics in <i>Chlamydomonas</i>. 		

Unit IV: Research Methodology and Computational Biology	1
<ul style="list-style-type: none"> • Concept of research, why and what and how. Types and approach, data collection, different resources, library, field and others. Experimental design, method and standardization, reproducibility of results. Ethics in research, plagiarism check. • Bioinformatic tools: BLAST, FASTA, RASMOL, Phylogenetic trees. 	

M.Sc	Semester II theory
RJSPGBOT204 Paper-IV Medicinal Botany, Cytogenetics and Population genetics	<p>Course outcomes2.4:</p> <ul style="list-style-type: none"> ➤ Detailed study of medicinal botany as Biological source, geographical distribution and physicochemical analysis ➤ Detailed study of Essential Oils, Fatty oils and Vegetable Fats. ➤ Molecular evolution, gene pool, gene frequencies, mobile genetic elements, role in plant breeding. ➤ Maternal inheritanceand dynamics of population genetics. ➤ Detailed study and analysis of bioinformatics tools. ➤ Submission of a review paper written by the student <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. ➤ Knowing the application of bioinformatics tools

M.Sc. Semester II Botany Syllabus

Course Code	Practical Title (Skill enhancement, research orientation)	Credits
RJSPGBOTP201	Plant Diversity - Cryptogams II (Bryophytaand Pteridophyta)	2
1. Study of vegetative and reproductive structures in <i>Targionia,PlagiochasmaFimbraria,PelliaandPoganatum</i> . 2. Study of vegetative and reproductive structures in : <i>Isoetes, OphioglossumPteris,Angiopteris, LygodiumandAzolla</i> 3. Study of fossils: <i>Sigillaria, Calamites, Rhynia, Sphenophyllum, Zygopteris,Botryopterisand Glossopteris</i> .		

M.Sc	Semester IIPractical
RJSPGBOTP201 Practical I Plant Diversity - Cryptogams II (Bryophytaand Pteridophyta)	Course Outcomes: Skill development, experiential learning, plant diversity 1. Slide preparation/ permanent slides study of vegetative and reproductive structures in <i>Targionia,Plagiochasma,Fimbraria,PelliaandPogonatum</i> . 2. Slide preparation/ permanent slides study of vegetative and reproductive structures in: <i>Isoetes, Ophioglossum,Pteris,Angiopteris, LygodiumandAzolla</i> . 3. Detailed study of fossils: <i>Sigillaria, Calamites, Rhynia, Sphenophyllum, Zygopteris, Botryopterisand Glossopteris</i> . Learning outcomes : ➤ Understanding the detailed study of vegetative and reproductive structures of plant diversity ➤ Recognising the evolution of plants through fossils study

M.Sc. Semester II Botany Syllabus

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. <i>In vitro</i> germination of pollen grains, effect of temperature on pollen viability and shortterm storage. 5. 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"> 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 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

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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 meteorological 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 Botany Syllabus

M.Sc	Semester II Practical
RJSPGBOTP203 Practical III Plant Physiology and Environmental Botany	<p>Course Outcomes:</p> <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 <p>Learning outcomes:</p> <ul style="list-style-type: none"> ➤ Learning the working of ecological impact assessment develop entrepreneurship.

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 genotypes. 		

M.Sc. Semester II Botany Syllabus

M.Sc	Semester IIPractical (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 4. Detailed study and analysis of bioinformatics tools. <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 ➤ Knowing the application of bioinformatics

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Scheme of Examinations

1. Internal Examination 40 marks various modes with different weightage (Presentation, seminar, assignment, mcq, quiz etc.)
2. One External (Semester End Examination) of 60 marks. Duration 2 ½ hours.
3. One Practical at the end of Semester consisting of Practical I 50 marks, Practical II 50 marks, Practical III 50 marks and Practical IV 50 marks separate passing in each practical
4. Minimum marks for passing Semester End Theory and Practical Exam is 40 %. Separate passing for Internal and Semester End examination.
5. For any KT examinations, there shall be ODD-ODD/EVEN-EVEN pattern followed.
6. Two short field excursions for habitat studies are compulsory. Field report submission is mandatory
7. Field work of not less than eight hours duration is equivalent to one period per week for a batch of 15students.
8. A candidate will be allowed to appear for the practical examinations if he/she submits a certified journal of Botany or a certificate from the Head of the department / Institute to the effect that the candidate has completed the practical course of M Sc. Botany, semester II, as per the minimum requirements.
9. In case of loss of journal, a candidate must produce a certificate from the Head of the department /Institute that the practical for the academic year were completed by the student. However, such a candidate will be allowed to appear for the practical examination but the marks allotted for the journal will not be granted.
10. HOD's decision, in consultation with the Principal, shall remain final and abiding to all.

