



Hindi Vidya PracharSamiti's

RamniranjanJhunjunwala College

of Arts, Science & Commerce

(Autonomous College)

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highlighting component

of Research Project

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

RJSPGBOT204	Title of paper:		
	Medicinal Botany, Cytogenetics and Research Methodology		
	I	Medicinal Botany	4
	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>		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
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 PPK • 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
RJSPGBOT202 Paper 2 Plant Diversity- Spermatophyta II (Anatomy, Developmental Botany and Palynology)	<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 Theory
RJSPGBOT203 Paper-III Plant Physiology and Environmental Botany	Course Outcomes 203 <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 Learning outcomes: <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.

M.Sc. Semester II Botany Syllabus

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>. 		

<p>Unit IV: Research Methodology and Computational Biology</p> <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. 	1
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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
<p>1. Study of vegetative and reproductive structures in <i>Targionia, Plagiochasma, Fimbraria, Pellia</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, Zygopteris, Botryopteris</i> and <i>Glossopteris</i>.</p>		

M.Sc	Semester II Practical
RJSPGBOTP201 Practical I Plant Diversity - Cryptogams II (Bryophytaand Pteridophyta)	<p>Course Outcomes: Skill development, experiential learning, plant diversity</p> <ol style="list-style-type: none"> Slide preparation/ permanent slides study of vegetative and reproductive structures in <i>Targionia, Plagiochasma, Fimbraria, Pellia</i> and <i>Pogonatum</i>. Slide preparation/ permanent slides study of vegetative and reproductive structures in: <i>Isoetes, Ophioglossum, Pteris, Angiopteris, Lygodium</i> and <i>Azolla</i>. Detailed study of fossils: <i>Sigillaria, Calamites, Rhynia, Sphenophyllum, Zygopteris, Botryopteris</i> and <i>Glossopteris</i>. <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

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)	<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 photosynthetic systems in leaves <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

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Course Code	Practical Title (Skill enhancement)	Credits
RJSPGBOTP203	Plant Physiology and Environmental Botany	2

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.

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 coastal 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

M. Sc Botany Syllabus Semester IV



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

Affiliated to
UNIVERSITY OF MUMBAI

Refer to page no: 02
highlighting component
of Research Project/Internship

Syllabus for the M.Sc.
Program: M.Sc. BOTANY
Program Code: RJSPGBOT
(CBCS 2020-2021)

M.Sc Botany Semester IV

Course Code RJSPGBOT401	Research based Project	Credit 12	Marks 300
RJSPGBOT402	Internship with Industry	Credit 12	Marks 300

PRE-WORK

- A. Resume making and selection of area of internship
- B. Identification of organization
- C. Rubrics for assessment

STEPS OF RUBRICS

- Step 1: - Goals and Policy
- Step 2: - Plan for internship
- Step 3: - Identify the appropriate agency/ organization/ industry/ NGO
- Step 4: - Monitoring progress of intern
- Step 5: - Assessment

PARTICIPANTS

1. Student
2. Organization/ agency/ industry/ NGO mentor/ co-supervisor
3. College mentor

REPORTS

- ❖ Fortnight report submission to Organization/ agency/ industry/ NGO mentor/ co-supervisor
- ❖ Monthly report submission to College mentor

Credits	24
Hours / credits	Minimum 360 hours
Duration	December to May

ORGANIZATION RESPONSIBILITY

- 1) Monitoring the attendance record of intern
- 2) Discipline
- 3) Fortnight report
- 4) Mentor grade for 200 marks

O	A+	A	B+	B	C+	C
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- 5) Mentor marks form 200 marks divided as follows:

Completion of work	100
Presentation and submission of report	100

COLLEGE RESPONSIBILITY

Final evaluation at the institution (400 marks)	
Monthly Report	100
Dissertation	100
Presentation	100
Viva	100

M. Sc Botany Syllabus Semester III



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

Affiliated to
UNIVERSITY OF MUMBAI

Refer to page no: 10
highlighting component
of Research Project/Internship

Syllabus for the M.Sc.
Program: M.Sc. BOTANY
Program Code: RJSPGBOT
(CBCS 2020-2021)

M. Sc Botany Syllabus Semester III

M.Sc Botany Semester III

Outline of the Course: RJSPGBOT301 and RJSPGBOT302 are common papers for all specialisations

RJSPGBOT301: Techniques and Instrumentation.

