



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

Affiliated to  
**UNIVERSITY OF MUMBAI**

Course: Environmental Science  
(Applied Component)

Syllabus for T.Y.B.Sc  
Program: B.Sc. Zoology & Botany  
Program Code: RJSUEVS  
(CBCS 2021-22)

**Refer to page no: 02**  
**highlighting component**  
**of Research Project**

## DISTRIBUTION OF TOPICS AND CREDITS

## APPLIED COMPONENT- ENVIRONMENTAL SCIENCES SEMESTER V

Course code	Nomenclature	Credits	Topic
RJSUEVS505	Indian ecological issues, Environmental pollution, Sustainable energy resources and green chemistry	2	1. Ecological issues of India
			2. Environmental Pollution
			3. Alternate Energy Resources
			4. Green chemistry and Sustainability
RJSUEVSP505	---	2	Practicals based on Course RJSUEVSP505

## APPLIED COMPONENT- ENVIRONMENTAL SCIENCES SEMESTER VI

Course code	Nomenclature	Credits	Topic
RJSUEVS605	Ecological restoration and conservation, ecotourism, climate change and disaster management	2	1. Ecological restoration
			2. Biodiversity conservation & ecotourism
			3. Climate change
			4. Disaster management
RJSUEVSP605	---	2	Practicals based on Course RJSUEVSP605

<b>SEMESTER-V (THEORY)</b>		<b>L</b>	<b>Cr</b>
<b>Paper Code: RJSUEVS505</b>		<b>60</b>	<b>2</b>
<b>UNIT I</b>		<b>15</b>	
<b>Ecological issues of India</b>			
1	<p><b>1.1 Introduction</b></p> <p><b>1.2 Environmental challenges of India:</b></p> <ul style="list-style-type: none"> <li>• Population, poverty &amp; environmental degradation.</li> <li>• Water crisis-Groundwater depletion in India.</li> <li>• Land degradation-Land use pattern.</li> <li>• Human settlement.</li> <li>• Energy crisis.</li> </ul> <p><b>1.3 Efforts to meet environmental challenges in India.</b></p> <ul style="list-style-type: none"> <li>• Sustaining life support system.</li> <li>• Urbanization and industrialization.</li> <li>• Capacity building for sustainable development.</li> <li>• India and the world or Global issues.</li> </ul> <p><b>1.4 Case studies:</b></p> <ul style="list-style-type: none"> <li>• Jhum cultivation or shifting cultivation in North east region of India.</li> <li>• Chipko movement.</li> </ul>		
<b>UNIT II</b>		<b>15</b>	
<b>Unit 2: Environmental Pollution</b>			
2	<p><b>2.1. Types of pollution:</b></p> <ul style="list-style-type: none"> <li>• Causes, effects, control measures and Pollution control standards:</li> <li>• Water pollution.</li> <li>• Air pollution.</li> <li>• Nuclear pollution.</li> <li>• Noise pollution</li> </ul> <p><b>2.2. Case studies related to pollution:</b></p> <ul style="list-style-type: none"> <li>• Bhopal gas tragedy, India.</li> <li>• Fukushima Daiichi nuclear disaster, Japan</li> </ul>		
<b>UNIT III</b>		<b>15</b>	
<b>Unit 3: Alternate Energy Resources</b>			
3	<p><b>3.1 Solar energy, wind energy, tidal energy, nuclear energy.</b></p> <p><b>3.2 Energy from Biomass, bio-fuels &amp; petro crops.</b></p> <p><b>3.3 Energy from solid waste.</b></p> <p><b>3.4. Case study:</b></p> <ul style="list-style-type: none"> <li>• Shirdi Devasthan. (Solar cooker)</li> <li>• Jaitapur power plant</li> </ul>		

## T.Y.B.Sc Zoology &amp; Botany Syllabus Semester V &amp; VI

UNIT IV		15	
<b>Green chemistry and Sustainability</b>			
<b>4.1 The Twelve Principles of Green Chemistry.</b> <b>4.2 Sustainable Development- Principles, characteristics and sustainable development indicators.</b> <b>4.3 Areas highlighted by Agenda 21.</b> <b>4.4 Case studies:</b> <ul style="list-style-type: none"> <li>• Ibuprofen (green synthesis).</li> <li>• Green paint.</li> </ul>			

T.Y.B.Sc	Semester V Theory
<b>RJSUEVS505</b>  <b>Indian ecological issues, Environmental pollution, Sustainable energy resources and green chemistry</b>	<b>Course Objectives:</b> <ol style="list-style-type: none"> <li>1. To make learner acquainted with environmental degradation and capacity building for sustainable development at national and global level.</li> <li>2. To make learner understand different types of pollution its causes, effects and various control measures.</li> <li>3. To expose learner to various alternate energy resources, energy technology and its advantages.</li> <li>4. To educate learner about the principles of Green Chemistry, sustainable development indicators, and areas highlighted by Agenda 21.</li> </ol>
	<b>Learning Outcomes:</b> <ol style="list-style-type: none"> <li>1. Learners would understand various aspects of environmental degradation and efforts taken to meet the related challenges.</li> <li>2. Learners would get to know the types and effects of environmental pollution and different measures to control it.</li> <li>3. Learners would be able to understand the significance of alternate energy resources and learn about related technologies.</li> <li>4. Learners would become aware about principles of green chemistry, sustainable development indicators, and areas highlighted by Agenda 21.</li> <li>5. Case studies would aid the learners to relate with the actual situation in field.</li> </ol>

<b>SEMESTER-V (PRACTICALS)</b>		<b>L</b>	<b>Cr</b>
<b>Paper Code: RJSUEVSP505</b>			<b>1</b>
	1. Study of Physico-chemical properties of sewage/ effluent water: <ul style="list-style-type: none"> <li>• Conductivity.</li> <li>• Dissolved oxygen.</li> <li>• BOD.</li> <li>• COD.</li> </ul>		
	2. Microbiological parameters: MPN.		
	3. Measurement of intensity of light by Lux meter.		
	4. Study of application of alternative energy resources (Solar panel, Biogas plant, Photovoltaic cell, Windmill).		
	5. Study of indoor plants for reduction of pollution (Adiantum, Cactus, Chlorophytum, Pachira,).		
	6. Photographic documentation of environment related issues/ conservation. Submission of soft & hard copy of 5 original photographs taken by the learner.		
	7. Study of air & noise pollution monitoring device.		

<b>T.Y.B.Sc</b>	<b>Semester V Practical</b>
<b>RJSUEVSP505</b>	<p><b>Course Objectives:</b></p> <ol style="list-style-type: none"> <li>1. To equip learners with the skill's necessary to measure of physico-chemical properties of sewage/ effluent water.</li> <li>2. To make the learner understand use of luxmeter and various pollution monitoring devices.</li> <li>3. To make the learner acquainted with pollution controlling plants.</li> <li>4. To educate learners to observe various environmental issues in his/her reach.</li> </ol> <p><b>Learning Outcomes:</b></p> <ol style="list-style-type: none"> <li>1. The learner will be able to measure the quality of water and will be able understand the criteria for safe drinking water.</li> <li>2. The learner will be able to demonstrate the use of luxmeter and would acquire knowledge about pollution monitoring devices.</li> <li>3. The learner will get the knowledge about role of indoor plants in controlling pollution.</li> <li>4. The learner will develop skill to observe and stay aware about various environmental issues.</li> </ol>

<b>SEMESTER-VI (THEORY)</b>		<b>L</b>	<b>Cr</b>
<b>Ecological restoration and conservation, ecotourism, climate change and disaster management.</b>		<b>60</b>	<b>2</b>
<b>Paper Code: RJSUEVS605</b>			
<b>UNIT I</b>		<b>15</b>	
<b>Unit 1: Ecological restoration</b>			
1	1.1 Domestic waste water treatment. 1.2 Industrial waste water treatment. 1.3 Bioremediation. 1.4 Alternatives to conventional resources: biodegradable plastic, biodiesel, bio ethanol & bio pesticides. <b>1.5 Case studies:</b> <ul style="list-style-type: none"> <li>• Developing effluent treatments.</li> <li>• Ice Stupa-Sonam Wangchuk.</li> </ul>		
<b>UNIT II</b>		<b>15</b>	
<b>Unit 2: Biodiversity Conservation &amp; Ecotourism</b>			
2	2.1 Hotspots of biodiversity and biosphere reserve. 2.2 Strategies for biodiversity conservation (in-situ and ex-situ). 2.3 Commercial wildlife photography. 2.4 Ecotourism—definition, policies and practices. <b>2.5 Case studies:</b> <ul style="list-style-type: none"> <li>• Govardhan Eco village</li> <li>• Thennamala Ecopark</li> </ul>		
<b>UNIT III</b>		<b>15</b>	
<b>Climate Change</b>			
3	3.1 Introduction to climate change, global warming and its effects. 3.2 Greenhouse substances: Sources & effects. 3.3 Remote Sensing & GIS. 3.4 Role of IPCC in climate change monitoring; Kyoto Protocol, Montreal Protocol, Earth Summit & UN Convention on Climate Change. <b>3.5 Case studies:</b> Climate change and apple farming in Indian Himalayas. The case of ozone depletion.		
<b>UNIT IV</b>		<b>15</b>	
<b>Disaster management</b>			
4	4.1 Introduction. 4.2 Disaster prone regions of India, major disasters of India. 4.3 Impact of disasters. 4.4 Disaster management plan for schools and colleges. 4.5 Cause, effects and control measures of disasters: <ul style="list-style-type: none"> <li>• Floods</li> <li>• Earthquakes</li> </ul>		

T.Y.B.Sc Zoology & Botany Syllabus Semester V & VI

	<ul style="list-style-type: none"> <li>• Cyclones</li> <li>• Landslides</li> </ul> <p><b>4.6 Case studies:</b></p> <ul style="list-style-type: none"> <li>• Mumbai flood, 26<sup>th</sup> July, 2005.</li> <li>• Odisha cyclone Fani, May, 2019.</li> </ul>		
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T.Y.B.Sc	Semester VI Theory
<p>RJSUEVS605</p> <p><b>Ecological restoration and conservation, ecotourism, climate change and disaster management.</b></p>	<p><b>Course Objectives:</b></p> <ol style="list-style-type: none"> <li>1. To acquaint learners with the details of waste water treatment and bioremediation.</li> <li>2. To enhance the knowledge of the learners about biodiversity conservation and ecotourism.</li> <li>3. To update the learners about climate change and global efforts in combating with it.</li> <li>4. To introduce the concept and strategies of disaster management.</li> <li>5. To introduce case studies on topics for enhanced learning.</li> </ol> <p><b>Learning Outcomes:</b></p> <ol style="list-style-type: none"> <li>1. Learners will get an idea on steps involved in waste water treatment and bioremediation.</li> <li>2. Learners will be able to understand importance of biodiversity conservation and also be able to promote ecotourism.</li> <li>3. Learners will be able to understand need of efforts to combat with global climate change.</li> <li>4. Learners will get an insight into disaster management and be prepared for taking correct steps during an event of disaster.</li> <li>5. Case studies will help the learners to understand the concepts in a more practical manner.</li> </ol>

<b>SEMESTER-VI (PRACTICALS)</b>		<b>L</b>	<b>Cr</b>
<b>Paper Code: RJSUEVSP605</b>			<b>1</b>
	1. Study of physical properties of soil: Temperature (for demonstration), moisture, & texture of soil.		
	2. Study of chemical properties of soil: Organic matter and Calcium carbonate.		
	3. Detection of heavy metal cation: Lead from water sample.		
	4. Study of logistic services for medical, toxic waste (Incinerator, Autoclave).		
	5. Observation & study of indicator species.		
	6. Visit to any waste treatment plant/ industry/laboratory/national park and submission of report. (Ref: Annexure II).		
	7. Group project and submission of report (group of 5).		

<b>T.Y.B.Sc</b>	<b>Semester VI Practical</b>
<b>RJSUEVSP605</b>	<p><b>Course Objectives:</b></p> <ol style="list-style-type: none"> <li>1. To familiarize the learner with practical techniques for evaluation of significant environmental parameters.</li> <li>2. To make the learner understand concepts of environmental remediation.</li> <li>3. To make the learner participate in group activity.</li> </ol> <p><b>Learning Outcomes:</b></p> <ol style="list-style-type: none"> <li>1. The learner will be able to analyse different parameters associated with quality of environment.</li> <li>2. The learner will be able to gain field knowledge on areas of environmental significance.</li> <li>3. The learner will be able to comprehend the skill of working in group and team spirit.</li> </ol>



**ANNEXURES**

**Annexure I: Suggested topics for assignment Semester V**

(Teachers are expected to develop additional innovative topics, varying every year, to be assigned to the students).

1. List out the instruments or funding agencies or permits required for setting up an environment testing laboratory.
2. Survey of NGO's working in the environmental field in your area.
3. Preparation of proposal for green building and sustainable development.
4. Prepare a cost sheet for setting up a bio degradable plastic unit.
5. Make an inventory of the water bodies presently existing/which existed in the urban/rural area of about 5kms.
6. Find out information regarding pollution testing booths that the Government proposes to set up.(List out the personnel who will man the booths and the indigenous equipment that these booths will have).
7. Make a report on amenities, trees, dimensions of open spaces in your locality. Assess their role in maintaining the ecological balance in the region.
8. Survey housing societies/institutions/ organizations to find out whether they are converting household/kitchen waste into anything utilizable like vermicomposting etc.
9. Meet entrepreneurs involved with manufacture of eco-friendly products/best out of waste etc. Make a report regarding how the entrepreneur decided to pursue such an initiative, its need, the process and benefits to the environment.
10. Calculate carbon footprint of your family/class-room or laboratory/housing society by visiting the appropriate site on internet.
11. Visit architectural /horticulturist firms that deal with vertical gardening /urban farming and prepare a first-hand report on the concept, where implemented and the advantages.

All topics mentioned above are suggestive, more creative and innovative topics are expected from the students, under the able guidance of the concerned teacher, to suit the expertise, human resources, infrastructure and local needs as also the interest of the students. The assignment may be submitted in a group not exceeding three students.

**Annexure II: Suggested Field Visits for Semester VI**

- There shall be various short and long excursions / study tours / field visits / industrial visits in every semester, at least one of which shall be financially affordable to every student in the class; and that assessment and marks of field trips shall be solely based upon such where no student was restrained for financial limitations.
  - Field visits are to be organized to facilitate students to have first-hand experience & exposure to technology/production/functioning of organization/units or witness a relevant activity.
  - Each student must make at least 01 (one) such visit to the units/treatment plants/aquatic or terrestrial habitat organized by the College.
  - The list is suggestive and not exhaustive.
1. Visit to Sewage treatment plant.
  2. Visit to Vermicomposting unit.
  3. Visit to Air Monitoring Laboratory.
  4. Visit to Environment Pollution Detecting Laboratory.
  5. Visit to Cooling towers in industries.
  6. Visit to Rain Water Harvesting System.
  7. Visit to Biogas Plant.
  8. Visit to Green Building/Ecotel Hotel.
  9. Visit to Water Filtration Plant.
  10. Visit to office of Pollution Control Board.
  11. Visit to Greenhouse.
  12. Visit to Solid Waste Management Plant.
  13. Visit to hydro/thermal power plants.
  14. Visit to Environmental Agencies-CITES
  15. Visit to National Parks, Sanctuaries, Biosphere Reserves etc. in Maharashtra/India/abroad.
  16. Visit to NEERI.
  17. Visit to Enviro Vigil, CSM Hospital Campus, Kalwa (W), Thane.

## REFERENCES

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- An Advanced Textbook on Biodiversity, K.V. Krishnamurthy, Oxford & IBH Publishing Co. Pvt. Ltd. 2009.
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- Text book of Environmental Chemistry & Pollution Control. Revised edition, Dara S.S. & Mishra D.D., S. Chand Publications.
- Waste Water Treatment for Pollution Control, Soli J. Arcivala, TMH 1986.
- Water & Water Pollution Handbook, L.L. Caccio, Marcel Dekker Inc. N.Y. 1971.
- Wildlife photography- Advanced field techniques for amazing images, Classen, Joe.

**SCHEME OF EXAMINATION (FOR BOTH SEMESTERS)**

**Internal examination**

The first internal class test comprising of 20 marks shall consist of 20 multiple choice questions with equal weightage.

The second class test of 20 marks will be in the form of an assignment that the student shall submit on notification.

**Question paper pattern for external theory**

Total: 60 marks

**Note: 1. All questions to be attempted from Q.1 to Q.5**

Q.1 Based on Unit I..... 12 M

a,b,c- Attempt any two questions out of three

Q.2 Based on Unit II.....12M

a,b,c- Attempt any two questions out of three

Q.3 Based on Unit III.....12M

a,b,c- Attempt any two questions out of three

Q.4 Based on Unit IV.....12M

a,b,c- Attempt any two questions out of three

Q.5 Short notes (Mixed from all units two questions from each unit)..... 12M (3M each)

Eight short notes of which the student is expected to attempt any four

**Practical Skeleton Paper Semester V**

**Maximum Marks: 100  
20**

**Q1. Identification:**

Identify spots 'a' to 'e' as per instructions

- Identify and describe the plant and its role in reducing pollution. (*Adiantum*, *Cactus*, *Chlorophytum*,  
• *Pachira*). (any two)
- Study of air and noise pollution monitoring devices-sound level meter, photoionization detector (any one).
- Identify and describe the picture and give application of alternative energy resources (Solar panel, Biogas plant, Photovoltaic cell, Windmill) (any two)

**Major Experiment**

**Q2.** Estimate Biological Oxygen Demand/Chemical Oxygen Demand from the given effluent samples (2) and submit the report. **25**

**Minor Experiment**

**Q3.** Estimate Dissolved Oxygen from the given water sample and submit the report. **15**  
**OR**

**Q3. a.** Determine the intensity of light using Lux meter. **08**  
**b.** Estimate the conductivity of the given sample. / Determine the MPN of the given water sample. **07**

**Q4. a.** Submission of five environment related original photographs. **10**  
**b.** Submission of assignment & viva based on it. **20**

**Q5.** Certified journal. **10**

**Practical Skeleton Paper Semester VI**

**Maximum Marks: 100**

**Q1. Identification:**

**15 M**

Identify spots 'a' to 'c' as per instructions

- a. Identify logistic services for medical, toxic waste (incinerator, Autoclave) (Any one)
- b. Identify and describe the given indicator species (river otters, lichen, northern spotted owl) (Any two)

**Major experiment**

**Q2.** Estimate organic matter content from the given sample and submit a report. **25**

**OR**

**Q2.** Estimate calcium carbonate content from the given sample and submit a report.

**OR**

**Q2.** Investigate the given sample and report about the presence of any (or all) of the following heavy metal cations:-Pb (II) from the given water sample.

**Minor experiment**

**Q3.** Analyse the texture and moisture content of the given soil sample and submit a report. **20**

Q4. Project and viva based on it.

**20**

Q5. Field report.

**10**

Q6. Certified journal.