Evaluation and Assessment

Evaluation (Theory): Total marks per course - 100.

CIA- 40 marks

**CIA 1 and CIA 2: Written Test / Assignment / Field Trip/mini project/
 & Report -40 marks**

Semester End Examination – 60 marks

Question paper covering all units

Evaluation of Practicals 200 marks (50 marks for each practical)

**Course Semester End Examination in Semester II (RJSPGBOT201,
 RJSPGBOT202, RJSPGBOT203 & RJSPGBOT204)**

Question	KNOWLEDGE	UNDERSTANDING	APPLICATION and ANALYSES	TOTAL MARKS- Per unit
Unit 1	06	03	03	12
Unit 2	06	03	03	12
Unit 3	06	03	03	12
Unit 4	06	03	03	12
Short notes from topics covering all the units	06	03	03	12
-TOTAL- Per objective	30	15	15	60
% WEIGHTAGE	50	25	25	100 %

Evaluation of Practicals 200 marks/Semester

**SEMESTER II: (50 marks for each practical RJSPGBOTP201, RJSPGBOTP202,
 RJSPGBOTP203 & RJSPGBOTP204)**

Continuous Evaluation of practical components which require adequate duration for completion of the task, observation and interpretation: 25%

Course end Practical Evaluation of skills of students in terms of skill, analysis, interpretation and conclusion.

ASSESSMENT OF BOTANY FIELD TRIP REPORT

Dept. of Botany Course Code _____ Date _____ Roll No _____

Name of student: _____ UID No _____

Marks ____/20 Place of visit _____

Assessment Grid :Place one tick in each appropriate row. Overall mark should reflect the positions of ticks in the individual rows

(20)	Field Trip and Report	80-100 % 17-20 Marks	60-80 % 13-16 Marks	40-60 % 09-12 Marks	20-40 % 05-08 Marks
30% (06)	Organization of report	Introduction about the location, vegetation, Botanical Names, Family, Local name, Description using Botanical Term, reporting all the species seen, Handwritten or typed. 6	Few mistakes, 5	Many mistakes 4	Inadequate presentation 3
50% (10)	Content	Excellent reporting of all the species observed in the field, ecological and morphological data, 10/9	Good reporting, species observed in the field but few of them missing in the list 8	Satisfactory, many species or relevant data missing from the report 6	Poor, inadequate and insufficient data or just a list of the species without any data. 5
10% (02)	Conclusion ----Marks----	Conclusion based on self observation. Type of forest and vegetation 2	Good conclusion, comments not independent 2 / 1	Satisfactory, but insufficient 1 / 0.5	Poor, irrelevant conclusion 0.5
5% (01)	References ----Marks----	Proper references, in required format 1	Proper references but no format 1	Few references 0.5	Irrelevant references 0
5% (01)	Attendance / participation ----Marks-----	Attended and participated actively 1	Attended and participated 1	Infrequent Participation 0.5	No participation 0

Comments:

Name and Signature of Faculty

Project Post graduate level Dept. of Course Code _____ Date _____

UIDNo _____ Roll No _____ Marks _____/20

Name of student -----

Title of Assignment: _____

Assessment Grid :Place one tick in each appropriate row. Overall mark should reflect the positions of ticks in the individual rows. In boxes that have more than one set of marks, cancel out the marks that are not applicable and circle the correctmarks.

Project work and report (Parameters)	Marks	80 – 100 % Excellent	60 -80 % Good	40 – 60 % Satisfactory	20 – 40 % Average
Project work done	10	10 / 9	8 / 7	6 / 5	4 / 3
Report writing and conclusions	10	10 / 9	8 / 7	6 / 5	4 / 3