RJSPGBOT302: Cell and Molecular Biology.

RJSPGBOT303 and RJSPGBOT304 are Optional Papers in any one of the following specialisations.

1. Plant Physiology and Biochemistry (PPB)
2. Molecular Biology, Cytogenetics and Biotechnology (MCB)

Theory – RJSPGBOT301	4 Credits
Theory – RJSPGBOT302	4 Credits
Theory – RJSPGBOTPPB303/ RJSPGBOTMCB303	4 Credits
Theory – RJSPGBOTPPB304/ RJSPGBOTMCB304	4 Credits
Practical's (based on all 4 courses) – RJSPGBOTP301, RJSPGBOTP302, RJSPGBOTPPBP303/ RJSPGBOTMCBP303, &RJSPGBOTPPBP304/ RJSPGBOTMCBP304	8 Credits

SEMESTER IV (Common Papers)

Course Code	UNIT	TOPIC HEADINGS	Credits	L / Week
RJSPGBOT301	Title of the Paper: TECHNIQUES AND INSTRUMENTATION			
	I	Cell signalling	4	1
	II	Nanotechnology		1
	III	Centrifugation and Tracer Technique		1
	IV	IPR		1
RJSPGBOT302	Title of the Paper: Molecular Biology			
	I	DNA replication and Transcription	4	1
	II	RNA processing and Translation		1
	III	Gene Regulation I and II		1
	IV	Gene Regulation III		1

RJSPGBOT P301	Techniques and instrumentation	2
RJSPGBOTP302	Molecular Biology	2

M. Sc Botany Syllabus Semester III**Specialization: Plant Physiology and Biochemistry**

RJSPGBOTPPB303	Title of the Paper: Plant Biochemistry		4
	I	Enzyme and plant proteins	1
	II	Cytosolic Carbon & Mitochondrial Metabolism	1
	III	Lipid and nucleotide metabolism	1
	IV	Amino Acid and sulphate Metabolism	1
RJSPGBOTPPB304	Title of the Paper: Plant Physiology		4
	I	Stress physiology – abiotic and biotic	1
	II	Membrane transport	1
	III	Metabolism of secondary metabolites	1
	IV	Senescence and sensory photobiology	1

RJSPGBOTPPBP303	Plant biochemistry	2
RJSPGBOTPPBP304	Plant physiology	2

M. Sc Botany Syllabus Semester III**Specialization: Molecular Biology, Cytogenetics and Biotechnology (MCB)**

RJSPGBOTMCB303	Title of the Paper: Plant Biotechnology			
	I	Plant tissue culture	4	1
	II	Industrial Biotechnology, Down processing and techniques		1
	III	Environmental Biotechnology		1
	IV	Food Biotechnology and Biotransformation		1
RJSPGBOTMCB304	Title of the Paper: Molecular Biology and Cytogenetics			
	I	Cytology and Cancer Biology	4	1
	II	Plant Breeding		1
	III	Immune system and genetic diseases		1
	IV	Molecular Plant Breeding and Plant Genetic Engineering		1

RJSPGBOTMCBP303	Plant Biotechnology	2
RJSPGBOTMCBP304	Molecular Biology and Cytogenetics	2

SEMESTER III (General Papers)

Course Code	Topic	Credits
RJSPGBOT301	TECHNIQUES AND INSTRUMENTATION	4
UNIT I: Cell signaling		1
<ol style="list-style-type: none"> Hormones and their receptors, cell surface receptor, intracellular receptor, signaling through G-protein coupled receptors, signal relay pathways-signal transduction pathways, second messengers, regulation of signaling pathways, bacterial and plant two-component systems, Modulation of plant genomes by natural PGRs- Auxins, GA, Cytokinins, Ethylene & ABA. Light signaling in plants, bacterial chemotaxis and quorum sensing. Forms of signaling (paracrine, synaptic, autocrine, endocrine, cell to cell contact). 		
Unit II: Nanotechnology		1
<ol style="list-style-type: none"> Synthesis of nanoparticles using biological samples. Characterization of nanoparticles (FTIR, SEM, TEM, STEM, Scanning Tunneling Microscope, Atomic Force Microscope, UV-Visible Spectrophotometer). Application of nanomaterials in food, cosmetics, agriculture, environment management and medicine. Risk of Nanomaterial to human health and Environment. 		
Unit III: Centrifugation and Tracer techniques		1
<ol style="list-style-type: none"> Basics principle of Sedimentation. Types of rotors and Differential & density gradient centrifugation. Preparative centrifugation & Applications; Analytical centrifugation & application. Pattern and rate of radioactive decay, Units of radioactivity, Stable Isotopes Principle, instrumentation & technique: Geiger-Muller counter, Liquid, scintillation counters & Autoradiography. Applications of isotopes in biology: Tracer techniques & Autoradiography. PCR and its applications. 		
Unit IV: IPR		1
<ol style="list-style-type: none"> Introduction to intellectual property right (IPR) Concept and kinds. IPR in India and world Patents Objectives, Rights, Patent Act 1970 and its amendments. Information Technology Related Intellectual Property Rights; Computer Software and Intellectual Property 		