**10**



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**Refer to page nos: 02 and 03  
highlighting component**

**Syllabus for the T.Y.B.Sc. of Research Project/Field Project**

**Program: B.Sc. BOTANY**

**Program Code: RJSUBOT**

**(CBCS 2020-2021)**

**T.Y.B.Sc Botany Syllabus Semester V & VI****DISTRIBUTION OF TOPICS AND CREDITS****T.Y.B.Sc. BOTANY SEMESTER V**

Course	Nomenclature	Credits	Topics
RJSUBOT501	Plant Diversity III	2.5	1. Microbiology 2. Algae 3. Fungi 4. Plant Pathology
RJSUBOT502	Plant Diversity IV	2.5	5. Palaeobotany 6. Angiosperms I 7. Anatomy I 8. Palynology
RJSUBOT503	Form and Function III	2.5	9. Cytology and Molecular Biology. 10. Physiology 11. Environmental Botany 12. Plant Tissue Culture
RJSUBOT504	Current Trends in Plant Sciences II	2.5	13. Ethnobotany and Mushroom Industry 14. Biotechnology I 15. Instrumentation 16. Pharmacognosy and Medicinal botany
RJSUBOTP501, RJSUBOTP502, RJSUBOTP503 &RJSUBOTP504	Practical I, II, III & IV	06	



**T.Y.B.Sc. BOTANY SEMESTER VI**

Course	Nomenclature	Credits	Topics
RJSUBOT601	Plant Diversity III	2.5	1. Bryophyta 2. Pteridophyta 3. Bryophytes and Pteridophytes: Applied Aspects. 4. Gymnosperms
RJSUBOT602	Plant Diversity IV	2.5	5. Angiosperms II 6. Anatomy II 7. Embryology 8. Biostatistics
RJSUBOT603	Form and Function III	2.5	9. Plant Biochemistry 10. Plant Physiology II 11. Genetics 12. Bioinformatics
RJSUBOT604	Current Trends in Plant Sciences II	2.5	13. Plant Biotechnology II 14. Plant Geography 15. Economic Botany 16. Post-Harvest Technology
RJSUBOT601, RJSUBOT602, RJSUBOT603 &RJSUBOT604	Practical I, II, III & IV	06	

**T.Y.B.Sc Botany Syllabus Semester V & VI**

<b>SEMESTER V (THEORY)</b>		<b>L</b>	<b>Cr</b>
<b>Paper-I: PLANT DIVERSITY- III</b>		<b>Paper Code: RJSUBOT501</b>	
		60	2.5
<b>UNIT I</b>		15	
<b>Microbiology</b>			
1	Types of Microbes.		
2	Culturing: Sterilization, media- types and composition, staining, colony characters.		
3	Pure cultures.		
4	Role of microbes in fermentation: Alcohol and Antibiotics- Penicillin		
<b>UNIT II</b>		15	
<b>ALGAE</b>			
1	Division Rhodophyta: Outline Classification upto order as per G. M. Smith. General Characters based on: Distribution, Cell structure, pigments, reserve food, range of thallus, reproduction: asexual and sexual. Economic Importance of Rhodophytes.		
2	<i>Polysiphonia</i> – Systematic position, Life cycle and Alternation of generations.		
3	Division Chrysophyta: Outline Classification upto class as per G. M. Smith. General Characters of Xanthophyceae based on: Distribution, Cell structure, pigments, reserve food, range of thallus, reproduction: asexual and sexual. Economic Importance of Chrysophyta.		
4	<i>Vaucheria</i> : Systematic position, Life cycle and Alternation of generations.		
<b>UNIT III</b>		15	
<b>FUNGI</b>			
1	Basidiomycetes: Outline Classification upto order as per G. M. Smith. General Characters based on: Thallus, Reproduction.		
2	<i>Agaricus</i> - Systematic position, Life cycle and Alternation of generations.		
3	<i>Puccinia</i> - Systematic position, Life cycle and Alternation of generations.		
4	Deuteromycetes: Outline Classification upto order as per G. M. Smith. General Characters.		
5	Life cycle of <i>Alternaria</i> .		

**T.Y.B.Sc Botany Syllabus Semester V & VI**

<b>UNIT IV</b>		15	
<b>PLANT PATHOLOGY</b>			
1	Study of plant diseases: Causative organism, symptoms, predisposing factors, disease cycle and control measures of the following: a) White Rust – <i>Albugo</i> sp. b) Tikka disease of ground nut: <i>Cercospora</i> sp. c) Citrus canker – <i>Xanthomonas</i> sp. d) Leaf curl – leaf curl virus. e) Plant disease caused by insect pest- Aphids		
2	Study of Physical, chemical and biological control methods of plant diseases.		
<b>SEMESTER V (THEORY)</b>		<b>L</b>	<b>Cr</b>
<b>Paper-II: PLANT DIVERSITY- IV</b>		<b>Paper Code: RJSUBOT502</b>	60
		60	2.5
<b>UNIT I</b>		15	
<b>PALAEOBOTANY</b>			
1	<i>Calamites</i> – All form genera Stem, leaf, male and female fructification.		
2	<i>Lepidodendron</i> –All form genera root, stem, bark, leaf, male and female fructification.		
3	<i>Lyginopteris</i> –All form genera root, stem, and leaf, male and female fructification.		
4	<i>Pentoxylon</i> –All form genera.		
5	Contributions of Birbal Sahni, (Birbal Sahni Institute of Palaeobotany, Lucknow).		
<b>UNIT II</b>		15	
<b>ANGIOSPERMS- I</b>			
1	Morphology of fruits- Simple, Aggregate and Composite.		
2	Complete classification of Bentham and Hooker (only for prescribed families), Merits and demerits.		
3	Bentham and Hooker's system of classification for flowering plants up to family with respect to the following prescribed families and economic and medicinal importance for members of the families: a) Capparidaceae b) Umbelliferae c) Cucurbitaceae d) Rubiaceae e) Solanaceae f) Commelinaceae g) Graminae		

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<b>UNIT III</b>		15	
<b>ANATOMY – I</b>			
1	Anomalous secondary growth in the Stems of <i>Bignonia</i> , <i>Salvadora</i> , <i>Achyranthes</i> , <i>Aristolochia</i> , <i>Dracaena</i> . Storage roots of Beet, Radish.		
2	Root- stems transition.		
3	Types of Stomata – Anomocytic, Anisocytic, Diacytic, Paracytic, and Gramineous.		
<b>UNIT IV</b>		15	
<b>PALYNOLOGY</b>			
1	Pollen Morphology.		
2	Pollen viability – storage.		
3	Germination and growth of pollen.		
4	Application of Palynology in honey industry, coal and oil exploration, Aerobiology and pollen allergies, forensic science.		
		<b>L</b>	<b>Cr</b>
<b>Paper-III: FORMS AND FUNCTIONS – III</b>		<b>Paper Code: RJSUBOT503</b>	60 2.5
<b>UNIT I</b>		15	
<b>CYTOLOGY AND MOLECULAR BIOLOGY</b>			
1	Structure and functions of nucleus.		
2	Structure and functions of vacuole.		
3	Structure and functions of giant chromosomes.		
4	The genetic code: Characteristics of the genetic code.		
5	Transcription and Translation in Prokaryotes and Eukaryotes.		
<b>UNIT II</b>		15	
<b>PHYSIOLOGY</b>			
1	Mineral Nutrition in plants		
2	Transpiration and stomatal movement		
3	Solute transport: Transport of ions across cell membranes, active and passive transport, carriers, channels and pumps.		
4	Translocation of solutes: Composition of phloem sap, girdling experiment, pressure flow model, phloem loading and unloading, anatomy of sieve tube elements, mechanisms of sieve tube translocation, Munch's hypothesis.		

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<b>UNIT III</b>		15	
<b>ENVIRONMENTAL BOTANY</b>			
1	Bioremediation: Principles, factors responsible and microbial population in bioremediation.		
2	Phytoremediation: Metals, Organic pollutants.		
3	Plant succession: Hydrosere and Xerosere –Succession on water and barren land respectively citing different seres leading upto the climax vegetation, mono- and poly- climax theories.		
<b>UNIT IV</b>		15	
<b>PLANT TISSUE CULTURE</b>			
1	Aspects of micropropagation with reference to Floriculture: Detailed study of Orchid cultivation.		
2	Plant cell suspension cultures for the production of secondary metabolites, with special reference to Shikonin production.		
3	Somatic embryogenesis and artificial seeds: General account based on- a) Types and Technique. b) Advantages/Importance.		
4	Protoplast fusion and Somatic hybridization: a) Concept, definition, and various methods of protoplast fusion b) Applications of somatic hybridization in agriculture.		
		<b>L</b>	<b>Cr</b>
<b>Paper-IV: CURRENT TRENDS IN PLANT SCIENCES- II</b>		<b>Paper Code: RJSUBOT504</b>	60 2.5
<b>UNIT I</b>		15	
<b>ETHNOBOTANY AND MUSHROOM INDUSTRY</b>			
1	<b>Ethnobotany</b> - Definition, history, sources of data and methods of study.		
2	<b>Traditional medicines</b> as used by tribal in Maharashtra towards: a) Skin ailments: <i>Rubia cordifolia</i> , <i>Santalum album</i> . b) Liver ailments: <i>Phyllanthus</i> , <i>Andrographis</i> . c) Wound healing and ageing: <i>Centella</i> , <i>Typha</i> , <i>Terminalia</i> , <i>Tridax</i> . d) Fever: <i>Vitex negundo</i> , <i>Tinospora cordifolia</i> leaves e) Diabetes: <i>Momordica charantia</i> , <i>Syzygium cuminii</i> .		
3	<b>Mushroom industry:</b> i) General account of production of mushrooms with respect to methods of Composting, spawning, casing, harvesting of mushroom. Cultivation of <i>Pleurotus</i> , <i>Agaricus</i> mushroom to be studied in detail. ii) General account of mushrooms: Nutritional value, picking and packaging, economic importance. iii) Entrepreneurship in Mushroom Industry		

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<b>UNIT II</b>		15	
<b>BIOTECHNOLOGY - I</b>			
1	Construction of genomic DNA libraries, Chromosome libraries and c- DNA libraries.		
2	Identification of specific cloned sequences in c-DNA libraries and Genomic libraries.		
3	Analysis of genes and gene transcripts – Restriction enzyme, analysis of cloned DNA sequences.		
4	Southern Hybridization.		
<b>UNIT III</b>		15	
<b>INSTRUMENTATION</b>			
1	Microscopy II- Instrumentation, working, principle and applications of SEM and TEM.		
2	Chromatography II: General account of Column chromatography. Principle and bedding material involved in adsorption and partition chromatography, Ion exchange chromatography, molecular sieve chromatography.		
<b>UNIT IV</b>		15	
<b>PHARMACOGNOSY AND MEDICINAL BOTANY</b>			
1	Monographs of drugs with reference to biological sources, geographical distribution, common varieties, macro and microscopic characters, chemical constituents, therapeutic uses, adulterants- <i>Strychnos</i> seeds, Clove buds, <i>Allium sativum</i> , <i>Acorus calamus</i> and <i>Curcuma longa</i> .		
<b>SEMESTER VI</b>		<b>L</b>	<b>Cr</b>
<b>Paper I: PLANT DIVERSITY- III</b>		<b>Paper Code: RJSUBOT601</b>	60
<b>Paper Code: RJSUBOT601</b>		2.5	
<b>UNIT I</b>		15	
<b>BRYOPHYTA</b>			
1	<i>Marchantia</i> - Systematic position, life cycle and Alternation of generations as per G. M. Smith.		
2	<i>Pellia</i> - Systematic position, life cycle and Alternation of generations as per G. M. Smith.		
<b>UNIT II</b>		15	
<b>PTERIDOPHYTA</b>			
1	Lepidophyta – Outline Classification upto orders as per G. M. Smith.		
2	General characters of Lepidophyta.		
3	<i>Lycopodium</i> - Systematic position, Life cycle, Alternation of generations.		

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4	Calamophyta – Outline Classification upto orders as per G. M. Smith.		
5	General characters of Calamophyta		
6	<i>Equisetum</i> : Systematic position, Life cycle, Alternation of generations.		
<b>UNIT III</b>		15	
<b>BRYOPHYTES AND PTERIDOPHYTES: APPLIED ASPECTS</b>			
1	Ecology of Bryophytes.		
2	Economic importance of Bryophytes.		
3	Bryophytes as ecological indicators. Evolution of Sporophyte and Gametophyte in Bryophytes.		
4	Economic importance of Pteridophytes.		
5	Diversity and distribution of Indian Pteridophytes.		
6	Types of sori and evolution of sori.		
<b>UNIT IV</b>		15	
<b>GYMNOSPERMS</b>			
1	<i>Biota (Thuja)</i> - Systematic position as per Coulter and Chamberlain, Life cycle, Alternation of generations.		
2	<i>Gnetum</i> -Systematic position as per Coulter and Chamberlain, Life cycle, Alternation of generations.		
3	<i>Ephedra</i> -Systematic position as per Coulter and Chamberlain, Life cycle, Alternation of generations.		
		<b>L</b>	<b>Cr</b>
<b>Paper II: PLANT DIVERSITY - IV</b>		<b>Paper Code: RJSUBOT602</b>	60
		2.5	
<b>UNIT I</b>		15	
<b>ANGIOSPERMS- II</b>			
1	Major Botanical gardens of India – Indian Botanical Garden, Howrah; National Botanical Research Institute's Garden (NBRI), Lucknow; Lloyd Botanical Garden, Darjeeling; Lalbaugh or Mysore State Botanical Garden, Bangalore.		
2	Botanical survey of India and regional plants of India.		
3	Study of following plant families: a) Rhamnaceae b) Combretaceae c) Asclepiadaceae d) Labiatae e) Euphorbiaceae		

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	f) Cannaceae		
4	Hutchinson's classification – merits and demerits.		
<b>UNIT II</b>		15	
<b>ANATOMY – II</b>			
1	Ecological anatomy: a) Hydrophytes – submerged, floating rooted. b) Hygrophytes - <i>Typha</i> c) Mesophytes. d) Sciophytes. e) Halophytes. f) Epiphytes. g) Xerophytes.		
<b>UNIT III</b>		15	
<b>EMBRYOLOGY</b>			
1	Microsporogenesis		
2	Megasporogenesis - Development of monosporic type, examples of all embryo sacs.		
3	Types of ovules.		
4	Double fertilization.		
5	Development of embryo – <i>Capsella</i> .		
<b>UNIT IV</b>		15	
<b>BIOSTATISTICS II</b>			
1	Testing of hypothesis- student's <i>t</i> -test (paired and unpaired). Theory and Problems based on these.		
2	Regression- Theory and Graphical method only.		
3	ANOVA (one way).		



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		<b>L</b>	<b>Cr</b>	
<b>PAPER III: FORM AND FUNCTION - III</b>		<b>Paper Code: RJSUBOT603</b>	60	2.5
<b><i>UNIT I</i></b>		15		
<b><i>PLANT BIOCHEMISTRY</i></b>				
1	Structure of biomolecules: Carbohydrates (sugars, starch, cellulose, pectin, lipids (fatty acids and glycerol), proteins (amino acids).			
2	Enzymes: Nomenclature, classification, mode of action, Enzyme kinetics, Michaelis - Menten equation, competitive non-competitive and uncompetitive inhibitors.			
<b><i>UNIT II</i></b>		15		
<b><i>PLANT PHYSIOLOGY- II</i></b>				
1	Nitrogen metabolism: Nitrogen cycle, root nodule formation, and leg haemoglobin, nitrogenase activity, assimilation of nitrates, (NR, NiR activity), assimilation of ammonia, (amination and transamination reactions), nitrogen assimilation and carbohydrate utilisation.			
2	Vegetative growth- Phases of growth, Factors affecting growth, Physiological effects and commercial applications of Auxins, Gibberillins, Cytokinins and Abscisic acid.			
<b><i>UNIT III</i></b>		15		
<b><i>GENETICS</i></b>				
1	Genetic mapping in eukaryotes: discovery of genetic linkage, gene recombination, construction of genetic maps, three-point crosses and mapping chromosomes, problems based on the same.			
2	Gene mutations: definition, types of mutations, causes of mutations, Spontaneous and Induced mutations and The Ame's test.			
3	Metabolic disorders – enzymatic and non-enzymatic: Gene control of enzyme structure Garrod's hypothesis of inborn errors of metabolism, Phenylketoneuria, albinism, sickle cell anaemia.			
<b><i>UNIT IV</i></b>		15		
<b><i>BIOINFORMATICS</i></b>				
1	Protein structure analysis and application.			
2	Multiple sequence analysis and phylogenetic analysis.			

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		<b>L</b>	<b>Cr</b>	
<b>Paper IV: Current Trends in Plant Sciences II</b>		<b>Paper Code: RJSUBOT604</b>	60	2.5
<b>UNIT I</b>		15		
<b>PLANT BIOTECHNOLOGY - II</b>				
1	DNA sequence analysis – Maxam – Gilbert Method and Sanger's method			
2	Polymerase Chain reaction (PCR) - Technique, Applications, DNA typing.			
3	DNA barcoding: Basic features, nuclear genome sequence, chloroplast genome sequence, <i>rbcL</i> gene sequence, <i>matK</i> gene sequence, present status of barcoding in plants.			
<b>UNIT II</b>		15		
<b>PLANT GEOGRAPHY</b>				
1	Phytogeographical regions of India.			
2	BIODIVERSITY : Definition, diversity of flora found in various forest types of India, Levels of biodiversity, Importance and status of biodiversity, Loss of biodiversity, Conservation of biodiversity, Genetic diversity- Molecular characteristics.			
<b>UNIT III</b>		15		
<b>ECONOMIC BOTANY</b>				
1	Essential Oils: Extraction, perfumes, perfume oils, oil of Rose, Patchouli, Champaca, grass oils: <i>Citronella</i> , Vetiver.			
2	Fatty oils: Drying oil (linseed and Soyabean oil), semidrying oils (Cotton seed, Sesame oil) and non-drying oils (Olive oil and Peanut oil).			
3	Vegetable Fats: Coconut and Palm oil.			
<b>UNIT IV</b>		15		
<b>POST HARVEST TECHNOLOGY</b>				
1	Storage of Plant Produce- Preservation of Fruits and Vegetables.			
2	Drying (Dehydration)- (Natural conditions – Sun drying; Artificial drying- hot air drying, Vacuum drying, Osmotically dried fruits, Crystallized or Candied fruits, Fruit Leather, Freeze Drying).			
3	Freezing (Cold air blast system, Liquid immersion method, Plate freezers, Cryogenic Freezing, Freeze drying).			
4	Canning. Pickling (in brine, in vinegar, Indian pickles). Sugar Concentrates (Jams, Jellies), Fruit juices.			
5	Food preservatives, Use of antioxidants in preservation			

