



College of Arts,  
Science &  
Commerce

RISE WITH EDUCATION  
Sion (W), Mumbai 400022

**Program: M.Sc.**  
**Course: BOTANY**  
**Syllabus for M. Sc. Part - II**  
**To be implemented from 2018-19**

Credit Based Semester and Grading System with  
effect from the academic year 2018-19

## **PREAMBLE**

The existing university syllabus of M.Sc. Botany was due for revision as per the CBSGS pattern will be implemented from the academic year 2018-2019 under autonomy.

In the revised autonomous syllabus, the committee has taken utmost care to maintain the continuity in the flow of information at M.Sc. level. Hence, some of the modules of the existing university syllabus have been upgraded with the new modules in order to introduce the learners to the recent developments in various branches of Botany.

All the papers of theory and practicals (Semester-III& Semester-IV together) are compulsory to the students according to their specialization.

### **Following two specialization subjects are offered:**

- Cytogenetics and Plant Biotechnology
- Environmental Botany

Each theory period shall be of 60 minutes duration. Theory component shall have 240 instructional periods per semester. Each practical will be of 4 periods and one period is of 60 minutes duration.

### **MODALITY OF ASSESSMENT:**

#### **Theory Examination Pattern**

A) Internal Assessment – 40M (30M Presentation/Assignment + 10 Class participation)

B) External examination – 60M (Semester End Theory Assessment)

- i. Duration - These examinations shall be of two and half hours duration.
- ii. Theory question paper pattern: attached separately.

#### **Practical Examination Pattern:**

- A. Internal Examination: There will not be any internal examination/ evaluation for practicals.
- B. External (Semester end practical examination)

The students are required to present a duly certified journal for appearing at the practical examination, failing which they will not be allowed to appear for the examination. In case of loss of Journal and/ or Report, a Lost Certificate should be obtained from Head of the Department/ Co-ordinator of the department; failing which the student will not be allowed to appear for the practical examination.

**SEMESTER III Common Papers**

Course Code	UNIT	TOPIC HEADINGS	Credits	L / Week
<b>SIPSBOT31</b>	<b>Title of the Paper: <u>TECHNIQUES AND INSTRUMENTATION</u></b>			
	<b>I</b>	<b>Biostatistics</b>	<b>4</b>	<b>1</b>
	<b>II</b>	<b>Bioinformatics</b>		<b>1</b>
	<b>III</b>	<b>pH and buffers and Electrophoresis</b>		<b>1</b>
<b>IV</b>	<b>Colorimeter, UV-visible spectrophotometer</b>	<b>1</b>		

<b>SIPSBOT32</b>	<b>Title of the Paper: <u>Molecular Biology</u></b>			
	<b>I</b>	<b>DNA replication</b>	<b>4</b>	<b>1</b>
	<b>II</b>	<b>Transcription</b>		<b>1</b>
	<b>III</b>	<b>RNA processing</b>		<b>1</b>
<b>IV</b>	<b>Translation</b>	<b>1</b>		

<b>SIPSBOT31</b>	<b>Techniques and Instrumentation</b>	<b>2</b>	<b>4</b>
<b>SIPSBOT32</b>	<b>Molecular Biology</b>	<b>2</b>	<b>4</b>

**Specialization: Molecular Biology, Cytogenetics & Plant Biotechnology (MBC)**

<b>SIPSBOTCP33</b>	<b>Title of the Paper: <u>Plant Biotechnology</u></b>			
	<b>I</b>	<b>Plant Tissue Culture I</b>	<b>4</b>	<b>1</b>
	<b>II</b>	<b>Plant Tissue Culture II</b>		<b>1</b>
	<b>III</b>	<b>Biotransformation</b>		<b>1</b>
<b>IV</b>	<b>Commercial Aspects</b>	<b>1</b>		

<b>SIPSBOTCP34</b>	<b>Title of the Paper: <u>Molecular Biology and Cytogenetics</u></b>			
	<b>I</b>	<b>Cytology</b>	<b>4</b>	<b>1</b>
	<b>II</b>	<b>Cancer Biology</b>		<b>1</b>
	<b>III</b>	<b>Immune System</b>		<b>1</b>
<b>IV</b>	<b>Genetic Diseases</b>	<b>1</b>		