M.Sc.	Semester IV Theory
RJSPGBOT301 Paper I Techniques and instrumentation	<p>Course Outcome 3.1:</p> <ol style="list-style-type: none">1. Study of mechanism and types of cell signaling.2. Detailed study and application of centrifugation and analysis of Differential & density gradient solution.3. Study of tracer techniques with applications of isotopes in biology4. Synthesis of nanoparticles using biological samples5. Detailed study of all type of chromatography techniques and its applications.6. Detailed study of IPR: Outcomes, process & scope.7. Instrumentation techniques <p>Learning outcome:</p> <ul style="list-style-type: none">➤ Learning mechanism and types of cell signaling with its application➤ Knowing the working and application of centrifugation➤ Mechanism of all different types of chromatography techniques➤ Understanding the application of nanoparticles➤ Learning the tracer techniques & PCR with applications➤ Understanding the application of IPR➤ Development of application skill

Course Code	Topic	Credits
RJSPGBOT302	Molecular Biology	4
<u>UNIT I: DNA Replication and Transcription</u>		1
<ul style="list-style-type: none"> ➤ Molecular details of DNA replication in prokaryotes and eukaryotes. ➤ Assembly of raw DNA into nucleosomes. ➤ DNA recombination, Holliday model for recombination. ➤ Transcription, RNA synthesis, classes of RNA and the genes that code for them. ➤ Transcription of protein coding genes, prokaryotes and eukaryotes, mRNA molecule. ➤ Transcription of other genes, ribosomal RNA, and ribosomes 		
<u>Unit II: RNA Processing and Translation</u>		1
<ul style="list-style-type: none"> ➤ Capping, polyadenylation, splicing, introns and exons. ➤ snRNA, Types of snRNA, snRNA in spliceosome, significance of snRNA ➤ Non-coding RNAs, ribozyme, riboswitches, RNA localization. ➤ Protein structure, nature of genetic code, translation of genetic message. ➤ Post translational modifications, localization, chaperons. 		
<u>Unit III: Gene Regulation I and II</u>		1
<ul style="list-style-type: none"> ➤ Regulations of gene expression in bacteria – TRP operon, ARA operon, Histidine operon. ➤ Regulation of gene expression in bacteriophage λ. ➤ Control of gene expression in eukaryotes, Transcriptional control, RNA processing control, mRNA translocation control, mRNA degradation control, protein degradation control. 		
<u>Unit IV: Gene Regulation III</u>		1
<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. 		

M. Sc Botany Syllabus Semester III

M.Sc.	Semester III Theory
RJSPGBOT302 Paper II Molecular Biology	<p>Course Outcome 3.2:</p> <ol style="list-style-type: none">1. Detailed study of Molecular details of DNA replication and recombination in prokaryotes and eukaryotes.2. Mechanism of gene expression in transcription, RNA synthesis, protein coding genes and RNA processing post transcription in prokaryotes and eukaryotes.3. Translation and post translational modifications.4. Detailed study of Regulations of gene expression in bacteria and bacteriophage λ.5. Genetic regulation of development stages in <i>Drosophila</i>. <p>Learning outcome:</p> <ul style="list-style-type: none">➤ Understanding concept of molecular biology in detail➤ Learning the application of tools in molecular biology➤ Understanding concept of Regulations of gene expressions➤ Understanding concept of molecular biology in detail

RJSPGBOTP301	TECHNIQUES AND INSTRUMENTATION	2
<ul style="list-style-type: none">➤ Purification of chloroplast using density gradient centrifugation➤ Isolation of mitochondria➤ Synthesis of nanoparticles.➤ Characterization of nanoparticles by UV spectroscopy.➤ Project based on IPR➤ Separation of plant proteins using PAGE➤ IPR assignment➤ Filing a patent.➤ Industrial visit and report submission.		