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Semester V (PRACTICALS)		L	Cr
<b>Practical I PLANT DIVERSITY- III</b>		<b>Paper Code: RJSUBOTP501</b>	
	<b>Microbiology</b>		2.5
1	Study of aeromicrobiota by petri plate exposed method Fungal culture; Bacterial culture.		
2	Determination of Minimum Inhibitory Concentration (MIC) of sucrose against selected microorganism.		
3	Study of antimicrobial activity by the disc diffusion method		
	<b>Algae</b>		
1	Study of stages in the life cycle of the following Algae from fresh / preserved material and permanent slides: a) <i>Polysiphonia</i> b) <i>Vaucheria</i>		
	<b>Fungi</b>		
1	Study of stages in the life cycle of the following Fungi from fresh / preserved material and permanent slides: a) <i>Agaricus</i> b) <i>Puccinia</i> c) <i>Alternaria</i>		
	<b>Plant Pathology</b>		
	Study of the following fungal diseases: a) White rust b) Tikka disease in Groundnut c) Citrus canker d) Insect Pest disease- Aphids		
<b>Practical II : PLANT DIVERSITY- IV</b>		<b>Paper Code: RJSUBOTP502</b>	
	<b>Paleobotany</b>		2.5
	Study of the following form genera with the help of permanent slides/ photomicrographs: a) <i>Calamites</i> b) <i>Lepidodendron</i> c) <i>Lyginopteris</i> d) <i>Pentoxylon</i>		
	<b>Angiosperms</b>		
1	Morphology of Fruits- Simple, Aggregate and Composite.		
2	Study of one plant from each of the following Angiosperm families: a) Capparidaceae b) Umbelliferae c) Cucurbitaceae d) Rubiaceae e) Solanaceae f) Commelinaceae		

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	g) Graminae		
3	Morphological peculiarities and economic importance of the members of the above-mentioned Angiosperm families.		
4	Identifying the genus and species of a plant with the help of Flora.		
	<b>Anatomy I</b>		
1	Study of anomalous secondary growth in the stems of the following plants using double staining technique: a) <i>Bignonia</i> b) <i>Salvadora</i> c) <i>Achyranthes</i> d) <i>Aristolochia</i> e) <i>Dracaena</i>		
2	Study of anomalous secondary growth in the roots of- a) Beet b) Radish		
3	Types of Stomata - a) Anomocytic b) Anisocytic c) Diacytic d) Paracytic e) Graminaceous		
	<b>Palynology</b>		
1	Study of pollen morphology (NPC Analysis) of the following by Chitale's Method: a) <i>Hibiscus</i> b) <i>Datura</i> c) <i>Ocimum</i> d) <i>Crinum</i> e) <i>Paneratium</i> f) <i>Canna</i>		
2	Determination of pollen viability.		
3	Pollen analysis from honey sample – unifloral and multifloral honey.		
4	Effect of varying concentration of sucrose on <i>In vitro</i> Pollen germination.		
<b>Practical III - Form and Function - II</b>		<b>Paper Code: RJSUBOTP503</b>	2.5
	<b>CYTOLOGY AND MOLECULAR BIOLOGY</b>		
1	Smear preparation from <i>Tradescantia</i> buds.		
2	Sequence Analysis- Maxam-Gilbert Method		

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	<b><u>PHYSIOLOGY</u></b>		
1	Estimation of Phosphate phosphorus (Plant acid extract).		
2	Estimation of Iron (Plant acid extract).		
	<b><u>ENVIRONMENTAL BOTANY</u></b>		
1	Estimation of the following in given water sample: a) Dissolved oxygen demand b) Biological oxygen demand c) Total Hardness d) Salinity and Chlorinity		
2	<b>Plant Tissue culture II:</b>		
	1. Preparation of stock solutions for preparation of MS medium.		
	2. Identification – Multiple shoot culture, hairy root culture, somatic embryogenesis.		
	<b>Practical IV-<u>CURRENT TRENDS IN PLANT SCIENCES - II</u></b>	<b>Paper Code: RJSUBOTP504</b>	2.5
	<b><u>ETHNOBOTANY AND MUSHROOM CULTIVATION</u></b>		
1	Study of plants mentioned in theory for Ethnobotany.		
2	Mushroom cultivation		
3	Identification of various stages involved in mushroom cultivation – spawn, pin head stage, mature/ harvest stage of <i>Agaricus</i> , <i>Pleurotus</i> .		
	<b><u>BIOTECHNOLOGY- I</u></b>		
1	Growth curve of <i>E. coli</i> .		
2	Plasmid DNA isolation and Separation of DNA using AGE.		
3	Restriction mapping (problems), Southern blotting.		
	<b><u>INSTRUMENTATION</u></b>		
1	Experiment based on ion exchange chromatography for demonstration.		
2	Experiment based on separation of dyes/ plant pigments using silica gel column.		
	<b><u>PHARMACOGNOSY</u></b>		
1	Macroscopic/ Microscopic characters and Chemical tests for active constituents of the following plants: a) <i>Allium sativum</i> b) <i>Acorus calamus</i> c) <i>Curcuma longa</i> d) <i>Strychnos nux-vomica</i> e) <i>Eugenia caryophyllata</i>		
	<b>SEMESTER VI (PRACTICALS)</b>		

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<b>Practical I - PLANT DIVERSITY- III</b>		<b>Paper Code: RJSUBOTP601</b>		2.5
	<b>Bryophyta</b>			
1	Study of stages in the life cycle of the following Bryophyta from fresh / preserved material and permanent slides a) <i>Marchantia</i> b) <i>Pellia</i>			
	<b>Pteridophyta</b>			
1	Study of stages in the life cycles of the following Pteridophytes from fresh / preserved material and permanent slides :- a) <i>Lycopodium</i> b) <i>Equisetum</i>			
	<b>Bryophytes and Pteridophytes: Applied aspects</b>			
1	Economic importance of Bryophytes.			
2	Economic importance of Pteridophytes.			
3	Types of sporophytes in Bryophytes (from Permanent slides).			
4	Types of sori and soral arrangement in Pteridophytes.			
	<b>Gymnosperms</b>			
1	Study of stages in the life cycles of the following Gymnosperms from fresh / preserved material and permanent slides: a) <i>Thuja/ Biota</i> b) <i>Gnetum</i> c) <i>Ephedra</i>			
<b>Practical - II : PLANT DIVERSITY- IV</b>		<b>Paper Code: RJSUBOTP602</b>		2.5
	<b>Angiosperms</b>			
1	Study of one plant from each of the following Angiosperm families: a) Rhamnaceae b) Combretaceae c) Asclepiadaceae d) Labiatae e) Euphorbiaceae f) Cannaceae			
2	Morphological peculiarities and economic importance of the members of the above-mentioned Angiosperm families.			
3	Identify the genus and species with the help of flora.			

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	<b>Anatomy</b>		
1	Study of Ecological Anatomy of : a) Hydrophytes: <i>Hydrilla</i> stem, <i>Nymphaea</i> petiole, <i>Eichhornia</i> offset b) Epiphytes: Orchid c) Sciophytes: <i>Peperomia</i> leaf d) Xerophytes: <i>Nerium</i> leaf, <i>Opuntia</i> phylloclade e) Halophytes: <i>Avicennia</i> leaf and pneumatophore, <i>Sesuvium</i> / <i>Sueda</i> leaf f) Mesophytes: <i>Vinca</i> leaf		
	<b>Embryology</b>		
1	Study of various stages of Microsporogenesis, Megasporogenesis and Embryo Development with the help of permanent slides / photomicrographs.		
2	Mounting of Monocot (Maize) and Dicot (Castor and Gram) embryo.		
3	<i>In vivo</i> growth of pollen tube in <i>Portulaca</i> / <i>Vinca</i> .		
	<b>Biostatistics II</b>		
1	<i>t</i> -test (paired and unpaired).		
2	Problems based on regression analysis.		
3	ANOVA.		
<b>Practical- III FORM AND FUNCTION –III</b>		<b>Paper Code: RJSUBOTP603</b>	2.5
	<b>PLANT BIOCHEMISTRY</b>		
1	Estimation of proteins by Biuret method.		
2	Effect of pH on the activity of amylase.		
3	Effect of substrate variation on the activity of amylase.		
	<b>PLANT PHYSIOLOGY</b>		
1	Determination of alpha-amino nitrogen.		
2	Effect of GA on seed germination.		
3	Estimation of reducing sugars by DNSA method.		
	<b>GENETICS</b>		
1	Problems based on three-point crosses, construction of chromosome maps.		
2	Identification of types of mutations from given DNA sequences.		
3	Study of mitosis using pre-treated root tips of <i>Allium</i> .		
	<b>Bioinformatics</b>		

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1	Protein structure analysis and application		
2	Multiple sequence analysis and phylogenetic analysis		
<b>Practical- IV : CURRENT TRENDS IN PLANT SCIENCES- II</b>		<b>Paper Code: RJSUBOTP604</b>	
	<b>PLANT BIOTECHNOLOGY II</b>		
1	DNA sequencing - Maxam-Gilbert Method.		
2	DNA barcoding of plant material by using suitable data.		
	<b>Plant Geography</b>		
1	Study of Phytogeographical regions of India.		
2	Preparation of vegetation map using Garmin's GPS Instrument.		
3	Problems based on Simpson's diversity Index.		
	<b>Economic Botany</b>		
1	Demonstration: Extraction of essential oil using Clevenger.		
2	Thin layer chromatography of essential oil of Patchouli and <i>Citronella</i> .		
3	Saponification value of Palm oil.		
	<b>Post-Harvest Technology</b>		
1	Preparation of: a) Squash b) Jam c) Jelly d) Pickle.		



T.Y.BSc	Semester V Theory
RJSUBOT501 Paper I Plant Diversity III	<p>Course Outcomes 5.1:</p> <ol style="list-style-type: none"> <li>1. Microbiology studies – various microbes, media type and composition, staining, colony characters.</li> <li>2. Pure cultures and Role of microbes in fermentation.</li> <li>3. Detailed study of algae (<i>Rhodophyta</i> and <i>Xanthophyta</i>) and fungi (Basidiomycetes and Deuteromycetes)</li> <li>4. Study of Systematic position, Life cycle and Alternation of generations of algae (<i>Polysiphonia</i>, and <i>Vaucheria</i>) and fungi (<i>Agaricus</i>, <i>Puccinia</i> and <i>Alternaria</i>.)</li> <li>5. Study of plant diseases and Physical, chemical and biological control methods of plant diseases.</li> </ol> <p>Learning outcomes:</p> <ul style="list-style-type: none"> <li>➤ Microbiology studies.</li> <li>➤ Understanding classical botany and application.</li> <li>➤ Knowing the cause and control of plant diseases.</li> </ul>

T.Y.BSc	Semester V Theory
RJSUBOT502 Paper II Plant diversity- IV	<p>Course Outcomes 5.2:</p> <ol style="list-style-type: none"> <li>1. Exploring palaeobotany with studies of <i>Calamites</i>, <i>Lepidodendron</i>, <i>Lyginopteris</i>, <i>Pentoxylon</i> and contributions of Birbal Sahni (Birbal Sahni Institute of Paleobotany, Lucknow.)</li> <li>2. Detailed study of Morphology of flower, Complete classification of Bentham and Hooker: Merits and demerits, system of classification for flowering plants up to family of Capparidaceae, Umbelliferae, Cucurbitaceae, Rubiaceae, Solanaceae, Commelinaceae and Graminae.</li> <li>3. Study of anomalous secondary growth in the stems, root- stem transition and types of stomata.</li> <li>4. Study of pollen morphology, viability, germination and growth of pollen and application of Palynology.</li> </ol> <p>Learning outcomes:</p> <ul style="list-style-type: none"> <li>➤ Understanding the past environment with the help of palaeobotany.</li> <li>➤ Learning of Bentham and Hooker classification.</li> <li>➤ Knowing the anomalous secondary growth reinforcement of tall plants</li> <li>➤ Understanding the pollen specificity.</li> </ul>

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T.Y.BSc	Semester V Theory
RJSUBOT503 Paper-III Forms and functions – III	<p>Course Outcomes 5.3:</p> <ol style="list-style-type: none"> <li>1. Detailed study of nucleus, vacuole and functions of giant chromosomes.</li> <li>2. Mechanism of Transcription and Translation in Eukaryotes and Characteristics of the genetic code.</li> <li>3. Understanding Plant- Water relations with Solute transport and Translocation.</li> <li>4. Study of bioremediation and Phytoremediation.</li> <li>5. Study of plant succession.</li> <li>6. Understanding the role of micropropagation in plant cell suspension, secondary metabolites, Somatic embryogenesis, artificial seeds, Protoplast fusion and Somatic hybridization.</li> </ol> <p>Learning outcomes: ( Research orientation, skill development)</p> <ul style="list-style-type: none"> <li>➤ Basic concepts of molecular biology.</li> <li>➤ Understanding solute transport and translocation in plant.</li> <li>➤ Use of bioremediation and Phytoremediation.</li> <li>➤ Application of plant tissue culture and micropropagation.</li> </ul>

T.Y.Bsc	Semester V theory
RJSUBOT504 Paper-iv Current trends in plant science- II	<p>Course outcomes 5.4:</p> <ol style="list-style-type: none"> <li>1. Detailed study of ethno botany and traditional medicines.</li> <li>2. Exploring mushroom cultivation and its nutritional value.</li> <li>3. Understanding c- DNA libraries, restriction enzyme, analysis of cloned DNA sequences and southern hybridization.</li> <li>4. Detailed study of instrumentation techniques colorimetry, spectrophotometry (visible, UV and IR), column chromatography, adsorption and partition chromatography, ion exchange chromatography, molecular sieve chromatography</li> <li>5. Pharmacognosy study of <i>Strychnos</i> seeds, Clove buds, <i>Allium sativum</i>, <i>Acorus calamus</i> and <i>Curcuma longa</i>.</li> </ol> <p>Learning outcome: ( Skill development and entrepreneurship)</p> <ul style="list-style-type: none"> <li>➤ Understanding ethno botany and traditional medicines.</li> <li>➤ Motivation of Entrepreneurship in mushroom cultivation.</li> <li>➤ Basic concept of molecular biology.</li> <li>➤ Learning analytical techniques.</li> <li>➤ Pharmacognosy study.</li> </ul>

**T.Y.B.Sc Botany Syllabus Semester V & VI**

T.Y.BSc	Semester V Practical Skill development
RJSUBOTP501 Practical I Plant Diversity III	<p>Course Outcomes 5.1:</p> <ol style="list-style-type: none"> <li>1. Detailed study of Aeromicrobiota, Minimum Inhibitory Concentration (MIC) and antimicrobial activity.</li> <li>2. Study of stages in the life cycle algae (<i>Polysiphonia</i>, and <i>Vaucheria</i>) and fungi (<i>Agaricus</i>, <i>Puccinia</i> and <i>Alternaria</i>).</li> <li>3. Detailed study of the fungal diseases (White rust, Tikka disease in Groundnut and Citrus canker.</li> </ol> <p>Learning outcomes:</p> <ul style="list-style-type: none"> <li>➤ Microbiology study.</li> <li>➤ Understanding classical botany and its application.</li> <li>➤ Detailed study of causative agent of plant diseases.</li> </ul>

T.Y.BSc	Semester V Practical Skill development, experiential learning, planning.
RJSUBOTP502 Practical II PLANT DIVERSITY- IV	<p>Course Outcomes 5.2:</p> <ol style="list-style-type: none"> <li>1. Study of palaeobotany with studies of <i>Calamites</i>, <i>Lepidodendron</i>, <i>Lyginopteris</i> and, <i>Pentoxylon</i>.</li> <li>2. Detailed study of <i>Capparidaceae</i>, <i>Umbelliferae</i>, <i>Cucurbitaceae</i>, <i>Rubiaceae</i>, <i>Solanaceae</i>, <i>Commelinaceae</i> and <i>Graminae</i>.</li> <li>3. Identifying the genus and species of a plant with the help of Flora.</li> <li>4. Study of anomalous secondary growth with double staining in the stems (<i>Bignonia</i>, <i>Salvadora</i>, <i>Achyranthes</i>, <i>Aristolochia</i> and <i>Dracaena</i>) and roots of beet and radish.</li> <li>5. Study of types of stomata.</li> <li>6. Study of pollen morphology (NPC analysis), viability and effect of varying concentration of sucrose on <i>In vitro</i> pollen germination and pollen analysis from honey sample.</li> </ol> <p>Learning outcomes:</p> <ul style="list-style-type: none"> <li>➤ Understanding the past environment with the help of palaeobotany.</li> <li>➤ Learning of Angiosperm's taxonomy.</li> <li>➤ Learning of double staining technique.</li> <li>➤ Understanding the pollen specificity and NPC analysis.</li> </ul>

**T.Y.B.Sc Botany Syllabus Semester V & VI**

T.Y.BSc	Semester V Practical Skill based training
RJSUBOTP503 Practical III FORMS AND FUNCTIONS – III	<p>Course Outcomes 5.3:</p> <ol style="list-style-type: none"> <li>1. Study of meiosis in <i>Tradescantia</i> buds.</li> <li>2. Predicting the sequence of amino acids in the polypeptide.</li> <li>3. Estimation of Phosphate phosphorus and Iron from plant acid extract.</li> <li>4. Estimation of Dissolved oxygen demand, biological oxygen demand, Total Hardness and Salinity and Chlorinity in given water sample.</li> <li>5. Understanding plant tissue culture and preparation of stock solutions for preparation of MS medium.</li> </ol> <p>Learning outcomes:</p> <ul style="list-style-type: none"> <li>➤ Understanding the stages of meiosis and sequencing of amino acids.</li> <li>➤ Assessment of Phosphate phosphorus and Iron content in plants.</li> <li>➤ Assessment of water quality.</li> </ul>

T.Y.BSc	Semester V Practical
RJSUBOTP504 Practical IV Current trends in plant science- II	<p>Course Outcomes 5.4: Tribal knowledge, ethics, entrepreneurship, research orientation</p> <ol style="list-style-type: none"> <li>1. Study of plants for Ethnobotany.</li> <li>2. Mushroom cultivation.</li> <li>3. Analysis of Growth curve of <i>E. coli</i>.</li> <li>4. Plasmid DNA isolation and separation of DNA using AGE and understanding restriction mapping (problems), southern blotting.</li> <li>5. Analysis of sample on Beer Lambert's Law.</li> <li>6. Study of macroscopic/ microscopic characters and Chemical tests for active constituents of <i>Allium sativum</i>, <i>Acorus calamus</i>, <i>Curcuma longa</i>, <i>Strychnos nux-vomica</i> and <i>Eugenia caryophyllata</i>.</li> </ol> <p>Learning outcomes :</p> <ul style="list-style-type: none"> <li>➤ Understanding ethno botany and traditional medicines. (Understanding and application of traditional knowledge and scientific understanding).</li> <li>➤ Motivation of Entrepreneurship in mushroom cultivation.</li> <li>➤ Determination of generation time of <i>E. coli</i>.</li> <li>➤ Learning analytical techniques</li> <li>➤ Pharmacognosy study of macroscopic/ microscopic characters of the above-mentioned plants.</li> </ul>

T.Y.BSc	Semester VI Theory
RJSUBOT601 Paper 1 Plant Diversity III	<p>Course Outcomes 6.1:</p> <ol style="list-style-type: none"> <li>1. Detailed study of Bryophyta (<i>Marchantia, Peltia, Sphagnum</i>) and Pteridophyta (<i>Lepidophyta, Lycopodium, Calamophyta, Equisetum, Pterophyta</i> and <i>Marsilea</i>).</li> <li>2. Study of Bryophytes in aspect of ecology, economic importance, ecological indicators and evolution of sporophyte and gametophyte.</li> <li>3. Study of Pteridophytes economic importance, diversity and distribution, types of sori and evolution of sori.</li> <li>4. Detailed study of gymnosperms (<i>Thuja, Gnetum and Ephedra</i>) and its economic importance.</li> </ol> <p>Learning outcomes:</p> <ul style="list-style-type: none"> <li>➤ Understanding Bryophytes and Pteridophytes and their applications.</li> <li>➤ Recognising the benefits of gymnosperms.</li> </ul>