<b>SIPSBOTPCP33</b>	<b>Plant Biotechnology</b>	<b>2</b>	<b>4</b>
<b>SIPSBOTPCP34</b>	<b>Project</b>	<b>2</b>	<b>4</b>

**Specialization: Environmental Botany (EB)**

<b>SIPSBOTEB33</b>	<b>Title of the Paper: <u>Ecology</u></b>			
	<b>I</b>	<b>Basic Ecological Concept</b>	<b>4</b>	<b>1</b>
	<b>II</b>	<b>Ecosystem</b>		<b>1</b>
	<b>III</b>	<b>Biogeochemical Cycles</b>		<b>1</b>
	<b>IV</b>	<b>Natural Resources</b>		<b>1</b>

<b>SIPSBOTEB34</b>	<b>Title of the Paper: <u>Recent Trends &amp; Applied Environmental Botany</u></b>			
	<b>I</b>	<b>Conservation Ecology I</b>	<b>4</b>	<b>1</b>
	<b>II</b>	<b>Conservation Ecology II</b>		<b>1</b>
	<b>III</b>	<b>Biodiversity Studies</b>		<b>1</b>
	<b>IV</b>	<b>Renewable and Non-renewable Sources of Energy</b>		<b>1</b>

<b>SIPSBOTPEB33</b>	<b>Ecology and Environmental Botany</b>	<b>2</b>	<b>4</b>
<b>SIPSBOTPEB34</b>	<b>Project</b>	<b>2</b>	<b>4</b>

**SEMESTER IV Common Papers**

<b>Course Code</b>	<b>UNIT</b>	<b>TOPIC HEADINGS</b>	<b>Credits</b>	<b>L / Week</b>
<b>SIPSBOT41</b>	<b>Title of the Paper: <u>Techniques And Instrumentation</u></b>			
	<b>I</b>	<b>Centrifugation</b>	<b>4</b>	<b>1</b>
	<b>II</b>	<b>Chromatography</b>		<b>1</b>
	<b>III</b>	<b>Tracer Technique &amp;PCR</b>		<b>1</b>
	<b>IV</b>	<b>Nanotechnology &amp; IPR</b>		<b>1</b>

<b>SIPSBOT42</b>	<b>Title of the Paper: <u>Molecular Biology</u></b>			
	<b>I</b>	<b>Gene Regulation I</b>	<b>4</b>	<b>1</b>
	<b>II</b>	<b>Gene Regulation II</b>		<b>1</b>
	<b>III</b>	<b>Gene Regulation III</b>		<b>1</b>
	<b>IV</b>	<b>Cell Signalling</b>		<b>1</b>

<b>SIPSBOTP41</b>	<b>Techniques And Instrumentation</b>	<b>2</b>	<b>4</b>
<b>SIPSBOTP42</b>	<b>Molecular Biology</b>	<b>2</b>	<b>4</b>

**Specialization: Molecular Biology, Cytogenetics & Biotechnology (MCB)**

<b>SIPSBOTCP43</b>	<b>Title of the Paper: <u>Plant Biotechnology</u></b>			
	<b>I</b>	<b>Environmental Biotechnology</b>	<b>4</b>	<b>1</b>
	<b>II</b>	<b>Traditional Knowledge &amp; IPR</b>		<b>1</b>
	<b>III</b>	<b>Nanotechnology</b>		<b>1</b>
	<b>IV</b>	<b>Food Biotechnology</b>		<b>1</b>

<b>SIPSBOTCP44</b>	<b>Title of the Paper: Molecular Biology and <u>Cytogenetics</u></b>			
	<b>I</b>	<b>Plant Breeding I</b>	<b>4</b>	<b>1</b>
	<b>II</b>	<b>Plant Breeding II</b>		<b>1</b>
	<b>III</b>	<b>Molecular Plant Breeding</b>		<b>1</b>
	<b>IV</b>	<b>Plant Genetic Engineering</b>		<b>1</b>

<b>SIPSBOTPCP43</b>	<b>Plant Biotechnology</b>	<b>2</b>	<b>4</b>
<b>SIPSBOTPCP44</b>	<b>Project</b>	<b>2</b>	<b>4</b>