RJSPGBOTP302	Molecular Biology	2
<ul style="list-style-type: none">➤ Aseptic techniques, safe handling of microorganisms.➤ Establishing pure cultures, Streak Plate method (T-streak and pentagon method), Pour plate, Spread plate.➤ Isolation and quantification of genomic DNA➤ Isolation of plasmid DNA.➤ Quantification of plasmid DNA.➤ Agarose gel electrophoresis separation of plasmid DNA.➤ Restriction enzyme digestion and separation of fragments.➤ Southern blot transfer technique.➤ Transformation of <i>E. coli</i> cell by plasmid DNA.➤ β-galactosidase expression and assay		

Specialization: Plant Physiology and Biochemistry (PPB)

Course Code	Topic	CREDITS
RJSPGBOTPPB303	Plant Biochemistry	4
<u>Unit I: Enzymes and Plant Proteins</u>		1
<ol style="list-style-type: none"> 1. Purification and Isolation 2. Biochemical regulation 3. Isoenzymes 4. Vitamins – structure and Coenzyme activity 5. Lectins and storage proteins in plants, transamination, oxidative deamination and Urea cycle. 		
<u>Unit II: Cytosolic carbon and Mitochondrial metabolism.</u>		1
<ol style="list-style-type: none"> 1. Synthesis and breakdown of Sucrose and Starch, regulation of Glycolysis and Gluconeogenesis. 2. Catabolic role of the TCA cycle, Anabolic role of the TCA cycle intermediates 3. Anapleurotic CO₂ fixation, provision of acetyl CoA for biosynthesis, Regulation of TCA. 		
<u>Unit III: Lipid and nucleotide metabolism</u>		1
<ol style="list-style-type: none"> 1. Biosynthesis and degradation of odd carbon chain FA, structural and storage lipids 2. Synthesis and Function of membrane, structural & storage lipids, Omega fatty acids, beta oxidation of odd and even carbon containing fatty acids. 3. Purine and Pyrimidine biosynthesis and regulation. 4. Recycling of Purine and Pyrimidine nucleotides by salvage pathways. 		
<u>Unit IV: Amino acid and sulphate metabolism.</u>		1
<ol style="list-style-type: none"> 1. Biosynthesis of Amino Acids (Proline, Glycine, Asparagine, Tryptophan, Phenylalanine), Regulation of amino acid biosynthesis 2. Sulphate Overview, Uptake and transport and Reductive sulphate pathway 		

M.Sc. (PPB)	Semester III Theory
RJSPGBOTPPB303 Paper-III Plant Biochemistry	<p>Course Outcome 3.3:</p> <ol style="list-style-type: none">1. Study of Mechanism of all types of enzyme, catalyst, regulation and kinetics.2. Study the role of lectins (plant proteins).3. Detailed study of nucleotide metabolism and its synthesis.4. Study of lipid metabolism synthesis and function of membrane, structural & storage lipids5. Detailed study biosynthesis and regulation of amino acids6. Study of the cytosolic carbon and mitochondrial metabolism <p>Learning outcome:</p> <ul style="list-style-type: none">➤ Understanding the regulation of all types of enzymes.➤ Know the importance of plant lectins.➤ Understanding the biosynthesis and regulation of nucleotide metabolism.➤ Understanding the lipid and aminoacids synthesis and regulation.➤ Learning the importance cytosolic carbon and mitochondrial metabolism.