T.Y.BSc	Semester VI Theory
RJSUBOT602 Paper 2 Plant diversity- IV	<p>Course Outcomes 6.2:</p> <ol style="list-style-type: none"> <li>1. Study of major botanical gardens of India, botanical survey of India and regional plants of India.</li> <li>2. Detailed study of angiosperm families (<i>Rhamnaceae, Combretaceae, Asclepiadaceae, Labiatae, Euphorbiaceae</i> and <i>Cannaceae</i>) and Hutchinson's classification.</li> <li>3. Anatomical study of hydrophytes, hygrophytes, mesophytes, sciophytes, halophytes, epiphytes and xerophytes.</li> <li>4. Development study of Microsporogenesis and Megasporeogenesis and embryo.</li> <li>5. Analysis of data by Student's <i>t</i>-test, Regression and ANOVA (one way).</li> </ol> <p>Learning outcomes :</p> <ul style="list-style-type: none"> <li>➤ Introduction of Indian regional flora.</li> <li>➤ Detailed study of some angiosperms families.</li> <li>➤ Study of plant adaptations in different environment.</li> <li>➤ Plant development study.</li> <li>➤ Bio-statistical analysis of data.</li> </ul>

T.Y.BSc	Semester VI Theory
RJSUBOT603 Paper-III forms and functions – III	<p>Course Outcomes 6.3 :</p> <ol style="list-style-type: none"> <li>1. Study of biomolecules: Carbohydrates (sugars, starch, cellulose, pectin, lipids (fatty acids and glycerol), proteins (amino acids).</li> <li>2. Detailed study of enzymes and it's mechanism.</li> <li>3. Detailed study of plant nitrogen metabolism, vegetative growth and commercial applications PGR.</li> <li>4. Understanding eukaryotes genetic mapping, gene mutations, metabolic disorders – enzymatic and non-enzymatic.</li> <li>5. Study of bioinformatics application (BLAST, protein structure analysis and application, multiple sequence analysis and phylogenetic analysis.</li> </ol> <p>Learning outcomes:</p> <ul style="list-style-type: none"> <li>➤ Understanding macromolecules and enzymes application.</li> <li>➤ Some concept learning of plant physiology and molecular biology.</li> <li>➤ Bioinformatics application. Computational biology</li> </ul>

T.Y.BSc	Semester VI theory
RJSUBOT604 Paper-IV Current trends in plant science- II	<p>Course Outcomes 6.4:</p> <ol style="list-style-type: none"> <li>1. Detailed study of DNA sequence analysis, Polymerase Chain reaction and DNA barcoding.</li> <li>2. Study of biodiversity and Phytogeographical regions of India.</li> <li>3. Detailed study of Essential Oils, Fatty oils and Vegetable Fats.</li> <li>4. Study of post-harvest technology (storage, drying, freezing, canning and food preservatives).</li> </ol> <p>Learning outcomes:</p> <ul style="list-style-type: none"> <li>➤ Concept of molecular biology of DNA.</li> <li>➤ Knowing biodiversity and Phytogeographical regions of India.</li> <li>➤ Understanding the application of oils and fats and post-harvest technology. (Entrepreneurship)</li> </ul>

T.Y.BSc	Semester VI Practical Skill
RJSUBOTP601 Practical I Plant Diversity III	<p>Course Outcomes 6.1:</p> <ol style="list-style-type: none"> <li>1. Slide preparation/ permanent slides study of <i>Bryophyta</i> (<i>Marchantia</i>, <i>Pellia</i> and <i>Sphagnum</i>) and <i>Pteridophyta</i> (<i>Lycopodium</i> and <i>Equisetum</i>).</li> <li>2. Study of types of sporophytes in Bryophytes and sori and soral arrangement in Pteridophytes.</li> <li>3. Detailed study of gymnosperms (<i>Thuja</i>, <i>Gnetum</i> and <i>Ephedra</i>) and its economic importance.</li> </ol> <p>Learning outcome:</p> <ul style="list-style-type: none"> <li>➤ Understanding the detailed morphology of Bryophyta and Pteridophyta. To understand their role in plant succession.</li> <li>➤ Recognising the benefits of gymnosperms.</li> </ul>

T.Y.BSc	Semester VI Practical: Skill enhancement, experiential learning, Application in field studies
RJSUBOTP602 Practical II PLANT DIVERSITY- IV	<p>Course Outcomes 6.2:</p> <ol style="list-style-type: none"> <li>1. Study of angiosperm families (<i>Rhamnaceae</i>, <i>Combretaceae</i>, <i>Asclepiadaceae</i>, <i>Labiatae</i>, <i>Euphorbiaceae</i> and <i>Cannaceae</i>)</li> <li>2. Identify the genus and species with the help of flora.</li> <li>3. Anatomical sectional study of hydrophytes, mesophytes, sciophytes, halophytes, epiphytes and xerophytes.</li> <li>4. Study of various stages of Microsporogenesis and Megasporogenesis, embryo and <i>In vivo</i> growth of pollen tube</li> <li>5. Analysis of data given by Student's <i>T</i>-Test, Regression and ANOVA (one way).</li> </ol> <p>Learning outcomes :</p> <ul style="list-style-type: none"> <li>➤ Detailed study of some angiosperm families.</li> <li>➤ Anatomical study of plant adaptations in different environment.</li> <li>➤ Study of plant development stages.</li> <li>➤ Bio-statistical analysis of data.</li> </ul>

**T.Y.B.Sc Botany Syllabus Semester V & VI**

T.Y.BSc	Semester VI Practical: Skill development, research orientation, experimental design
RJSUBOTP603 Practical III FORMS AND FUNCTIONS – III	<p>Course Outcome 6.3:</p> <ol style="list-style-type: none"> <li>1. Estimation of proteins from sample.</li> <li>2. Study the effect of temperature, pH and substrate variation on the activity of amylase.</li> <li>3. Estimation of alpha-amino nitrogen, reducing sugars and Effect of GA on seed germination.</li> <li>4. Analysis of problems based on three-point crosses, construction of chromosome maps.</li> <li>5. Identification of types of mutations from given DNA sequences.</li> <li>6. Study of mitosis using pre-treated root tips of <i>Allium</i>.</li> </ol> <p>Learning outcomes :</p> <ul style="list-style-type: none"> <li>➤ Understanding enzymology application.</li> <li>➤ Nutritional value finding</li> <li>➤ Mapping of gene and construction of chromosome maps.</li> <li>➤ Mutation effect study.</li> </ul>

T.Y.BSc	Semester VI Practical : Entrepreneurship
RJSUBOTP604 Practical IV Current trends in plant science- II	<p>Course Outcomes 6.4:</p> <ol style="list-style-type: none"> <li>1. DNA sequencing and barcoding of plant material</li> <li>2. Study of Phyto geographical regions of India, vegetation map using Garmin's GPS Instrument.</li> <li>3. Analysis of problems based on Simpson's diversity Index.</li> <li>4. Distillate extraction of essential oil using Clevenger and application of thin layer chromatography.</li> <li>5. Estimation of saponification value of palm oil.</li> <li>6. Preparation of Squash, Jam, Jelly and Pickle.</li> </ol> <p>Learning outcomes :</p> <ul style="list-style-type: none"> <li>➤ Molecular identification of plant material.</li> <li>➤ Tree census study.</li> <li>➤ Distillate application in perfumery.</li> <li>➤ Entrepreneurship in post-harvest technology.</li> </ul>



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### **Scheme of Examinations**

1. Two Internals of 20 marks each. Duration 30min for each.
2. One External (Semester End Examination) of 60 marks. Duration 2 hours.
3. One Practical at the end of Semester consisting of Practical I 50 marks, Practical II 50 marks, Practical III 30 marks and Practical IV 50 marks but passing combined out of 200.
4. Minimum marks for passing Semester End Theory and Practical Exam is 40 %.
5. Student must appear at least one of the two Internal Tests to be eligible for the Semester End Examination.
6. For any KT examinations, there shall be ODD-ODD/EVEN-EVEN pattern followed.
7. Two short field excursions for habitat studies are compulsory. Field report submission is mandatory
8. Field work of not less than eight hours duration is equivalent to one period per week for a batch of 15students.
9. A candidate will be allowed to appear for the practical examinations if he/she submits a certified journal of T.Y.B.Sc. 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.
10. In case of loss of journal, a candidate must produce a certificate from the Head of the department /Institute that the practical's 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.
11. 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/ &amp; Report -20 marks

**Semester End Examination – 60 marks**

Question paper covering all units

**Evaluation of Practicals 100 marks (50 marks for each practical RJSUBOTP501, RJSUBOTP502, RJSUBOTP503, RJSUBOTP504, RJSUBOTP601, RJSUBOTP602, RJSUBOTP603 & RJSUBOTP604)****Course Semester End Examination in Semester V and VI Paper I, II, III and IV (RJSUBOT501, RJSUBOT502, RJSUBOT503, RJSUBOT504, RJSUBOT601, RJSUBOT602, RJSUBOT603 & RJSUBOT604)**

Question	Knowledge	Understanding	Application and analyses	Total marks-Per unit
<b>Unit 1</b>	06	03	03	12
<b>Unit 2</b>	06	03	03	12
<b>Unit 3</b>	06	03	03	12
<b>Unit 4</b>	06	03	03	12
<b>Short notes from topics covering all the units</b>	06	03	03	12
<b>-TOTAL- Per objective</b>	30	15	15	<b>60</b>
<b>% WEIGHTAGE</b>	50	25	25	<b>100%</b>

**Evaluation of Practicals 200 marks/Semester****SEMESTER V: (50 marks for each practical RJSUBOTP501, RJSUBOTP502, RJSUBOTP503 & RJSUBOTP504)****SEMESTER VI: RJSUBOTP601, RJSUBOTP602, RJSUBOT603 & RJSUBOTP604)**

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.

**T.Y.B.Sc Botany Syllabus Semester V & VI****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)	<b>Organization of report</b>	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)	<b>Content</b>	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)	<b>Conclusion</b>	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)	<b>References</b>	Proper references, in required format	Proper references but no format	Few references	rrrelevant references
	----Marks----	1	1	0.5	0
5%          (01)	<b>Attendance / participation</b>	Attended and participated actively	Attended and participated	Infrequent Participation	No participation
	----Marks----	1	1	0.5	0

Comments:

Name and Signature of Faculty

**T.Y.B.Sc Botany Syllabus Semester V & VI**

Mini Project Under graduate level

Dept. of Course Code \_\_\_\_\_ Date \_\_\_\_\_

UID No \_\_\_\_\_ 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.

<b>Project work and report (Parameters)</b>	<b>Marks</b>	<b>80 – 100% Excellent</b>	<b>60 -80% Good</b>	<b>40 – 60% Satisfactory</b>	<b>20 – 40% Average</b>
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

**Mapping of the course to employability/ Entrepreneurship/skill development**

<b>Class</b>	<b>Course Name</b>	<b>Course Code</b>	<b>Topic focussing on Employability/ Entrepreneurship/skill development</b>	<b>Employability/ Entrepreneurship/ Skill development</b>	<b>Specific activity</b>
T Y B Sc Botany	Pant Diversity III & IV	RJSUBOT501, RJSUBOT502	Plant Diversity III, IV focuses on identification of plants ranging from microbes to angiosperms including fossils forms, involving details of detailed analysis of internal structure special features of developmental biology. Biostatistical tools for analysis of data	The topics focuses on identification resulting in strain selection, this find opportunities in industries involved in enzymes, antimicrobial agents, plant identification and tree census	Plant identifications use key characters, Palynology identification of pollen grains
T Y B Sc Botany	Forms and Functions III	RJSUBOT503 RJSUBOT603	Thrust areas like cytology, molecular biology, plant physiology, plant Biochemistry, Environmental Botany, Plant tissue culture, genetics and Bioinformatics	Employability in field of the teaching and research. Domain knowledge essential for further progression	Interpretation of biochemical pathways, Computational skills for biological data analysis
T Y B Sc Botany	Current trends II	RJSUBOT504 RJSUBOT604	Ethnobotany, mushroom industry, biotechnology, post-harvest technology, Pharmacognosy and medicinal botany	Analytical skills; Interpretation Skills; Writing skills; entrepreneurship skills;	Mushroom industries: post-harvest technology to achieve sustainable development goals
T Y B Sc Botany	Practicals-plant diversity III & IV;	RJSUBOTP501, RJSUBOTP502, RJSUBOTP601, RJSUBOTP602	Macroscopical and Microscopical identification of sample from lower to higher forms	Organisational skills, record keeping, interpretation skills	Field trip , techniques
T Y B Sc Botany	Practicals - Forms and Functions III	RJSUBOTP503, RJSUBOTP603	Sampling techniques, quality and quantitative test, water analysis, extraction of plasmid	Skill enhancement, employability as technicians	Training and use of analytical instrument; plant propagation using tissue culture technique; industrial visit
T Y B Sc Botany	Practicals - Current trends II	RJSUBOTP504, RJSUBOTP604	Mushroom cultivation, authentication of plant sample, extraction of essential oils,	Employability in research laboratory, NGOs; analysis of crude drug , natural product development	Workshop on mushroom cultivation; preparation of jam, jellies, etc.



Hindi Vidya Prachar Samiti's

## **Ramniranjan Jhunjunwala College**

**of Arts, Science & Commerce**

**(Autonomous College)**

**Affiliated to**

**UNIVERSITY OF MUMBAI**

**Refer to page nos: 02 and 03**

**highlighting component**

**of Research Project/Field Project**

**Syllabus for the S.Y.B.Sc.**

**Semester III & IV**

**Program: B.Sc. BOTANY**

**Program Code: RJSUBOT**

**REVISED**

**(CBCS 2022-2023)**



**DISTRIBUTION OF TOPICS AND CREDITS****S.Y.B.Sc. BOTANY SEMESTER III**

<b>Course</b>	<b>Nomenclature</b>	<b>Credits</b>	<b>Topics</b>
RJSUBOT301	Plant Diversity II	02	1. Algae 2. Bryophyta 3. Pteridophyta and Paleobotany
RJSUBOT302	Forms & Functions II	02	4. Cytology 5. Physiology 6. Genetics
RJSUBOT303	Current Trends in Plant Sciences– I	02	7. Instrumentation 8. Economic Botany 9. Molecular Biology
RJSUBOTP301, RJSUBOTP302 & RJSUBOTP303	Practical I, II & III	03	
RJSUBOTDSE1 AND RJSUBOTPDSE1 RJSUBOTDSE2 AND RJSUBOTPDSE2 RJSUBOTDSE3 AND RJSUBOTPDSE3	1. DSE 1 Plant Propagation 2. DSE2 Post Harvest technology 3. DSE3 Aesthetic Botany	02	Student can choose any one in one semester

**S.Y.B.Sc. BOTANY SEMESTER IV**

<b>Course</b>	<b>Nomenclature</b>	<b>Credits</b>	<b>Topics</b>
RJSUBOT401	Plant Diversity II	02	1. Fungi 2. Gymnosperms 3. Angiosperms
RJSUBOT402	Forms & Functions II	02	4. Anatomy 5. Ecology 6. Pharmacognosy

**S.Y.B.Sc Botany Syllabus Semester III & IV**

RJSUBOT403	Current Trends in Plant Sciences – I	02	7. Biotechnology I 8. Horticulture 9. Biostatistics I & Bioinformatics I
RJSUBOTP401, RJSUBOTP402 & RJSUBOTP403	Practical I, II & III	03	
RJSUBOTDSE1 AND RJSUBOTPDSE1 RJSUBOTDSE2 AND RJSUBOTPDSE2 RJSUBOTDSE3 AND RJSUBOTPDSE3	1. DSE 1 Plant Propagation 2. DSE2 Post Harvest technology 3. DSE3 Aesthetic Botany	02	Student can choose any one in one semester

<b>SEMESTER III (THEORY)</b>		<b>L</b>	<b>Cr</b>
<b>Paper-I: Plant Diversity- II</b>	<b>Paper Code: RJSUBOT301</b>	45	2
<b>UNIT I</b>		15	
<b>THALLOPHYTA- ALGAE</b>			
1	Outline classification of Phaeophyta up to order as per G.M. Smith.		
2	The general characters of Phaeophyta based upon Thallus, Reproduction. Economic importance of Phaeophyta.		
3	<i>Sargassum</i> - Systematic position, Life cycle and Alternation of generations.		
4	General characters of Bacillariophyta based upon thallus structure, cell structure, reproduction. Economic and ecological significance of Bacillariophyceae		
5	<i>Pinnularia</i> - Systematic position, Life cycle and Alternation of generations.		
<b>UNIT II</b>		15	
<b>BRYOPHYTA</b>			
1	Outline classification of Anthocerotae up to order as per G.M. Smith.		
2	General characters of Anthocerotae based upon Thallus, Reproduction.		
3	<i>Anthoceros</i> - Systematic position, Life cycle and Alternation of generations.		
4	<i>Funaria</i> - Systematic position, Life cycle and Alternation of generations.		
<b>UNIT III</b>		15	
<b>PTERIDOPHYTA AND PALEOBOTANY</b>			
1	Outline classification of Psilophyta and Lepidophyta up to order as per G M Smith.		
2	General characters of Psilophyta and Lepidophyta based upon Plant structure and Reproduction.		
3	<i>Selaginella</i> - Systematic position, Life cycle and Alternation of Generations.		
4	Stelar evolution in Pteridophytes.		
5.	Geological time scale.		
6.	Formation and types of Fossils.		
7.	<i>Rhynia</i> - Systematic position and structure.		