M. Sc Botany Syllabus Semester III

Course Code	Topic	Credits
RJSPGBOTPPB304	Plant Physiology	4
Unit I: Stress Physiology – Abiotic stress and Abiotic stress		1
<ol style="list-style-type: none"> 1. Drought - Morphological and cellular adaptations, mechanism of drought tolerance, role of Proline, Glycine betaines, Mannitol, Pinitol and Osmotin in stress resistance. 2. Salinity - Generic Pathway for Plant Response to stress effect of salt on metabolic processes, Mechanism of salt resistance- salt avoidance (exclusion, extrusion and dilution) and tolerance (Regulation of ion homeostasis by SOS pathway), Role of Glycine betaine and Proline in Salinity Stress, DEAD-Box Helicases in Salinity Stress Tolerance. 3. Freezing stress, Oxygen stress and Flooding 4. Oxidative stress and Heat stress 		
Unit II: Membrane transport		1
<ol style="list-style-type: none"> 1. Overview and Organisation of transport at plant membrane 2. Pumps – Proton pump, H⁺ ATPase and Ca⁺² ATPase 3. Carriers and Ion Channels – K⁺ and Ca⁺² channels 4. Aquaporins 		
Unit III: Metabolism of secondary metabolites and Phytoremediation		1
<ol style="list-style-type: none"> 1. General biosynthetic pathways in the formation of secondary metabolites. Biosynthesis and role of Phenols, Phenylpropanes, Coumarins, lignins, flavonoids, alkaloids, tannins, and terpenes 2. Types of Phytoremediation- Advantages & limitations, Remedial measures- Rhizosphere based & Plant based, Hyper accumulators. 3. Role of genetic engineering & various enzymes in phytoremediation. 		
Unit IV: Senescence and sensory photobiology		1
<ol style="list-style-type: none"> 1. Pigment Metabolism, Protein metabolism and Oxidative metabolism during senescence. Programmed cell death (PCD) an overview. 2. Structure, function and mechanism of phytochromes, Cryptochromes and Phototropins, Phytochrome induced whole plant response, Molecular basis of flower organization: MADS box genes and their expression. Problems based on ABC model for flower organization. 		

M. Sc Botany Syllabus Semester III

M.Sc. (PPB)	Semester III Theory
RJSPGBOTPPB304 Paper-IV Plant Physiology	<p>Course outcome 3.4:</p> <ol style="list-style-type: none"> 1. Detailed study of concept of water potential, transport and translocation in plants. 2. Understanding the mechanism of adaptation of plants under stress conditions 3. Physiology of plants under stress 4. Detailed study of biosynthetic pathways and biosynthesis of secondary metabolites 5. Study of pigment, protein and oxidative metabolism during senescence. 6. Understanding the mechanism of sensory photobiology and molecular basis of flower organization. <p>Learning outcome:</p> <ul style="list-style-type: none"> ➤ Understanding the role of water, ions, solutes and macromolecules in transport and translocation in plants ➤ Understanding detailed concept of stress metabolites their importance and applications ➤ Understanding the role of secondary metabolites and its Commercial application ➤ Understanding the senescence regulation and Phytochrome for desired designed plants

RJSPGBOTPPBP303	Plant Biochemistry	2
<ul style="list-style-type: none"> ➤ Separation of proteins by Ion exchange chromatography. ➤ Separation of amino acids by two-dimensional chromatography. ➤ Viscosity studies of proteins: standard BSA and varying concentrations of urea ➤ Estimation of Tryptophan. ➤ Estimation of polyphenols from suitable plant material ➤ Extraction & separation of Glucosinolates from Mustard. ➤ Extraction & separation of Piperine from <i>Piper</i>. ➤ Extraction & separation of lycopene from <i>Lycopersicum</i>. ➤ Study of enzyme SDH and effect of inhibitor on its activity ➤ Extraction and estimation of vitamin C from suitable plant material 		

M. Sc Botany Syllabus Semester III

M.Sc.	Semester IV Practical
RJSPGBOTPPBP303 Practical III Plant Biochemistry	<p>Course Outcomes</p> <ol style="list-style-type: none"> 1. Estimation of tryptophan and polyphenols. 2. Study of enzymes SDH and effect of inhibitors on its activity. 3. Extraction & separation of Glucosinolates from Mustard, Piperine from <i>Piper</i> and lycopene from <i>Lycopersicum</i>. 4. Study of enzyme activity <p>Learning outcome:</p> <ul style="list-style-type: none"> ➤ Know the importance and use of fats and oil, chlorophylls, tryptophan and polyphenols in plants. ➤ Understanding the biosynthesis and storage of secondary metabolite in plant cell and its commercial application

RJSPGBOTPPBP304	Plant Physiology	2
<ul style="list-style-type: none"> ➤ Estimation of GOT from the given plant material ➤ Estimation of GPT from the given plant material ➤ Preparation of acid extract from any halophyte and estimation of sodium and potassium content by flame photometer ➤ Estimation of proline content from suitable plant material ➤ Study of superoxide dismutase (SOD) from suitable plant material ➤ Isolation and estimation of DNA ➤ Estimation of RNA by orcinol method ➤ Measurement and Characterization of Chlorophylls and Carotenoids by Spectroscopy at different stages of Senescence. 		