S.Y.BSc	Semester III Theory
RJSUBOT301 Paper I Plant Diversity II	<p>Course Outcome 3.1 :</p> <ol style="list-style-type: none"><li>1. Algae: Phaeophyta general structure and <i>Sargassum</i> a type genus to study the various stages of the life cycle.</li><li>2. Bacillariophyta and its features with <i>Pinnularia</i> as a representative. Diatoms and their role in aquatic ecosystem.</li><li>3. Bryophyta: Anthocerotae and Musci with <i>Anthoceros</i> and <i>Funaria</i> as type genera.</li><li>4. Detailed study of classification of Psilophyta and Lepidophyta</li><li>5. Study of <i>Selaginella</i>- Systematic position, Life cycle and Alternation of Generations.</li><li>6. Geological time scale and Formation and types of Fossils.</li><li>7. Study of <i>Rhynia</i>- Systematic position and structure</li></ol> <p>Learning outcome:</p> <ul style="list-style-type: none"><li>➤ Detailed study of diversity in algae, bryophyte and its future applications in industry and environment.</li><li>➤ Learning the diversity in Pteridophyta.</li><li>➤ Understanding the past environment with the study of palaeobotany, fossils and geological time scale.</li></ul>

**S.Y.B.Sc Botany Syllabus Semester III & IV**

SEMESTER	:	III CORE SUBJECT
TITLE OF THE SUBJECT/COURSE	:	PLANT DIVERSITY II
COURSE CODE	:	RJSUBOT301
CREDITS	:	02
DURATION	:	45 LECTURES

LEARNING OBJECTIVES	
1	To Understand the diversity of Phaeophyta and Bacillariophyta and their economic importance
2	To Understand the life cycle of Bryophytes <i>Anthoceros</i> and <i>Funaria</i>
3	Understanding the life cycle of <i>Selaginella</i> . Understand fossilisation of plant parts, <i>Rhynia</i> as a type genus

COURSE OUTCOME NUMBER	On completing the course the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	Understand the classification and structural organisation of Phaeophyta ( <i>Sargassum</i> ) and Bacillariophyta ( <i>Pinnularia</i> ) and correlate their role in aquatic with the economic importance of seaweeds and diatoms	1	BT Level I, II, III remember, understand and apply
CO2	Understand the structure, life cycle of Bryophytes ( <i>Anthoceros</i> and <i>Funaria</i> ) and Pteridophytes ( <i>Selaginella</i> ). Understand the evolution of plants. Geological time scale	1, 5	BT level II and III Understand and apply
CO3	Draw connections with living and extinct plants through study of fossil. Trace the evolutionary path, Geological Time Scale.	1,5	BT level IV Analyse draw connections among ideas

<b>SEMESTER III (THEORY)</b>		<b>L</b>	<b>Cr</b>
<b>Paper-II: Forms and Functions-II</b>	<b>Paper Code: RJSUBOT302</b>	45	2
<b>UNIT I</b>		15	
<b>CYTOLOGY</b>			
1	Ultra-structure and functions of the following cell organelle: Chloroplast, plant cell vacuoles, prokaryotic and eukaryotic ribosomes		
2	Cell Cycle		
3.	Cell division and its significance, Mitosis, Meiosis.		
<b>UNIT II</b>		15	
<b>PHYSIOLOGY</b>			
1	Photosynthesis: Light reaction Photosystem I and II , Dark reaction, C <sub>3</sub> ,C <sub>4</sub> and CAM pathways		
2	Photorespiration- Mechanisms and its significance.		
3	Photoperiodism: Phytochrome Response and Vernalization with reference to flowering in higher plants; Physio-chemical properties of phytochrome. Pr-Pfr interconversion; role of phytochrome in flowering of SDPs and LDPs. .		
<b>UNIT III</b>		15	
<b>GENETICS</b>			
1	Variation in Chromosome structure (Chromosomal Aberrations) Definition, Origin, Cytological and Genetic Effects of the following: Deletions, Duplications, Inversions and Translocations.		
2	Variation in Chromosome Number - Origin and production, morphological and cytological features, applications in crop improvement and evolution of Aneuploids and Euploids (Monoploids, Autopolyploid and Allopolyploids).		
3	Sex determination- Chromosomal basis, Gene Balance Theory. Sex determination based on hormones and environment. Morphology of X and Y chromosomes' determination in plants Sex linkage- X and Y linkage, crisscross Inheritance, holandric genes, Sex limited and sex-influenced traits. Sex reversal, Gynandromorphs		
4	Giant Chromosomes		

S.Y.BSc	Semester III Theory
RJSUBOT302	Course Outcomes 3.2 :
Paper II	1. Cell Biology Ultrastructure of cell organelles: Chloroplast
Form and	2. Cell Division to learn how cells divide by equational division and
Function II	reduction division.
	3. Detailed study of Photosynthesis- C3, C4 and CAM pathways
	4. Photorespiration and Photoperiodism study in plants.
	5. Chromosomal aberrations, and variations in chromosome number,
	Polyploidy, sex determination and sex-linkage in plants and
	animals.
	Learning outcome:
	➤ Basic concept of cell biology and cell division.
	➤ Understanding the mechanism of Photosynthesis, Photoperiodism.
	➤ Knowing the effect of Chromosomal Aberrations, Variation in
	Chromosome Number, Sex linkage and Sex determination.
	Application in genetic counselling.

SEMESTER	:	III CORE SUBJECT
TITLE OF THE SUBJECT/COURSE	:	FORMS AND FUNCTIONS II
COURSE CODE	:	RJSUBOT302
CREDITS	:	02
DURATION	:	45 LECTURES

LEARNING OBJECTIVES	
1	To understand the ultra-structure and functions of cell organelle: Chloroplast , vacuole, ribosomes.
2	To understand cell cycle, mitosis and meiosis
3	To understand the various photosynthetic pathways in plants, photorespiration and photoperiodism
4	To Understand the structural variations in chromosomes and correlate with syndromes. Understand the change in chromosome number and its implications in organisms.
5	To understand the mechanism of sex determination in organisms. Structure of giant chromosomes

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	Understand the ultrastructure of chloroplast and correlate with the mechanism of photosynthesis in plants. Understand the check points in cell cycle and different stages of mitosis and meiosis.	2	BT Level I, II, IV remember, understand, Analyse draw connections among ideas
CO2	Understand the mechanism of photosynthesis in plants and various biochemical pathways for carbon fixation. Recognise the importance of assimilation in photorespiration	2	BT level II and III Understand and apply
CO3	Understand the mechanism of photoperiodism in plants and its implications in various photo morphogenetic responses in plants	1,2	BT level II,IV Understand, Analyse draw connections among ideas
CO4	Understand chromosomal aberrations, variations in chromosome number its role in plant evolution. Sex determination and sex linkage in organisms. Applications in genetic counselling.	2	BT level II, III, IV Understand, apply, Analyse draw connections among ideas



<b>SEMESTER III (THEORY)</b>		<b>L</b>	<b>Cr</b>
<b>Paper-III: Current Trends in Plant Sciences – I</b>	<b>Paper Code: RJSUBOT303</b>	45	2
<b>UNIT I</b>		15	
<b>INSTRUMENTATION</b>			
1	Microscopy – Light and Phase contrast- Instrumentation, Principle and working. Applications of light and phase contrast microscopy.		
2	Colorimetry and Spectrophotometry (Visible)- Instrumentation, Principles, Working and Applications.		
3	Chromatography – Paper and TLC- Instrumentation, Principles, Working and Applications.		
<b>UNIT II</b>		15	
<b>ECONOMIC BOTANY</b>			
1	Fibers: Types of fibers, fiber yielding plants. Paper: Types of paper, paper yielding plants, paper processing. Timber : Types of Timber, Timber yielding plants		
2	Spices and condiments: Botanical source and Uses- Nutmeg, Mace, Clove, Cardamom, Cumin, Carom and Saffron.		
<b>UNIT III</b>		15	
<b>MOLECULAR BIOLOGY</b>			
1	Types, structure and functions of DNA and RNA.		
2	Structure of Chromosome.( Eukaryotic and Prokaryotic)		
3	DNA replication in prokaryotes and eukaryotes.		

S.Y.BSc	Semester III Theory
RJSUBOT303 Paper III Current trends in Plant Science I	<p>Course Outcomes 3.3 :</p> <ol style="list-style-type: none"><li>1. Analytical techniques learning (microscopy, colorimetry and chromatography).</li><li>2. Economic importance of plants with the help of examples of plants yield in terms of fibres, paper, timber and spices.</li><li>3. Basic molecular biology concept with respect to DNA, RNA, chromosome, and DNA replication.</li></ol> <p>Learning outcome:</p> <ul style="list-style-type: none"><li>➤ Learning of principles and working of microscopy, colorimetry, Spectrophotometry and Chromatography. Research orientation</li><li>➤ Identification and understanding the economic importance of forest products and Spices and condiments. Develop Entrepreneurial skills among the learners</li><li>➤ Basic molecular biology concept learning. Research orientation</li></ul>

SEMESTER	:	III CORE SUBJECT
TITLE OF THE SUBJECT/COURSE	:	CURRENT TRENDS IN PLANT SCIENCES
COURSE CODE	:	RJSUBOT303
CREDITS	:	02
DURATION	:	45 LECTURES

LEARNING OBJECTIVES	
1	Student will learn about the principle and working of light and phase contrast microscopes. Working and principle of colorimetry and Spectrophotometry
2	Learn about chromatography as a separation technique
3	To understand the economic importance of plants as a source of fibres, paper, timber, spices, and condiments.
4	Understand the structure of DNA and RNA. Organisation of chromosomes. Mechanism of DNA replication.

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	Understand the principles and applications of light and phase contrast microscopy. Understand the principles of colorimetry and Spectrophotometry	2	BT Level I, II and III remember, understand and apply
CO2	Classify different types of chromatography techniques. Apply suitable technique for separation of phytochemicals	2, 3	BT level II and III Understand and apply
CO3	Understand the core concepts of Economic Botany. Appreciate the diversity of plants and the plant products in human life. Increase the awareness of plants and plant products encountered in everyday life.	4,5	BT level II, IV Understand, analyse draw connections
CO4	Analyse the structure and chemical properties of DNA and RNA	1,5	BT level II Understand
CO5	Understand the organisation of chromosomes and replication of DNA	1,5	BT level IV Analyse draw connections among ideas

<b>SEMESTER IV (THEORY)</b>		<b>L</b>	<b>Cr</b>	
<b>Paper-I: Plant Diversity - III</b>		<b>Paper Code: RJSUBOT401</b>	45	2
<b>UNIT I</b>		15		
<b>FUNGI</b>				
1	<i>Xylaria</i> - Systematic position, Life cycle and Alternation of generations			
2	Outline classification of Basidiomycetes upto order as per G.M. Smith. Industrial applications of fungi			
3.	General characters of Basidiomycetes based upon Thallus, Reproduction.			
4	<i>Agaricus</i> : Systematic position, Life cycle and Alternation of generations.			
5	Industrial applications of fungi			
<b>UNIT II</b>		15		
<b>GYMNOSPERMS</b>				
1	Outline classification of Coniferophyte as per Chamberlain.			
2	<i>Pinus</i> - Systematic position, Life cycle and Alternation of Generations.			
3	Geographical distribution of Indian Gymnosperms			
4	Study of <i>Cordaites</i>			
<b>UNIT III</b>		15		
<b>ANGIOSPERMS</b>				
1	Morphology of Inflorescence- All types.			
2	Morphology of Flower- Terminologies associated with description of flowers, Calyx and its modifications, Corolla and its modifications, Perianth, Androecium- structure, Adhesion and Cohesion types, staminodes, Gynoecium- carpels, Gynostegium, Placentation types.			
2	Study of National Parks in the city of Mumbai: Biodiversity of Mahim Nature park, Sanjay Gandhi National Park			
3	Taxonomy – study of plant families- a) Magnoliaceae b) Asteraceae c) Myrtaceae d) Combretaceae e) Apocynaceae			

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f) Amaranthaceae		
g) Palmae		

S.Y.BSc	Theory Semester IV
RJSUBOT401 Paper-I Plant Diversity – III	<p>Course Outcomes 4.1 :</p> <ol style="list-style-type: none"> <li>1. Fungi: Students to learn the classification of Basidiomycetes. Life cycle of <i>Agaricus</i>. Life cycle study of <i>Xylaria</i>. Industrial applications of fungi</li> <li>2. Detailed study of <i>Pinus</i> and Distribution of Conifers in India.</li> <li>3. Study of flower morphology and all types of inflorescence</li> <li>4. Taxonomy of selected plant families Magnoliaceae, Asteraceae, Myrtaceae, Combretaceae, Apocynaceae, Amaranthaceae and Palmae.</li> </ol> <p>Learning outcomes:</p> <ul style="list-style-type: none"> <li>➤ Learning the diversity in gymnosperms and distribution of Conifers in India.</li> <li>➤ Detailed study of morphology of flowers and some angiosperm families. Plant identification skills</li> <li>➤ Study of Biodiversity in National parks would create awareness among students the need for conservation</li> </ul>

SEMESTER	:	IV CORE SUBJECT
TITLE OF THE SUBJECT/COURSE	:	PLANT DIVERSITY II
COURSE CODE	:	RJSUBOT401
CREDITS	:	02
DURATION	:	45 LECTURES

LEARNING OBJECTIVES	
1	Students will learn about the complexity in Basidiomycetes and understand the life cycle of <i>Agaricus</i>
2	Students will learn and understand the diversity of Gymnosperms and their distribution. Life cycle of <i>Pinus</i>
3	Understand the types of inflorescence and floral morphology
4	Assign plants to families based on characters. Create awareness among students about biodiversity and its conservation

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	Understand classification of Basidiomycetes and Life cycle of <i>Agaricus</i> Understand life cycle of <i>Xylaria</i>	1	BT Level I, II and III remember, understand and apply
CO2	Understand the diversity of Gymnosperms and distribution of gymnosperms. Climate change and its effect on extinction of plants. Understand life cycle of <i>Pinus</i> and correlate with adaptations in it	1,5	BT level II and III Understand and apply
CO3	Understand the arrangement of flowers in various types of inflorescences for attracting pollinators. Understand floral morphology so as to classify plants to their respective families. Identify and assign plants to respect families.	2,5	BT level II, IV Understand, analyse draw connections
CO4	Understand the biodiversity of National Parks.	5	BT level II Understand
CO5	Understand the importance of flora and fauna need for conservation	5	BT level IV Analyse draw connections among ideas

<b>SEMESTER IV (THEORY)</b>		<b>L</b>	<b>Cr</b>
<b>Paper-II: Forms and Functions-III</b>	<b>Paper Code: RJSUBOT402</b>	45	2
<b><i>UNIT I</i></b>		15	
<b>ANATOMY</b>			
1	Secondary growth in Dicot stem and root, Monocot stem		
2	Mechanical tissue system- Distribution, I- girders, adaptation for Inextensibility, Incompressibility, Inflexibility, Shearing stress.		
3	Types of Vascular bundles.		
4	Growth rings, Periderm and Tyloses		
5	Palynology : Pollen morphology with respect to polarity, size and shape, exine ornamentation, excrescences and apertures		
<b><i>UNIT II</i></b>		15	
<b><i>ECOLOGY</i></b>			
1	Ecological factors: Concept of environmental factors. Soil as an edaphic factor, Soil composition, types of soil, soil formation, soil profile.		
2	Community ecology- Qualitative characters- Phenology, Growth forms- Raunkiaer's Classification, Biological spectrum, Stratification. Quantitative characters- Density, Frequency. Types of sampling methods in vegetation study		
3	Soil Pollutants- Pesticides and synthetic fertilizers.		
<b><i>UNIT III</i></b>		15	
<b><u>Pharmacognosy</u></b>			
1	Introduction to Pharmacopoeia.		
2	Study of secondary metabolites (sources, classification, properties and uses) with reference to Alkaloids, Glycosides, Tannins, Volatile oils and Gums and resins (example of one plant for each category).		

S.Y.BSc	Theory Semester IV
<p>RJSUBOT402</p> <p>Paper II</p> <p>Forms and Functions-III</p>	<p>Course Outcomes 4.2 :</p> <ol style="list-style-type: none"> <li>1. Understanding the secondary growth structure and types of vascular bundles of dicot and monocot stem and root.</li> <li>Understand pollen morphology correlate with adaptations for pollination.</li> <li>2. Soil profile and composition analysis</li> <li>3. Understanding Qualitative characters of Community ecology</li> <li>4. Study of secondary metabolites (sources, properties and uses) with reference to Alkaloids, Glycosides, Tannins, Volatile oils and Gums and resins.</li> </ol> <p>Learning outcomes:</p> <ul style="list-style-type: none"> <li>➤ Knowing the process and need of secondary growth in plant, mechanical tissue system and vascular bundles functions in plant</li> <li>➤ Study of Ecological factors, community ecology and assessment of Soil Pollutants</li> <li>➤ Detailed study of secondary metabolites and its application for drug making. Industrial applications of fine chemicals</li> </ul>



SEMESTER	:	IV CORE SUBJECT
TITLE OF THE SUBJECT/COURSE	:	FORMS AND FUNCTIONS II
COURSE CODE	:	RJSUBOT402
CREDITS	:	02
DURATION	:	45 LECTURES

LEARNING OBJECTIVES	
1	Student would learn about how normal secondary growth takes place in dicot and monocot stem and root. Organisation of vascular tissue in vascular bundles
2	Student would learn about the soil profile and its composition
3	Student would learn about community ecology and assessment of land based on these characters
4	Learn about Pharmacognosy, introduction to Pharmacopoeia and secondary metabolites

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	Understand the secondary growth and types of vascular bundles in dicot and monocot stem and roots.	1	BT Level I, II and III remember, understand and apply
CO2	Understand the importance of soil profile and composition correlate with plant growth and development	1,2	BT level II and III Understand and apply
CO3	Understand the qualitative characters of community ecology	1,2,5	BT level II, IV Understand, analyse draw connections
CO4	Understand the factors polluting soil and use and misuse of synthetic fertilisers	1,2,5	BT level II and IV Understand , analyse
CO5	Understand the types of secondary metabolites in plants and their application in industry as naturals	1,2,5	BT level IV Analyse draw connections among ideas

<b>SEMESTER IV (THEORY)</b>		<b>L</b>	<b>Cr</b>
<b>Paper-III: Current Trends in Plant Sciences - I</b>	<b>Paper Code:RJSUBOT403</b>	45	2
<b>UNIT I</b>		15	
<b>BIOTECHNOLOGY</b>			
1	Introduction to plant tissue culture- Totipotency, organogenesis, organ culture, root culture, meristem culture, pollen and embryo culture.		
2	rDNA technology - Gene cloning, enzymes in gene cloning and vectors in gene cloning.		
<b>UNIT II</b>		15	
<b>HORTICULTURE</b>			
1	Introduction to Horticulture: Branches of Horticulture.		
2	Gardening: Locations in the garden- Paths and Pathways, Avenue, Edges, Hedges, Lawn, Flower beds, Arches and Pergolas, Topiary, Water Garden (with names of two plants for each category). Focal point.		
3	Formal and informal Gardens, Landscape designing		
4	Status of Floriculture and Olericulture with reference to Indian market		
<b>UNIT III</b>		15	
<b>BIOSTATISTICS AND BIOINFORMATICS- I</b>			
1	Biostatistics -Testing of hypothesis - Chi square; Coefficient of correlation. Theory and Problems based on these.		
2	Bioinformatics – a) Introduction and aims – Information technology, history, the Internet & its uses. b) Data organization and Retrieval- Biological databases, Software tools related to Biology (Biotechnology), Nucleic Acid Database, Protein Database, ENTREZ. c) BLAST d) Institutes- NCBI, EBI, Bioinformatics programme and Institutes in India.		