M.Sc.	Semester IV Practical
RJSPGBOTPPBP 304 Practical IV Plant Physiology	<p>Course Outcome:</p> <ol style="list-style-type: none"> 1. Study of various enzyme assays and interpretations 2. Isolation and estimation of nucleic acids 3. Techniques of elemental analysis 4. Dynamics of stress induced enzymes <p>Learning outcome:</p> <ul style="list-style-type: none"> ➤ Application of all knowledge and interpretation ➤ Understanding the regulation of enzymes

Specialization: Molecular Biology, Cytogenetics and Biotechnology (MCB)

Course Code	Topic	Credits
RJSPGBOTMCB303	Plant Biotechnology	4
Unit I: Plant Tissue Culture and Commercial Aspects		1
<ol style="list-style-type: none"> 1. Micropropagation of floricultural and medicinal plants using organogenesis and embryogenesis. 2. Factors responsible for <i>in vitro</i> and <i>ex vitro</i> hardening. 3. Plant improvement through soma clonal variations. 4. Plant cell cultures as chemical factories: Cell suspension, enhancement of product formation using biotic and abiotic elicitors, immobilization, permeabilization and product recovery. 5. Problems in plant tissue culture: Contamination, Phenolics and Recalcitrant. 6. The quest for commercial production from plant cell: scaling up of cell cultures, Shikonin production by <i>Lithospemum erythrorhizon</i> cell cultures. 		
Unit II: Industrial biotechnology down processing and techniques		1
<ol style="list-style-type: none"> 1. Bioreactors: factors for bioreactor design, pneumatically agitated bioreactors, comparison of bioreactors, operating mode, batch, fed batch, semi continuous, two stage operation, continuous cultivation. 2. Factors for growth in Bioreactors. 3. General types of Industrial processes, list of antibiotics produced by fungi. Industrial production of penicillin 4. Industrial enzymes, Pectinase production as a case study 5. Single Cell Protein 6. Distillation, Flootation, Filtration, Centrifugation 7. Extraction methods: Solvent, absorption chromatography, gel filtration 		
Unit III: Environmental Biotechnology.		1
<ol style="list-style-type: none"> 1. Biosorption: use of fungi, algae and biological components. 2. Biomass for energy: Sources of biomass, advantages & disadvantages, uses of biomass. 3. Biogas production from food processing waste: vegetable canning waste, flour, molasses etc. 4. Ethanol from biomass and Lignocellulosic residue. 5. Risks of GMO 		

<p>Unit IV: Food Biotechnology and biotransformation</p> <ul style="list-style-type: none"> ➤ Factors affecting spoilage. ➤ Quality control of food. ➤ Enzyme immunoassays (ELISA). ➤ Radioimmunoassay (RIA), Monoclonal antibodies and DNA probes. ➤ Biotransformation using: Freely suspended plant cells and Immobilized plant cells. ➤ Biotransformation for Vanillin production from Capsicum cell cultures. ➤ In vitro storage of germplasm, Cryopreservation. 	1
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M.Sc. (MCB)	Semester IV Theory
<p>RJSPGBOTMCB303 Paper-III Plant Biotechnology</p>	<p>Course Outcome 3.3:</p> <ol style="list-style-type: none"> 1. Molecular biology techniques, aseptic techniques, safe handling of microorganisms and establishment of pure cultures 2. Preparation of cultures and stock solutions 3. Students will learn industrial processes of recovery important products by various processes. 4. Study of Food Biotechnology and its application for Quality control of food 5. Environmental issues like solid waste management and green fuel technology 6. Mass Propagation of plants using <i>in vitro</i> technique 7. Industrial production of fine chemicals using plant cell cultures <p>Learning outcome:</p> <ul style="list-style-type: none"> ➤ Industrial Biotechnology will enable students to learn the practical application of the subject. ➤ Learning the importance of Quality control of food. ➤ Application of techniques of plant tissue culture. ➤ To learn production of value-added chemicals by using green techniques like Biotransformation.

M. Sc Botany Syllabus Semester III

Course Code	Topic	Credits
RJSPGBOTMCB304	Molecular Biology and Cytogenetics	4
Unit I: Cytology and Cancer Biology		1
<ol style="list-style-type: none"> 1. 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. 2. Cell Cycle and Apoptosis: Mechanism of Cell division; Regulation, Roles of Cyclins and Cyclin dependent kinases, Cell Plate formation, PCD. 3. Organization and function of mitochondrial and chloroplast genomes. 4. Cancer cells: Characteristics, division, spread, treatment. Course of cancer cell formation 5. Carcinogens: radiations, chemicals, Oncogenic virus. 6. Cancer and mutations, reproductive properties of transformed animal cell in culture, oncogenes, proto oncogenes and their conversion. Oncogenes and growth factors. 		
Unit II: Plant Breeding		1
<ol style="list-style-type: none"> 1. Aims and objectives, plant introductions and acclimatization. 2. Selection – Mass, Pure line and Clonal. 3. Hybridization techniques, hybridization in self-pollinated and cross-pollinated plants. 4. Genetic control and manipulation of breeding systems including male sterility and apomixes. 5. Distant hybridization: In nature (plant breeding) – Barriers to the production of distant hybrids; Unreduced gametes in distant hybridization; Sterility in distant hybrids; Consequences of segregation in distant hybrids; 6. Applications and Achievements of distant hybridization in crop improvement; Limitations of distant hybrids. 		
Unit III: Immune System and Genetic Diseases		1
<ol style="list-style-type: none"> 1. 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. 2. Immunity in Health and Disease: Immunodeficiency and AIDS 3. Genetic disorders, genetic counselling and gene therapy. 4. Biochemical disorders, sex linked disorders, cardiovascular disorders. 		
Unit IV: Molecular plant Breeding (Transgenic Crops) and Plant Genetic Engineering		1
<ol style="list-style-type: none"> 1. Natural method of gene transfer (<i>Agrobacterium</i> and virus), selectable markers. 2. Artificial methods of gene transfer: Direct DNA uptake by protoplast, Electroporation, Liposome mediated and particle gun transformation 3. Production of Transgenic plants: Virus resistant & Herbicide –resistant, 		

M. Sc Botany Syllabus Semester III

<p>plants, Bt Cotton, Golden rice.</p> <p>4. Production of bio pharmaceuticals in transgenic plants.</p> <p>5. Edible vaccines & Plant antibodies.</p> <p>6. DNA-based molecular marker aided breeding: RAPD, RFLP, AFLP, STS, ISSR, Microsatellites.</p>	
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M.Sc. (MCB)	Semester IV Theory
<p>RJSPGBOTMCB304</p> <p>Paper-IV</p> <p>Molecular Biology and Cytogenetics</p>	<p>Course outcome 3.4:</p> <ol style="list-style-type: none"> 1. Detailed study of plant breeding with hybridization techniques and its applications. 2. Mechanism of molecular plant breeding of transgenic crops 3. Detailed study of plant genetic engineering 4. Cell cycle, Programmed cell death 5. Organisation and functions of mitochondria and chloroplast genome <p>Learning outcome:</p> <ul style="list-style-type: none"> ➤ Understanding the mechanism of cancer biology and immunology ➤ Application in diagnostics ➤ Understanding the importance of plant breeding ➤ Understanding detailed concept of molecular plant breeding of transgenic crops ➤ Knowing the effect of plant genetic engineering and its applications

M. Sc Botany Syllabus Semester III

Practical	Plant Biotechnology	
RJSPGBOTMCBP303	<ol style="list-style-type: none"> 1. Preparation of stock solution and medium preparation 2. Preparation of culture medium, stock solutions 3. Establishment of different types of cultures: callus, root, micro propagation 4. Visit to plant tissue culture laboratory 5. Types of Bioreactors 6. <i>Allium cepa</i> bioassay 7. ELISA and Flow Cytometry 8. Production of wine from different fruits and measurement of alcohol content 9. Removal of aromatic amines from water sample by using enzymes from suitable source 	2
RJSPGBOTMCBP304	<ol style="list-style-type: none"> 1. Microscopic identification of cancer cell 2. Genetic disorders 3. Visit to a diagnostic laboratory and report writing 4. Identify cultivars of any vegetable by Isoenzymes. 5. Culturing of Drosophila and study of genetic traits. 6. Blood group testing, Karyotypes of genetic disorders. 7. <i>Allium cepa</i> bioassay for screening of toxicants 	2