S.Y.BSc.	Theory Semester IV
RJSUBOT403  Paper III  Current Trends in  Plant Sciences - I	<p>Course Outcomes 4.3 :</p> <ol style="list-style-type: none"> <li>1. Introduction and learning of plant tissue culture.</li> <li>2. Study of r DNA technology.</li> <li>3. Introduction to Horticulture and gardening study.</li> <li>4. Biostatistics -Testing of hypothesis - Chi square; Coefficient of correlation. Theory and Problems based on these.</li> <li>5. Study of Bioinformatics with respect to Internet, Databases, Software tools, Bioinformatics Service Institutes.</li> </ol> <p>Learning outcome:</p> <ul style="list-style-type: none"> <li>➤ Application of plant tissue culture and R-DNA technology.</li> <li>➤ Designing of gardens and application of horticulture. (Entrepreneurship)</li> <li>➤ Understanding the application of biostatistics with the given data.( Data Analysis)</li> <li>➤ Virtual data/ literature study and use of bioinformatics. (Computational biology)</li> </ul>

**S.Y.B.Sc Botany Syllabus Semester III & IV**

SEMESTER	:	IV CORE SUBJECT
TITLE OF THE SUBJECT/COURSE	:	CURRENT TRENDS IN PLANT SCIENCES I
COURSE CODE	:	RJSUBOT403
CREDITS	:	02
DURATION	:	45 LECTURES

LEARNING OBJECTIVES	
1	Student will learn about use of technology in mass propagation of plants by plant tissue culture. Concept of recombinant DNA technology
2	Student will learn practical application of Botany in the field of horticulture
3	Learn to use statistical tools for data analysis
4	Use Computation tools in Biology

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	Understand the core concept of plant biotechnology and genetic engineering	1,2	BT Level I, II and III remember, understand and apply
CO2	Develop competency on different types of plant tissue culture	2,5	BT level II and III Understand and apply
CO3	Design gardens and develop entrepreneurship skills to be a horticulturist	2,5	BT level II, IV Understand, analyse draw connections
CO4	Apply statistical tools for data analysis in biological studies both for secondary and primary data	2,4	BT level II, IV Understand, Analyse draw connections among ideas
CO5	Use data bases, use of bioinformatics in molecular biology	1,4	BT level IV Analyse draw connections among ideas

**S.Y.B.Sc Botany Syllabus Semester III & IV**

Semester III (PRACTICALS)		L	Cr
<b>Practical-I: Plant Diversity- II</b>		<b>Paper Code: RJSUBOTP301</b>	
1	<b>Algae</b> -Study of stages in the life cycle of <i>Sargassum</i> from fresh/ preserved material and permanent slides.		
2	Study of stages in the life cycle of <i>Pinnularia</i> from fresh/ preserved material and permanent slides.		
3	Economic importance of Phaeophyta and Bacillariophyceae		
4	Range of thallus in Phaeophyta.		
5	<b>Bryophyta</b> - Study of stages in the life cycle of <i>Anthoceros</i> from fresh/ preserved material and permanent slides.		
6	Study of stages in the life cycle of <i>Funaria</i> from fresh/ preserved material and permanent slides.		
7	<b>Pteridophyta</b> -Study of stages in the life cycle of <i>Selaginella</i> from fresh/ preserved material and permanent slides.		
8	Study of form genera <i>Rhynia</i> with the help of permanent slides/ photomicrographs.		
9	Study of different types of stele		
<b>Practical-II: Forms and Functions - II</b>		<b>Paper Code: RJSUBOTP302</b>	
1	Study of the ultra-structure of cell organelles prescribed for theory from Photomicrographs chloroplast, vacuoles and ribosomes.		
2	Isolation and localization of mitochondria using density gradient centrifugation		
3	Identification of CAM plants by testing pH of the sap in the morning and introduction to TAN		
4	Estimation of sugars using Colorimeter and preparation of standard graph.		
5	Study of inheritance pattern with reference to Plastid Inheritance		
6	Aberrations --- Karyotypes - Cri – du- chat, Philadelphia, D-G translocation, Down's Syndrome.		

<b>Practical-III: Current Trends in Plant Sciences – I</b>		<b>Paper Code: RJSUBOTP303</b>	30	1
1	Separation of amino acids using circular paper chromatography.			
2	Separation of carotenoids using TLC.			
3	Determination of $\lambda$ max for the given-colored solution.  Experiments based on Beer Lambert's Law from the given coloured solution.			
4	Sources, properties and uses of:  a) Fibers  b) Paper.			
4	Extraction of fiber from the given plant material and to check the tensile strength of the fiber			
5	Sources, properties and uses of : ( as per theory)  a) Spices  b) Condiments.			
6	Determining the sequence of amino acids in the protein molecule synthesized from the given m-RNA strand (prokaryotic and eukaryotic).			
7	Estimation of DNA by DPA method.			

S.Y.BSc	Semester III Practical
RJSUBOTP301 Practical I Plant Diversity II	<p>Course Outcomes They aim at enhancing the skills of the students learning by doing</p> <p>1. Experiential learning to use microscope, mount the specimens of <i>Sargassum</i>, <i>Pinnularia</i>, <i>Anthoceros</i>, <i>Funaria</i> and <i>Selaginella</i> identify various stages in the life cycle of these plants.</p> <p>Learning outcomes:</p> <ul style="list-style-type: none"><li>➤ Learning the diversity in algae, bryophyte and Pteridophytes, its future application</li></ul>

S.Y.BSc	Semester III Practical
RJSUBOTP302 Practical II Forms and Functions - II	<p>Course Outcomes:</p> <ol style="list-style-type: none"><li>1. Study of the ultra-structure of cell organelles</li><li>2. Learning different stages of mitosis. Staining techniques</li><li>3. Preparation of standard graph using sugars.</li><li>4. Study of types of mechanisms of photosynthesis in plants</li><li>5. Study of inheritance pattern and Aberrations using Karyotypes</li></ol> <p>Learning outcomes:</p> <ul style="list-style-type: none"><li>➤ Understanding the ultra-structure of Chloroplast</li><li>➤ Able to identify morphology of chromosomes</li><li>➤ Construction of standard graphs, calibration curves data interpretations</li><li>➤ Knowing the effect of Chromosomal Aberrations with the study of karyotypes (Cri-du chat, Philadelphia, D-G translocation, Down's syndrome). Genetic counselling</li></ul>



S.Y.BSc	Semester III Practical
<p>RJSUBOTP303</p> <p>Practical III</p> <p>Current Trends in Plant Sciences – I</p>	<p>Course Outcomes: Skill enhancement</p> <ol style="list-style-type: none"> <li>1. Learning Circular paper chromatography and thin layer chromatography techniques.</li> <li>2. Determination of <math>\lambda</math> max</li> <li>3. Analysing the interpretation of sequencing of amino acids in the protein molecule synthesised from the given m-RNA strand.</li> <li>4. Quantifying the DNA by DPA method.</li> </ol> <p>Learning outcomes:</p> <ul style="list-style-type: none"> <li>➤ Separating amino acid and carotenoids with Chromatography.</li> <li>➤ Determination of <math>\lambda</math> max for any given-coloured solution.</li> <li>➤ Identification and knowing the economic importance of forest products and spices and condiments</li> <li>➤ Basic molecular biology concept learning of sequencing m-RNA strand.</li> </ul>

**S.Y.B.Sc Botany Syllabus Semester III & IV**

SEMESTER	:	III CORE SUBJECT PRACTICAL COMPONENT
TITLE OF THE SUBJECT/COURSE	:	Plant Diversity II, Forms and functions II and Current Trends in Plant Sciences I
COURSE CODE	:	RJSUBOTP301, RJSUBOTP302 & RJSUBOTP303
CREDITS	:	03
DURATION	:	60 hour

LEARNING OBJECTIVES	
1	To learn the diversity in algae, bryophyte pteridophytes and its future application.
2	To learn use of separation techniques like centrifugation, chromatography (paper and thin layer)
3	To identify genetic disorders in human by karyotype analysis. Learn about morphology of chromosomes
4	To learn about the economic importance of forest products and spices by identifying the source and products

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	Student will develop expertise in use of microscope, observation, identification skills to identify seaweeds, diatoms and industrial products using them. Identify various types of Bryophytes, Pteridophytes	1,4, 5	BT Level I, II and III remember, understand and apply
CO2	Apply separation techniques viz. centrifugation for isolating plant organelles. Chromatography techniques for separation of components of a mixture.	2,3	BT level II and III Understand and apply
CO3	Use Colorimeter and develop techniques for quantification	2,3	BT level II, IV Understand, analyse draw connections
CO4	Determine amino acid sequence from the given mRNA template	2,3	BT level II, IV Understand, Analyse draw connections among ideas
CO5	Identify chromosomal aberrations by karyotype analysis and correlate with syndromes	2,3	BT level II, IV Analyse draw connections among ideas

**S.Y.B.Sc Botany Syllabus Semester III & IV**

Semester IV (PRACTICALS)		L	Cr
<b>Practical-I: Plant Diversity- II</b>		<b>Paper Code: RJSUBOTP401</b>	
1	<b>Fungi-</b> Study of life cycle of <i>Xylaria</i>		
2.	Study of life cycle of <i>Agaricus</i>		
3.	Plant Pathology- Powdery Mildew.		
4.	Plant Pathology-Late Blight of Potato.		
5.	<b>Gymnosperm-</b> Study of stages in the life cycle of <i>Pinus</i> from fresh/ preserved material and permanent slides. Study of fossil <i>Cordaites</i> with the help of permanent slides		
6	<b>Angiosperms-</b> Study of inflorescence.		
7	Study of flower morphology and functional modifications of floral whorls.		
8.	Study of the following angiosperm families: a) Magnoliaceae b) Asteraceae c) Myrtaceae d) Combretaceae e) Apocyanaceae f) Amaranthaceae g) Palmae		
<b>Practical-II: Forms and Functions - II</b>		<b>Paper Code: RJSUBOTP402</b>	
1	Study of normal secondary growth in the stem and root of a Dicotyledonous plant.		
2	Study of secondary growth in monocot stem ( <i>Dracaena</i> ).		
3	Types of mechanical tissues, mechanical tissue system in aerial, underground organs.		
4	Study of different types of vascular bundles.		
5	Mechanical analysis of soil by the sieve method & pH of soil.		
6	Study of water holding capacity of different soil samples.		
7	Quantitative estimation of organic matter of the soil by Walkley and Black's Rapid titration method.		
8	Study of vegetation by the list quadrat method.		
9	Tests for alkaloids from <i>Strychnos</i> (seeds) and <i>Holarrhena</i> (bark)		

10	Tests for glycosides from <i>Glycyrrhiza</i> rhizome/ <i>Aloe</i> leaf.		
11	Grandma's Pouch, Prakruti Nidan		
12	Tests for tannins.		
12	Stomatal index.		
13	Measurement of length of fibre using ocular meter		
<b>Practical-III: Current Trends – I</b>		<b>Paper Code: RJSUBOTP403</b>	1
1	Various sterilization techniques in Plant Tissue Culture.		
2	Technique of seed sterilization, callus induction and plant regeneration from callus.		
3	Encapsulation of axillary buds /formation of synthetic seeds.		
4	Identification of the cloning vectors – pBR322, pUC 19, Ti plasmid.		
5	Bottle and dish garden preparation.		
6	Study of five examples of plants for each of the garden locations as prescribed for Theory.		
7	Preparation of garden plans – formal and informal gardens.		
8	Preparation of Terrarium		
9	Chi square test.		
10	Calculation of coefficient of correlation.		
11	Web Search – Google- NCBI, EBI		
12	ENTREZ, BLAST.		

S.Y.BSc	Semester IV Practical
<p>RJSUBOTP401</p> <p>Practical I</p> <p>Plant Diversity</p> <p>II</p>	<p>Course Outcomes: Skill development plant identification in field</p> <ol style="list-style-type: none"> <li>1. Slide preparation of <i>Xylaria</i> and <i>Agaricus</i>.</li> <li>2. Slide preparation of <i>Pinus</i> needle, stem, microspores.</li> <li>3. Understanding <i>Pinus</i> and <i>Cordaites</i> with the help of permanent slide ( Evolution of plants)</li> <li>4. Study of inflorescence, flower morphology and functional modifications of floral whorls.</li> <li>5. Study of Magnoliaceae, Asteraceae, Myrtaceae, Combretaceae, Apocynaceae, Amaranthaceae and Palmae with the help of suitable specimen</li> </ol> <p>Learning outcomes:</p> <ul style="list-style-type: none"> <li>➤ Learning the diversity and stages of life cycle in fungi and gymnosperms.</li> <li>➤ Understanding the past environment with the study of palaeobotany, fossils and geological time scale.</li> <li>➤ Detailed study of morphology of flowers and some angiosperms. families.</li> </ul>

S.Y.BSc	Semester IV Practical
RJSUBOTP402  Practical II  Forms and  Functions - II	<p>Course Outcomes: Skill development</p> <ol style="list-style-type: none"><li>1. Exploring the normal secondary growth in the stem and root of a Dicotyledonous plant and Monocot stem (<i>Dracaena</i>).</li><li>2. Study of different types of vascular bundles and conducting tissues- Xylem and phloem elements in Gymnosperms and Angiosperms.</li><li>3. Analysis of soil by the sieve method &amp; pH of soil and water holding capacity of different soil samples.</li><li>4. Quantitative estimation of organic matter of the soil by Walkley and Black's Rapid titration method. (Industrial application)</li><li>5. Study of vegetation by the list quadrat method.</li><li>6. Tests for alkaloids, glycosides and tannins.</li><li>7. Study of Stomatal index.</li></ol> <p>Learning outcomes:</p> <ul style="list-style-type: none"><li>➤ Knowing the reason of secondary growth, mechanical tissue system and vascular bundles functions in plant.</li><li>➤ Study of Ecological factors and assessment of soil pH, water holding capacity and organic content.</li><li>➤ Detailed study of secondary metabolites and its application for drug making.</li><li>➤ Analysis of Stomatal index.</li></ul>

S.Y.BSc	Semester IV Practical
RJSUBOTP403 Practical III Current Trends in Plant Sciences – I	<p>Course Outcomes: Entrepreneurial skills</p> <ol style="list-style-type: none"> <li>1. Exploring the sterilization techniques in Plant Tissue Culture, Technique of seed sterilization, callus induction and plant regeneration from callus.</li> <li>2. Encapsulation of axillary buds /formation of synthetic seeds.</li> <li>3. Study of pBR322, pUC 19, Ti plasmid.</li> <li>4. Preparation of Bottle and dish garden and study of five examples of plants for each of the garden locations.</li> <li>5. Data analysis using Chi square test.</li> <li>6. Data collection using Web Search – Google- NCBI, EBI and ENTREZ.</li> </ol> <p>Learning outcomes:</p> <ul style="list-style-type: none"> <li>➤ Application of plant tissue culture and recombinant DNA technology</li> <li>➤ Identification of the cloning vectors – pBR322, pUC 19, Ti plasmid.</li> <li>➤ Designing of gardens and application of horticulture (Entrepreneurship).</li> <li>➤ Understanding the application of biostatistics on data. (data analysis)</li> <li>➤ Virtual data/ literature study and use of bioinformatics.</li> </ul>

SEMESTER	:	IV CORE SUBJECT PRACTICAL COMPONENT
TITLE OF THE SUBJECT/COURSE	:	PLANT DIVERSITY II, FORMS AND FUNCTIONS II AND CURRENT TRENDS IN PLANT SCIENCES I
COURSE CODE	:	RJSUBOTP401, RJSUBOTP402 & RJSUBOTP403
CREDITS	:	03
DURATION	:	60 HOURS

LEARNING OBJECTIVES	
1	Microscopic study of fungi belonging to Ascomycetes and basidiomycetes. Identify fungal pathogens of plants.
2	To study the morphological and anatomical characters of Pinus and study of the male cone, microspores, female cone and ovule of Pinus correlate with adaptations
3	Practical observation learn about types of inflorescence, floral morphology and modifications. Plant identification in field and assign them to their respective family.
4	To take hand sections, skill enhancement staining technique for tissue differentiation
5	Soil analysis employability skills quantitative ecology field studies.
6	Quality tests for presence or absence of plant secondary metabolites
7	Will be able to prepare plant tissue culture medium, aseptic technique. Select plants for various types of gardens, develop skills for entrepreneurship.
8	Analyse data using statistical tools. Learn basics of computational biology

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	Microscopic techniques, staining, wood anatomy of <i>Pinus</i> . Identify fungal pathogens. Understanding past environment with the help of fossils. Identification of types of inflorescences, floral modifications, adaptations, taxonomic identification of plants for the families as prescribed	1,3,5	BT Level I, II and III remember, understand and apply
CO2	Analyse the reasons for secondary growth distribution of mechanical tissues and their arrangement	1,3,4	BT level II and III Understand and apply
CO3	Soil analysis factors responsible for types of soil and will be apply to apply these techniques for growing of plants in field or nurseries	1,4,5	BT level II, IV Understand, analyse draw connections
CO4	Analyse plant drugs to identify their phytoconstituents	3,4,5	BT level II. III Understand and apply
CO5	Make plant tissue culture medium, apply different sterilisation techniques	3,4,5	BT level IV Analyse draw connections among ideas
CO6	Make bottle, dish garden, terrarium and identify and select plants for different garden location. Entrepreneurship skills for becoming a horticulturist	3,4,5	BT level IV Analyse draw connections among ideas
CO7	Data analysis using statistical tools, basics of computational biology and use of search engines	3,4	BT level II, III Understand and apply



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### **Scheme of Examinations**

1. Two Internals of 20 marks each. Duration 30min for each.
2. One External (Semester End Examination) of 60 marks. Duration 2 hours.
3. One Practical at the end of Semester consisting of Practical I- 50 marks, Practical II- 50 marks and Practical III -50 marks but passing combined out of 150.
4. Minimum marks for passing Semester End Theory and Practical Exam is 40 %.
5. **Student must appear for at least one of the two Internal Tests to be eligible for the Semester End Examination. All students must complete the mandatory project work along with the project report and presentation will be held.**
6. **Two short field excursions for habitat studies are compulsory. A field project report must be submitted.**
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 S.Y.B.Sc. Botany or a certificate from the Head of the department / Institute to the effect that the candidate has completed the practical course of S.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 practicals 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 150 marks per semester ( 50 marks for each practical RJSUBOTP301, RJSUBOTP302& RJSUBOTP303, RJSUBOTP401, RJSUBOTP402 & RJSUBOTP403 )**

**Course Semester End Examination in Semester 1 and II : Paper I, II and III ( RJSUBOT301, RJSUBOT302 & RJSUBOT303, RJSUBOT401, RJSUBOT402 & RJSUBOT403)**

<b>Question</b>	<b>KNOWLEDGE</b>	<b>UNDERSTANDING</b>	<b>APPLICATION and ANALYSES</b>	<b>TOTAL MARKS- Per unit</b>
<b>Unit 1</b>	08	03	04	15
<b>Unit 2</b>	08	03	04	15
<b>Unit 3</b>	08	03	04	15
<b>Short notes from topics covering all the units</b>	08	03	04	15
<b>-TOTAL - Per objective</b>	32	12	16	<b>60</b>
<b>% WEIGHTAGE</b>	53	20	27	<b>100%</b>

**Evaluation of Practicals 150 marks per semester ( 50 marks for each practical RJSUBOTP301, RJSUBOTP302 & RJSUBOTP303, RJSUBOTP401, RJSUBOTP202 & RJSUBOTP403)**

Continuous Evaluation of 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 PROJECT 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 field project Report	80-100% 17-20 Marks	60-80% 13-16 Marks	40-60% 09-12 Marks	20-40% 05-08 Marks
30%  (06)	<b>Organization of report</b>	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)	<b>Content</b>	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)	<b>Conclusion</b>	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)	<b>References</b>	Proper references, in required format	Proper references but no format	Few referen ces	Irrelevant references
	----Marks----	1	1	0.5	0
5% (01)	<b>Attendance / participation</b>	Attended and participated actively	Attended and participated	Infrequent Participation	No participation
	----Marks----	1	1	0.5	0

Comments:

Name and Signature of Faculty\_.

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.