M.Sc.	Semester IV Practical
RJSPGBOTMCBP303 RJSPGBOTMCBP304 Practical III and IV Plant Biotechnology	<p>Course Outcome:</p> <ol style="list-style-type: none"> 1. Hands on training in various aspects of plant tissue culture 2. Mass propagation of plants using tissue culture technique 3. Working on Aseptic techniques, safe handling of microorganisms and establishing pure cultures 4. Maintenance of cultures - Paraffin embedding, Lyophilisation. 5. Preparation of culture medium, stock solutions 6. Determination of cell number, viable count method (using pour plate and serial dilution technique). 7. Molecular Biology techniques <p>Learning outcome:</p> <ol style="list-style-type: none"> 1. Skill based training in plant tissue culture 2. Establishment and maintenance of culture 3. Understanding the application of molecular biology

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M. Sc Botany Syllabus Semester III

Scheme of Examinations

1. Internal Examination 40 marks various modes with different weightage (Presentation, seminar, 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 T.Y. B.Sc. Botany 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: Written test -20 marks

CIA 2: Written Test / Assignment / Field Trip/mini project/ & Report -20 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 III (RJSPGBOT301, RJSPGBOT302, RJSPGBOTPPB303/RJSPGBOTMCB303 & RJSPGBOTPPB304/RJSPGBOTMCB304)**

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 V: (50 marks for each practical RJSPGBOTP301, RJSPGBOTP302, RJSPGBOTPPBP303/ RJSPGBOTMCBP303 & RJSBOTPPBP304/ RJSPGBOTMCBP304)**

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.

M. Sc Botany Syllabus Semester III

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.	Few mistakes,	Many mistakes	Inadequate presentation
		6	5	4	3
50% (10)	Content	Excellent reporting of all the species observed in the field, ecological and morphological data,	Good reporting, species observed in the field but few of them missing in the list	Satisfactory, many species or relevant data missing from the report	Poor, inadequate and insufficient data or just a list of the species without any data.
		10/9	8	6	5
10% (02)	Conclusion	Conclusion based on self observation. Type of forest and vegetation	Good conclusion, comments not independent	Satisfactory, but insufficient	Poor, irrelevant conclusion
	----Marks----	2	2 / 1	1 / 0.5	0.5
5% (01)	References	Proper references, in required format	Proper references but no format	Few references	Irrelevant references
	----Marks----	1	1	0.5	0
5% (01)	Attendance / participation	Attended and participated actively	Attended and participated	Infrequent Participation	No participation
	----Marks----	1	1	0.5	0

Comments:

Name and Signature of Faculty.

M. Sc Botany Syllabus Semester III

Mini Project Under 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 correct marks.

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

M. Sc Botany Syllabus Semester III

Mapping of the course to employability/ Entrepreneurship/skill development

Class	Course Name	Course Code	Topic focussing on Employability/ Entrepreneurship/skill development	Employability/ Entrepreneurship/ Skill development	Specific activity
S Y B Sc Botany	Plant Diversity I	RJSUBOT301, RJSUBOT401	Plant Diversity III,IV focuses on identification of plants ranging from microbes	The topics focuses on identifying plants ranging from lower forms Thallophyta till	Preparation of bio fertilizers
S Y B Sc Botany		RJSUBOT301 RJSUBOT302 RJSUBOT303	Concepts in Plant Anatomy, Biochemistry, Physiology, Genetics and Ecology which are essential to take up a career in research and teaching since these provide the Domain knowledge. Medicinal Botany gives a glimpse on plant based drugs and economically important products	Employability in field of the teaching and research. To learn the techniques to identify plant based drugs.	
S Y B Sc Botany	Practicals	RJSUBOTP301 RJSUBOTP302 RJSUBOTP303 RJSUBOTP301 RJSUBOT302 RJSUBOT303	Microscopical identification of lower forms of plants, identification of higher forms using morphological studies. Study of plants in different habitats and their adaptation. Plant pigments as natural pH indicator	1Analytical skills 2Interpretation skills 3Writing skills	Miniproject for developing Entrepreneurial skills, Field trips enhances skills of identification of plants in situ, organisational skills, team work.