<b>Project work and report (Parameters)</b>	<b>Marks</b>	<b>80 – 100% Excellent</b>	<b>60 -80% Good</b>	<b>40 – 60% Satisfactory</b>	<b>20 – 40% Average</b>
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

## Mapping of the course to employability/ Entrepreneurship/skill development

Class	Course Name	Course Code	Topic focusing on Employability/ Entrepreneurship/skill development	Employability/Entrepreneurship/Skill development	Specific activity
S Y B Sc Botany	Plant Diversity II	RJSUBOT301, RJSUBOT401	Plant Diversity II focuses on identification of industrially and environmentally useful algae, fungi, Bryophytes, Pteridophytes, Gymnosperms and Angiosperms	The topics focuses on identifying plants ranging from lower forms Thallophyta till Land plants. Plant identification Applications of these types in agriculture	Identification of plants
S Y B Sc Botany	Forms and Functions II	RJSUBOT302 RJSUBOT402	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 focuses on plant based drugs	Employability in field of the teaching and research. To learn the techniques to identify plant based drugs.	
S Y B Sc Botany	Current Trends in Plant sciences I	RJSUBOT303 RJSUBOT403	Applied aspects of plants sciences	Skill development in the area of instrumentation and its applications, molecular biology, use of computers in deciphering biological problems, Horticulture	Bottle and dish gardens, Terrarium, Garden design In silico biology
S Y B Sc Botany	Practicals	RJSUBOTP301 RJSUBOTP302 RJSUBOTP303 RJSUBOTP401 RJSUBOTP402 RJSUBOTP403	Microscopical identification of lower forms of plants, identification of higher forms using morphological studies.	<ol style="list-style-type: none"> <li>1. Analytical skills</li> <li>2. Interpretation skills</li> <li>3. Writing skills</li> </ol>	Mini project for developing Entrepreneurial skills, Field trips enhances skills of identification of plants in situ, organizational skills, team work.



**S.Y.B.Sc Botany Syllabus Semester III & IV****Botany****Discipline Specific Elective**

There are three courses of which student must choose one. The courses have the following credit pattern: Lecture 1 Credit, Practical 1 Credit

Evaluation Pattern: 40 marks Internal (continuous evaluation) and 60 marks External

Theory : 50 marks ( 20 Internal and 30 External)

Practicals: 50 marks (20 Internal and 30 External)

**Discipline Specific Elective: Plant Propagation (Course Code: RJSUBOTDSE1)**

<b>Discipline Specific Elective</b>			
	<b>Plant Propagation (Course Code: RJSUBOTDSE1)</b>	<b>Lecture and Practical</b>	<b>Credit (Theory and Practical)</b>
		<b>45 hour</b>	<b>2</b>
	UNIT I		
	Concept of Plant Propagation, Soil, types of soil, preparation of soil for propagation, soil free medium, compost, farmyard manure, nutrient solutions.		
	UNIT II		
	Propagation through seeds: Seed selection, seed testing, viability, seed dormancy, seed storage, seed conservation. Seed germination, nursery, transplantation, care of seedlings.		
	UNIT III		
	Vegetative Propagation: Stem cutting, leaf, layering, budding, grafting, propagation through modified stems and roots. Propagation of plants for aquariums.		
	UNIT IV		
	Hydroponics, Aquaponics, Concept of Micropropagation and application of micropropagation		
	PRACTICALS (Course Code: RJSUBOTPDSE1)		
	<ol style="list-style-type: none"> <li>1. Types of Soil, water holding capacity, soil pH and correction of soil pH.</li> <li>2. TTC test for viability and calculation of percentage of viable seeds.</li> <li>3. Breaking of seed dormancy: Physical and Chemical method</li> <li>4. Microgreens: Project work</li> <li>5. Vegetative methods of Plant Propagation</li> <li>6. Field visit to a plant nursery</li> </ol>		

**Course Outcomes (Plant Propagation Course Code: RJSUBOTDSE1 AND RJSUBOTPDSE1)**

1. On completion of the course the learner would be able to understand the concept of propagating plants, nursery management and care.
2. The learner will be able to propagate plants by vegetative methods and seed propagation
3. The learner will be able to appreciate sustainable living
4. Practical application of the concept learnt would be translated in action by performing the experiments and project work

## References:

1. Lewis Hill ( 1985). Secrets of Plant Propagation. American Horticultural Society. Storey Books.
2. Toogood A R ( 1999) Plant Propagation. American Horticultural Society Practical Guides. D K Publishers
3. Hartman H I and Kester O T (2015) Plant Propagation: Principles and Practices 8<sup>th</sup> Edition, Pearson.
4. Sadhu M K ( 1994) Plant Propagation John Wiley and Sons.

**Mapping of the course**

Class	Course Name	Course Code	Topics focusing on Employability / Entrepreneurship / Skill development	Employability / Entrepreneurship / Skill development
S Y B Sc	Botany	RJSUBOTDSE1 AND RJSUBOTPDSE1	All topics focus on skill development, shall make the learner employable and develop skills to be an employer	1.employability as a nursery supervisor, nursery manager. 2. Entrepreneur having own nursery for plants, supplier of planting materials

**Botany Discipline Specific Elective**

There are three courses of which student must choose one. The courses have the following credit pattern: Lecture 1, Practical 1

Evaluation Pattern: 40 marks Internal (continuous evaluation) and 60 marks External

Theory : 50 marks ( 20 Internal and 30 External)

Practicals: 50 marks (20 Internal and 30 External)

**Discipline Specific Elective: Post Harvest Technology (Course Code: RJSUBOTDSE2)**

<b>Discipline Specific Elective</b>			
	<b>Post Harvest Technology (Course Code: RJSUBOTDSE2)</b>	<b>Lecture and Practical</b>	<b>Credit ( Theory and Practical)</b>
		<b>45 hour</b>	<b>2</b>
	<b>UNIT I</b>		
	Post Harvest Technology: Importance and overview of post harvest handling: Principles and methods of preservation and processing. Methods of minimizing losses during storage and transportation. Harvesting and handling of fruits, cut flowers, vegetables, herbs.		
	<b>UNIT II</b>		
	Post harvest processing: Canning, fruit juice beverages, pickles, jam, jellies, candies, food additives, labelling. Food irradiation, food safety.		
	<b>UNIT III</b>		
	Protection of post harvest produce: Harvesting, cleaning, and drying technologies. Post harvest diseases and losses by insects. Seed storage techniques and control of insect pest chemical and biological control methods.		
	<b>UNIT IV</b>		
	Post harvest processing and Transport: Pre-treatment before transport. Chlorination, waxing, chemicals, biocontrol agents. Packaging, cold storage, cold chain.		
	<b>PRACTICALS (Course Code: RJSUBOTPDSE2)</b>		
	1. Post harvest drying of leafy ( methi, palak) and storage vegetables like onion, garlic 2. Drying and preparation of powder of spices like cumin, coriander 3. Preparation of juice 4. Preparation of syrup 5. Preparation of Jam and Jelly (Project) 6. Preparation of fruit candies (Project) 7. Identification of Insect pest in grains 8. Extraction of essential oil from <i>Ocimum/ Geranium</i> 9. Field visit to a food processing unit field project submission		

**Course Outcomes: (Post Harvest Technology Course Code: RJSUBOTDSE2 and RJSUBOTPDSE2)**

1. At the end of the course the learner would be able to understand how to prevent crop losses and add value to the produce
2. Visualise the post-harvest problems
3. Learn the various techniques for increasing shelf life and develop value added produce

**References:**

1. Chakravarty A., Majumdar A S., Raghavan G S V and Ramaswamy H S ( 2003). Handbook of Postharvest Technology Cereals Fruits, Vegetables, Tea and Spices. Marcel dekker Inc. N Y.
2. Wills, R B H., Glasson W B and Mc Graham D ( 2007). Postharvest: An introduction to the physiology and handling of fruits, vegetables and Ornamentals., CABI
3. Ramaswamy H (2015) Post harvest Technologies of Fruits and vegetables DE Stech Publications
4. Mathur G K ., Rathore N S and Chastha S S ( 2012) Post Harvest Management and Processing of Fruits and Vegetables. The Energy and Resource Institute.

**Mapping of the course**

Class	Course Name	Course Code	Topics focusing on Employability / Entrepreneurship / Skill development	Employability / Entrepreneurship / Skill development
S Y B Sc	Botany	RJSUBOTDSE2 AND RJSUBOTPDSE2	All topics focus on skill development, shall make the learner employable and develop skills to be an employer	1.Consultant to growers for value addition of produce 2. Entrepreneur having own business of various products like Jam, Jelly, syrups etc.

**Botany Discipline Specific Elective**

There are three courses of which student has to choose one. The courses have the following credit pattern: Lecture 1, Practical 1

Evaluation Pattern: 40 marks Internal (continuous evaluation) and 60 marks External

Theory : 50 marks ( 20 Internal and 30 External)

Practicals: 50 marks (20 Internal and 30 External)

Subject Specific Elective: Aesthetic Botany (Course Code: RJSUBOTDSE3)

Discipline Specific Elective			
	<b>Aesthetic Botany (Course Code: RJSUBOTDSE3)</b>	Lecture and Practical	Credit (Theory and Practical)
		45 hours	2
	<b>UNIT I</b>		
	Types of Botanical materials which can be used aesthetically: Flowers, fillers, leaves, vases, containers. Flower arrangement : Types, Western style, Eastern style, Ikebana, arrangement for different occasions. Dry Flower Arrangements: Drying of flowers and leaves, types of arrangements using dry flowers.		
	<b>UNIT II</b>		
	Floral decorations for weddings, Hotels, ceremonies, floral Rangoli, Bouquets, garlands, floral decorations for bride, head gears. Project work		
	<b>UNIT III</b>		
	Salad decoration, Fruit and Vegetable carvings along with the nutritive value of the materials used. Project work		
	<b>UNIT IV</b>		
	Botanical artifacts, Indoor plants maintenance, terrariums. Techniques used, plant materials used. Entrepreneur skills: How to start your own business in Aesthetic Botany.		
	<b>PRACTICALS (Course Code: RJSUBOTPDSE3)</b>		
	<ol style="list-style-type: none"> <li>1. Types of Flower arrangements</li> <li>2. Types of Bouquets</li> <li>3. Decoration of wedding mandap, stage</li> <li>4. Floral rangolis</li> <li>5. Fruit and vegetable cravings, salad decorations and nutrient chart</li> <li>6. Botanical Artifacts for home décor, gift</li> <li>7. Business plan and costing for floral outlet business</li> </ol>		

**Course Outcomes: (Aesthetic Botany Course Code: RJSUBOTDSE3 AND RJSUBOTPDSE3)**

1. At the end of the course the learner will be able to utilize flowers and leaves for providing aesthetic value to any area
2. Learner would be proficient in the art of developing artifacts using plant material
3. Learner would be able to use plants indoors as air purifiers
4. Learner would be able to use knowledge of Botany to be an entrepreneur

Reference:

1. The Art of Flower arrangement by Rekha Sarin UBS Publishers Distributors Ltd. N Delhi.1995
2. Arora J S (1999) Introduction to ornamental Horticulture, Kalyani Publishers, Ludhiana India.

**Mapping of the course**

Class	Course Name	Course Code	Topics focusing on Employability / Entrepreneurship / Skill development	Employability / Entrepreneurship / Skill development
S Y B Sc	Botany	RJSUBOTDSE3 AND RJSUBOTPDSE3	All topics focus on skill development, shall make the learner employable and develop skills to be an employer	1.Trainer for flower arrangements, decorations, salad decorations 2.Employment in Hotels, banquet halls, events 3. Entrepreneur starting a floral outlet taking contracts



Hindi Vidya Prachar Samiti's

# Ramniranjan Jhunjhunwala College

of Arts, Science & Commerce

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**Refer to page no: 02**

**highlighting component**

**of Research Project/Field Project**

Syllabus for the F.Y.B.Sc.

Program: B.Sc. BOTANY

Program Code: RJSUBOT

(REVISED 2021-2022)

(CBCS 2021-2022)

**F.Y.B.Sc Botany Syllabus Semester I & II****DISTRIBUTION OF TOPICS AND CREDITS****F.Y.B.Sc. BOTANY SEMESTER I**

<b>Course</b>	<b>Nomenclature</b>	<b>Credits</b>	<b>Topics</b>
RJSUBOT101	Plant Diversity I	02	1. Algae 2. Fungi 3. Bryophyta & Pteridophyta
RJSUBOTI02	Forms & Functions I	02	4. Cell Biology 5. Physiology & Biochemistry 6. Genetics
RJSUBOTP101 &RJSUBOTP102	Practical I & II	02	Algae, Fungi, Bryophyta, Pteridophyta, cell biology, physiology and Biochemistry, genetics

**F.Y.B.Sc. BOTANY SEMESTER II**

<b>Course</b>	<b>Nomenclature</b>	<b>Credits</b>	<b>Topics</b>
RJSUBOT201	Plant Diversity I	02	1.Lichens & Mycorrhiza 2. Gymnosperms 3. Angiosperms
RJSUBOT202	Forms & Functions I	02	4.Plant Anatomy 5.Ecology & Phytogeography 6.Medicinal Botany & Human Welfare
RJSUBOTP201 &RJSUBOTP202	Practical I & II	02	Lichens& Mycorrhiza, Gymnosperms, Angiosperms, plant anatomy, ecology & phytogeography, medicinal Botany &human welfare



**F.Y.B.Sc Botany Syllabus Semester I & II**

<b>SEMESTER I (THEORY)</b>		<b>L</b>	<b>Cr</b>
<b>Paper-I: Plant Diversity I</b>	<b>Paper Code: RJSUBOT101</b>	45	2
<b>UNIT I</b>		15	
<b>ALGAE</b>			
1	General Characters of Cyanophyta. Cell structure and life cycle of <i>Nostoc</i>		
2	General characters of Chlorophyta based upon - Range of thallus, cell structure and types of chloroplasts, Reproduction. Economic importance of Chlorophyta. Life cycle of <i>Spirogyra</i> .		
3	Emerging areas of algal biotechnology- Single cell protein ( <i>Spirulina</i> ), Biofertilizers ( <i>Anabaena</i> ), algae as food (kelp), algae as industrial product (Agar-agar and diatomite)		
<b>UNIT II</b>		15	
<b>FUNGI</b>			
1	General characters of Phycomycetes based on thallus structure and reproduction, Life cycle of <i>Rhizopus</i> .		
2	General characters of Ascomycetes, Life cycle of <i>Penicilium</i> and <i>Aspergillus</i> .		
3	Dermatophytes- causative organisms and control measures of candidiasis and dandruff		
<b>UNIT III</b>		15	
<b>BRYOPHYTA &amp; PTERIDOPHYTA</b>			
1	General characters of Hepaticae based on - Thallus structure, Reproduction. Life cycle of <i>Riccia</i>		
2	General characters of Pterophyta based on plant body and reproduction, Life cycle of <i>Nephrolepis</i>		

F.Y.B.Sc	Semester I Theory
RJSUBOT101  Paper I  Plant Diversity I	<p>Course Outcomes 1.1 :</p> <ol style="list-style-type: none"><li>1. Introduce students to algae and let them explore the diversity in the thallus structure ranging from simple to complex. Learn the taxonomy of Cyanophyta and Chlorophyta represented by <i>Nostoc</i> and <i>Spirogyra</i>. Also create awareness about emerging trends in algal biotechnology through the study of SCP, use of algae as biofertilizers, algal food and industrial products derived from algae.</li><li>2. Introduction to fungi from Phycomycetes form represented by <i>Rhizopus</i> to the Ascomycetes form represented by <i>Penicillium</i> and <i>Aspergillus</i>. Study of dermatophytes will bring awareness about prevention and control of diseases caused in human beings by fungi.</li><li>3. Bryophytes amphibious habitat, features of bryophytes, general characters of Hepaticae and life cycle of widely available <i>Riccia</i>. First land plants Pteridophytes represented by the common ornamental fern, namely <i>Nephrolepis</i>.</li></ol> <p>Learning outcomes:</p> <ul style="list-style-type: none"><li>➤ Understanding the diversity of lower plants, its life cycle, type of chloroplast and application of algae for commercial purposes.</li></ul>

	<ul style="list-style-type: none"><li>➤ Detailed study of fungi life cycle, mode of nutrition and its selection for economic products.</li><li>➤ Detailed study of Bryophytes and Pteridophyte life cycle, types of thallus and alternation of generations. It will help students to understand the role of Bryophytes in plant succession.</li><li>➤ Conquest of land by Pteridophytes, transition of plants from aquatic life to terrestrial habitat.</li></ul>
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<b>SEMESTER I (THEORY)</b>		<b>L</b>	<b>Cr</b>
<b>Paper-II: Forms and Functions-I</b>	<b>Paper Code: RJSUBOT102</b>	45	2
<b>UNIT I</b>		15	
<b>CELL BIOLOGY</b>			
1	General structure of plant cell, Structure of Cell wall, Plasma membrane ( bilayer lipid structure, fluid mosaic model).		
2	Ultra structure and functions of the following cell organelles: Mitochondria and Microbodies.		
<b>UNIT II</b>		15	
<b>PHYSIOLOGY &amp; BIOCHEMISTRY</b>			
1	Plant Water Relations- Water Potential, Transport through membrane, Osmosis, Imbibition.		
2	Enzymes- Classification, mechanism of action (activation energy, lock and key hypothesis, induced-fit theory), Michaelis Menten equation, Enzyme inhibition.		
<b>UNIT III</b>		15	
<b>GENETICS</b>			
1	Extension of Mendelian genetic analysis- Multiple alleles, modification of dominance relationship, incomplete dominance & Co-dominance.		
2	Gene interaction and Modified Mendelian ratios, Epistasis		
3	Quantitative characters : Polygene Inheritance		

**F.Y.B.Sc Botany Syllabus Semester I & II**

F.Y.B.Sc	Semester I Theory
RJSUBOT102 Paper II Forms and Functions I	<p>Course Outcomes 1.2 :</p> <ol style="list-style-type: none"><li>1. Introduction to cell Biology, ultrastructure of cell wall, plasma membrane, to understand the transport mechanisms via these membranes.</li><li>2. Student will be able to understand the ultrastructure of mitochondria and microbodies so that they can correlate with the physiological functions of these organelles in the plant cell. understand the biochemical processes, study of enzymes is a prerequisite.</li><li>3. To understand the concept of water transport in plant cells.</li><li>4. To go beyond Mendelian inheritance and understand the concept of genetic interaction, epistatic interactions, multiple alleles and inheritance of blood groups in man. To understand how multiple genes are involved in inheritance of quantitative characters and their cumulative effect on expression of the character.</li></ol> <p>Learning outcomes:</p> <ul style="list-style-type: none"><li>➤ Basic concept of cell and its ultra microscopic structure of cell organelle.</li><li>➤ Detailed study of enzymes nomenclature and functioning.</li><li>➤ Detailed study of Mendelian genetics, multiple alleles and epistatic and non-epistatic interactions. Genetic basis of inheritance of quantitative characters</li></ul>

<b>SEMESTER II (THEORY)</b>		<b>L</b>	<b>Cr</b>
<b>Paper-I: Plant Diversity I</b>	<b>Paper Code: RJSUBOT201</b>	45	2
<b>UNIT I</b>		15	
<b>LICHENS AND MYCORRHIZA</b>			
1	Lichens- Types of lichens, general characters, economic importance, ecological significance.		
2	Ecto- and endotrophic mycorrhiza and their agricultural applications.		
<b>UNIT II</b>		15	
<b>GYMNOSPERMS</b>			
1	General characters of Cycadophyta based upon - Plant body, Reproduction, Life cycle of <i>Cycas</i> .		
2	Economic importance of Gymnosperms.		
<b>UNIT III</b>		15	
<b>ANGIOSPERMS</b>			
1	Morphology- Leaf: simple leaf, types of compound leaves, Modifications of leaf: spine, tendril, hooks, phyllode, pitcher. Morphology of Seed – Monocot, Dicot and endospermic and non-endospermic seeds. Seed germination types.		
2	Taxonomy - Bentham and Hooker's classification – Broad outline upto series (with reasons). Study of plant families: Malvaceae, Leguminosae, Amaryllidaceae		

F.Y.BSc	Theory Semester II : Plant Diversity
RJSUBOT201 Plant Diversity -I	<p>Course Outcomes 2.1 :</p> <ol style="list-style-type: none"> <li>1. Study of Lichens students would be aware about plants as indicators of pollution, symbiotic relationship between algae and fungi, fungi and higher plant roots -mycorrhiza</li> <li>2. Student will be able to identify the characters, structure, life cycle of a commonly grown gymnosperm <i>Cycas</i>. Appreciate the economic importance of Gymnosperms.</li> <li>3. Morphological identification of leaves and seed morphology and seed germination so as to understand their function and taxonomic relevance. Seed morphology would help them understand the storage of primary metabolites; germination would enable them to develop skills needed for nursery.</li> <li>4. Bentham and Hooker's system of classification. Introduction to plant families by study of family Malvaceae, Leguminosae and Amaryllidaceae.</li> </ol> <p>Learning outcomes:</p> <ul style="list-style-type: none"> <li>➤ Detailed study of symbiotic association of algae and fungi –Lichen and role of mycorrhiza to improve plant nutrition.</li> <li>➤ Study of gymnosperms, life cycle, plant body and alternation of generations with help of <i>Cycas</i> as an example.</li> <li>➤ Understanding the type of modifications of leaves and morphology of seed for monocot and dicot. To apply the gained information to understand plant propagation and nutritional value of plant parts used as food.</li> <li>➤ Study of Bentham and Hooker's classification for Malvaceae, Leguminosae, Amaryllidaceae families</li> </ul>

<b>SEMESTER II (THEORY)</b>		<b>L</b>	<b>Cr</b>
<b>Paper-II: Forms and Functions-I</b>	<b>Paper Code: RJSUBOT202</b>	45	2
<b><i>UNIT I</i></b>		15	
<b><i>ANATOMY</i></b>			
1	Plant tissues:- Simple tissues, Complex tissues.		
2	Anatomy of primary structures – Dicot and Monocot root, stem and leaf.		
3	Adaptive and Protective systems- Epidermal tissue system, Trichomes, Dicot & Monocot Stomata.		
<b><i>UNIT II</i></b>		15	
<b><i>ECOLOGY &amp; PHYTOGEOGRAPHY</i></b>			
1	Ecosystem- abiotic and biotic components and their interactions, Types of ecosystems – aquatic and terrestrial, Energy flow in an ecosystem.		
2	Ecological pyramids: Based on energy, biomass and number.		
3	Phytogeographical divisions of India.		
<b><i>UNIT III</i></b>		15	
<b><i>MEDICINAL BOTANY AND HUMAN WELFARE</i></b>			
1	Introduction to Pharmacognosy- Biological source, geographical distribution, macro- and microscopic characters, chemical constituents, therapeutical uses of clove buds.		
2	Beverages- Cocoa: History, Origin, processing and production of chocolate.		



F. Y. BSc	Theory Semester II : Plant Diversity
RJSUBOT202 Paper II Forms and Functions-I	<p>Course Outcomes 2.2 :</p> <ol style="list-style-type: none"><li>1. Anatomy of plants, cells, tissues, salient characters of simple and complex tissues. Understand the primary structure of dicot and monocot root, stem and leaf. Students will be to differentiate dicot and monocot by using anatomical characters. Students will be able to apply this knowledge in identification of isolated plant organs.</li><li>2. Study of epidermal outgrowths and stomata of dicot and monocot leaves.</li><li>3. Ecology: Study of flow of energy at different trophic levels. Study of aquatic and terrestrial ecosystems, phytogeographical regions of India.</li><li>4. Medicinal Botany and Human welfare: Introduction to pharmacognosy to identify plant based drugs with the help of macro and microscopic character and phytochemical qualitative tests with the help of clove. Introduction to economic Botany with <i>Theobroma cocoa</i> tree. Cocoa a popular beverage obtained by processing seeds of cocoa, popularity as a drink and chocolate.</li></ol> <p>Learning outcomes:</p> <ul style="list-style-type: none"><li>➤ Detailed study of anatomical structures of plant tissues, root, stem, leaf and types of epidermis, epidermal outgrowths and stomata.</li><li>➤ Understand the ecological pyramids, energy flow, types of ecosystem and phytogeographical regions of India</li><li>➤ Study of macro and microscopic characters of a plant drug clove and identification using phytochemical tests. Learn how cocoa is a processed and product used in production of popular chocolates.</li></ul>

<b>F.Y.B.Sc Botany Syllabus Semester I &amp; II</b>		<b>L</b>	<b>Cr</b>
<b>Semester I (PRACTICALS)</b>			
<b>Practical-I: Plant Diversity I</b>		<b>Paper Code: RJSUBOTP101</b>	
			<b>1</b>
1	With the help of fresh/preserved specimens, identification of <i>Nostoc</i> .		
2	With the help of fresh/preserved specimens, identification of <i>Spirogyra</i> -vegetative stage, scalariform and lateral conjugation.		
3	<i>Rhizopus</i> - Study of asexual stage from temporary mounts and sexual structures through permanent slides.		
4	<i>Aspergillus</i> - Study of asexual stage from temporary mounts and sexual structures through permanent slides.		
5	Study of human yeast and <i>Malassezia globosa</i> (causative organism of dandruff) with the help of permanent slides.		
6	With the help of fresh/preserved specimens, study of life cycle stages in <i>Riccia</i> .		
7	With the help of fresh/preserved specimens, study of life cycle stages in <i>Nephrolepis</i> .		
<b>Practical-II: Forms and Functions I</b>		<b>Paper Code: RJSUBOTP102</b>	
			<b>1</b>
1	Study of mitotic stages in onion root tip.		
2	Study of Cell inclusions: Starch grains (Potato, Pea and Rice); Aleurone Layer (Maize) Cystolith ( <i>Ficus</i> ), Raphides ( <i>Pistia</i> ), Sphaeraphides ( <i>Opuntia</i> ).		
3	Identification of cell organelles with the help of photomicrograph: Mitochondria, Peroxisomes and Glyoxysomes.		
4	To study Plasmolysis using suitable plant material.		
5	Effect of change of pH on color of anthocyanin pigment and its applications		
6	Calculation of mean, median and mode.		
7	Calculation of standard deviation.		
8	Frequency distribution, graphical representation of data- frequency		

polygon, histogram, pie chart.		
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F.Y.B.Sc	Semester I
RJSUBOTP101 Practical - I	<p>Course Outcomes: Experiential learning, identification of algae and fungi by observing them under microscope</p> <ol style="list-style-type: none"> <li>1. Experiential learning of mounting and identification with the help of fresh/preserved material and permanent slides of <i>Spirogyra</i>. Vegetative and reproductive lateral and scalariform conjugation, <i>Nostoc</i>.</li> <li>2. Microscopic observation, mounting and identification of fresh/preserved material and permanent slides of <i>Rhizopus</i>, <i>Aspergillus</i> and <i>Penicillium</i>.</li> <li>3. Identification of causative organism of candidiasis and dandruff. Control measures zone of inhibition demonstration</li> <li>4. Study of morphological features and internal structure of <i>Riccia</i> with help of fresh /preserved material and permanent slides.</li> <li>5. Study of morphological and internal structure of <i>Nephrolepis</i> with the help of fresh/preserved material and permanent slides.</li> </ol> <p>Learning outcomes: Use of microscope, application of technique of microscopy</p> <ul style="list-style-type: none"> <li>➤ Understanding the diversity of lower plants.</li> <li>➤ Detailed study of life cycle of <i>Rhizopus</i>, <i>Aspergillus</i> and <i>Penicillium</i> so students can correlate with Aeromycoflora.</li> <li>➤ Detailed study of bryophyte's life cycle, types of thallus and gametophytes.</li> </ul>

**F.Y.B.Sc Botany Syllabus Semester I & II**

	<ul style="list-style-type: none"><li>➤ Detailed study of <i>Nephrolepis</i>, mounting of hydathode, ramentum, study of internal structure of stolon and sporophyll, mounting of sporangium and identification of prothallus.</li><li>➤ Create awareness and take precaution to prevent and or control skin diseases caused by fungi.</li></ul>
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F.Y.B.Sc	Semester I
RJSUBOTP 102 Practical II	<p>Course Outcome:</p> <ol style="list-style-type: none"><li>1. Squash preparation to study various stages of mitosis, learning the technique of chromosomal staining observation of stages of cell division.</li><li>2. Slide preparation to study types of starch grains in potato, pea and rice. Mounting of aleurone layer from maize grain.</li><li>3. Students would take transverse section of <i>Ficus elastica</i> leaf and observe under light microscope to look at cystolith, similarly other mineral crystals like raphides and sphaeraphides would be observed by taking transverse section of <i>Pistia</i> leaf and <i>Opuntia</i> phylloclade respectively. This would enable students to explore the diversity of cell inclusions in plants. Bio mineralization in plants</li><li>4. Cell organelles would be studied using photomicrographs.</li><li>5. Water relations of plants using coloured leaves like <i>Tradescantia</i> to explain concept of plasmolysis, incipient plasmolysis, hyper, hypo and isotonic solution. Understand use of natural pigments like anthocyanins as pH indicators.</li><li>6. Introduction to biostatistics, sampling, central tendency calculation of mean, median and mode, graphical representation of data, frequency polygon, histogram, pie chart. Calculation of standard deviation.</li></ol> <p>Learning outcomes:</p> <ul style="list-style-type: none"><li>➤ Detailed study of different stages of mitosis, plasmolysis and cell inclusions.</li><li>➤ Basic concept and functions of cell organelles.</li><li>➤ Study the effect of change of pH on colour of anthocyanin pigment and its applications for other natural indicators.</li><li>➤ To find the central tendency for any given data and calculation of standard deviation.</li></ul>

	<p>➤ Data presentation with the help of frequency distribution, graphical representation of data- frequency polygon, histogram, pie chart.</p>
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**F.Y.B.Sc Botany Syllabus Semester I & II**

<b>Semester II (PRACTICALS)</b>		<b>L</b>	<b>Cr</b>
<b>Practical-I: Plant Diversity -I</b>	<b>Paper Code: RJSUBOTP201</b>		1
1	Study of growth forms of lichens ( crustose, foliose, fruticose).		
2	Study of thallus and reproductive structures in lichen ( soredia and apothecium).		
3	Study of ecto mycorrhizae and endo mycorrhizae with the help of microphotographs/permanent slides.		
4	<i>Cycas</i> : T.S of leaflet ( <i>Cycas</i> pinna) and study of megasporophyll, microsporophyll, coralloid root, microspore and L.S. of ovule with the help of specimens/ slides.		
5	Simple leaf and types of compound leaves		
6	Study of leaf modification- spine, tendril, hooks, phyllode, pitcher		
7	Study of seed germination through growing of micro greens (Mini project for students).		
8	Family Malvaceae		
7	Family Leguminosae		
8	Family Amaryllidaceae		
<b>Practical-II: Forms and Functions-I</b>	<b>Paper Code: RJSUBOTP202</b>		1
1	Study of primary structure of dicot and monocot roots with the help of sectioning of fresh specimen.		
2	Study of primary structure of dicot and monocot stem with the help of sectioning of fresh specimen.		

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3	Study of primary structure of dicot and monocot leaf with the help of photograph/slide.		
4	Study of epidermal tissue system, trichome, dicot and monocot stomata.		
5	Study of plants from terrestrial and aquatic ecosystems – morphological adaptations- Hydrophytes, mesophytes, xerophytes, hygrophytes		
6	Study of phytogeographic regions of India with the help of map.		
7	Study of macroscopic and microscopic character of clove buds , Chemicals tests to identify its chemical constituents.		
8	Visit to Jijamata Udyan		
9	Visit to Cadbury factory at least virtual and Preparation of chocolate.		



F.Y.B.Sc	Practicals Semester II
RJSUBOTP201  Practical I  Plant Diversity I	<p>Course Outcomes: Experiential learning, skill development</p> <ol style="list-style-type: none"><li>1. Students would learn to observe specimens, identify with the help of morphological and anatomical characters. Understand symbiotic relationship in lichens and mycorrhiza. Learn the technique of sectioning and differentiate the tissues based on cell wall composition Learn to observe different stages in the life cycle of <i>Cycas</i>.</li><li>2. Study of leaf morphology and types of seed germination.</li><li>3. An introduction to classification of flowering plants and study of families <i>Malvaceae</i>, <i>Leguminosae</i> and <i>Amaryllidaceae</i>.</li></ol> <p>Learning outcomes:</p> <ul style="list-style-type: none"><li>➤ Detailed study of <i>Cycas</i> pinna, Megasporophyll, Microsporophyll, Coralloid root, Microspore structure.</li><li>➤ Understanding the morphology of roots, stems, leaves and morphology of seed for monocot and dicot.</li><li>➤ Study of angiosperm families (<i>Malvaceae</i>, <i>Leguminosae</i> and <i>Amaryllidaceae</i>)</li><li>➤ Field trips provide experiential learning to students.</li></ul>

F.Y.BSc	Practicals Semester II
RJSUBOTP202 Practical II Forms and Functions I	<p>Course Outcomes: Skill development</p> <ol style="list-style-type: none"><li>1. Sectioning of dicot and monocot root, stem and leaves to study the primary structure. Mounting of epidermal outgrowths. Learner would learn technique of sectioning, staining. Types of epidermal outgrowth and its role in a plants life cycle.</li><li>2. Based on observations of morphological characters plants would be identified as hydrophytes, mesophytes, hygrophytes and xerophytes. Characters to be observed for hydrophytes would be thin wiry stem, absence of roots (submerged), absence of root hair, roots with root pockets, lateral roots present, stem modified as offset, swollen petiole, leaves coated with wax ( free floating), roots with root hair, long petiole coated with mucilage, floating leaves coated with wax.</li><li>3. Simple test for tannin's identification and botanical names of plants in everyday life to cure common ailments and scientific explanation for their curative properties.</li></ol> <p>Learning outcomes:</p> <ul style="list-style-type: none"><li>➤ Detailed study of anatomical structures of leaf, types of stomata and epidermal outgrowths.</li><li>➤ Ecological study of plants. Morphological adaptations from terrestrial and aquatic ecosystems.</li><li>➤ Macro and microscopic features and qualitative test to identify the phytochemicals in clove buds.</li></ul>

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**Scheme of Examinations**

1. Two Internals of 20 marks each. Duration 30min for each.
2. One External (Semester End Examination) of 60 marks. Duration 2 hours.
3. One Practical at the end of Semester consisting of practical I-50 marks and Practical II-50 marks but passing combined out of 100.
4. Minimum marks for passing Semester End Theory and Practical Exam is 40 %.
5. Student must appear for at least one of the two Internal Tests to be eligible for the Semester End Examination.
6. For any KT examinations, there shall be ODD-ODD/EVEN-EVEN pattern followed.
7. Two short field excursions for habitat studies are compulsory.
8. Field work of not less than eight hours duration is equivalent to one period per week for a batch of 15students.
9. A candidate will be allowed to appear for the practical examinations if he/she submits a certified journal of F.Y.B.Sc. Botany or a certificate from the Head of the department / Institute to the effect that the candidate has completed the practical course of F.Y.B.Sc. Botany as per the minimum requirements.
10. In case of loss of journal, a candidate must produce a certificate from the Head of the department /Institute that the practicals 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.
11. 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 Practical's 100 marks ( 50 marks for each practical RJSUBOTP101& RJSUBOTP102, RJSUBOTP201 & RJSUBOTP202 )****Course Semester End Examination in Semester I and II Paper I and II  
( RJSUBOT101 & RJSUBOT102, RJSUBOT201 & RJSUBOT202)**

<b>Question</b>	<b>KNOWLEDGE</b>	<b>UNDERSTANDING</b>	<b>APPLICATION and ANALYSES</b>	<b>TOTAL MARKS- Per unit</b>
<b>Unit 1</b>	08	03	04	15
<b>Unit 2</b>	08	03	04	15
<b>Unit 3</b>	08	03	04	15
<b>Short notes from topics covering all the units</b>	08	03	04	15
<b>-TOTAL - Per objective</b>	32	12	16	<b>60</b>
<b>% WEIGHTAGE</b>	53	20	27	<b>100%</b>

**Evaluation of Practical's 100 marks ( 50 marks for each practical RJSUBOTP101& RJSUBOTP102, RJSUBOTP201 & RJSUBOTP202)**

Continuous Evaluation of 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
(06)	<b>Organization of report</b>	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
(10)	<b>Content</b>	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)	<b>Conclusion</b>	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)	<b>References</b>	Proper references, in required format	Proper references but no format	Few references	Irrelevant references
	----Marks----	1	1	0.5	0
5% (01)	<b>Attendance / participation</b>	Attended and participated actively	Attended and participated	Infrequent Participation	No participation
	----Marks----	1	1	0.5	0

Comments:

Name and Signature of Faculty\_.

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.

<b>Project work and report (Parameters)</b>	<b>Marks</b>	<b>80 – 100% Excellent</b>	<b>60 -80% Good</b>	<b>40 – 60% Satisfactory</b>	<b>20 – 40% Average</b>
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



**F.Y.B.Sc Botany Syllabus Semester I & II**

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
F Y B Sc Botany	Plant Diversity I	RJSUBOT101, RJSUBOT201	Plant Diversity I, II focuses on identification of industrially and environmentally useful algae, fungi, Bryophytes, Pteridophytes, Lichens and Mycorrhizae, Gymnosperms and Angiosperms	The topics focuses on identifying plants ranging from lower forms Thallophyta till Land plants. Applications of these types as nutraceuticals, agriculture	Preparation of biofertilizers
F Y B Sc Botany	Forms and Functions I	RJSUBOT201 RJSUBOT202	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 like cocoa which is used in production of popular beverage and chocolate	Employability in field of the teaching and research. To learn the techniques to identify plant based drugs.	
F Y B Sc Botany	Practicals	RJSUBOTP101 RJSUBOTP102 RJSUBOTP201 RJSUBOTP202	Microscopical identification of lower forms of plants, identification of higher forms	<ol style="list-style-type: none"> <li>1. Analytical skills</li> <li>2. Interpretation skills</li> <li>3. Writing skills</li> </ol>	Mini project for developing Entrepreneurial skills, Field trips enhances skills of

**F.Y.B.Sc Botany Syllabus Semester I & II**

			using morphological studies. Study of plants in different habitats and their adaptation. Plant pigments as natural pH indicator		identification of plants in situ, organisational skills, team work.
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