**Specialization : Environmental Botany (EB)**

<b>SIPSBOTE43</b>	<b>Title of the Paper: <u>Ecology &amp; Environmental Botany</u></b>			
	<b>I</b>	<b>Pollution</b>	<b>4</b>	<b>1</b>
	<b>II</b>	<b>Climate Change</b>		<b>1</b>
	<b>III</b>	<b>Plant Population Dynamics</b>		<b>1</b>
	<b>IV</b>	<b>Coastal Zone Management of India</b>		<b>1</b>

<b>SIPSBOTE44</b>	<b>Title of the Paper: <u>Recent Trends &amp; Applied Environmental Botany</u></b>			
	<b>I</b>	<b>Restoration of Ecosystem I</b>	<b>4</b>	<b>1</b>
	<b>II</b>	<b>Restoration of Ecosystem II</b>		<b>1</b>
	<b>III</b>	<b>Restoration of Land</b>		<b>1</b>
	<b>IV</b>	<b>Water shed Management</b>		<b>1</b>

<b>SIPSBOTPEB43</b>	<b>Ecology &amp; Environmental Botany</b>	<b>2</b>	<b>4</b>
<b>SIPSBOTPEB44</b>	<b>Project</b>	<b>2</b>	<b>4</b>

**SEMESTER III**  
**General Papers**

Course Code	Title	Credits
<b>SIPSBOT31</b>	<b>Techniques and Instrumentation</b>	<b>4</b>
<p><b>LEARNING OBJECTIVES</b> The students will be able to-</p> <ul style="list-style-type: none"> <li>❖ Learn testing of hypothesis; different statistical tests &amp; their applications.</li> <li>❖ Study different types of databases; their organization &amp; analysis.</li> <li>❖ Understand various instrumentation techniques and bio-analysis through spectrophotometry &amp; electrophoresis. Measurements of pH &amp; buffers.</li> </ul>		
<p><b><u>UNIT I: Biostatistics</u></b></p> <ol style="list-style-type: none"> <li>1. Hypothesis testing: Theory of errors – Type I and Type II errors, Null Hypothesis, z-test, Test of significance.</li> <li>2. Introduction to ANOVA, One-way &amp; two way ANOVA, Dunett's test.</li> <li>3. Randomized Block Design and Latin Square. (5 problems to be solved in each category)</li> </ol>		<b>1</b>
<p><b><u>Unit II: Bioinformatics</u></b></p> <ol style="list-style-type: none"> <li>1. Organization of biological data, databases (raw and processed), Queering in data bases.</li> <li>2. Gene finding, motif finding and multiple sequence alignment.</li> <li>3. Protein sequence analysis (theory and algorithms).</li> <li>4. Exploration of databases, retrieval of desired data, BLAST etc.</li> </ol>		<b>1</b>
<p><b><u>Unit III: pH and Buffers; Electrophoresis</u></b></p> <ol style="list-style-type: none"> <li>1. pH and buffer solutions, acids and bases, hydrogen ion concentration, dissociation of acids and bases, measurement of pH, titration curves. Physiological Buffers.</li> <li>2. Electrophoresis: Theory and application,</li> <li>3. PAGE (Native &amp; SDS) and AGE</li> <li>4. 2D Electrophoresis</li> </ol>		<b>1</b>
<p><b><u>Unit IV: Microscopy &amp; Spectroscopy</u></b></p> <ol style="list-style-type: none"> <li>1. Principles, instrumentation, working and applications of Fluorescence microscope, TEM, SEM, Biological sample preparation for electron microscopy</li> <li>2. IR, AAS, Plasma Emission spectroscopy, NMR, MS</li> </ol>		<b>1</b>

Course Code	Topic	Credits: 4
SIPSBOT32	Molecular Biology	
<b>LEARNING OBJECTIVES</b>		
The students will be able to- <ul style="list-style-type: none"> <li>❖ Study molecular mechanism of DNA replication &amp; recombination.</li> <li>❖ Understand mechanism of transcription and RNA processing.</li> <li>❖ Learn method of translation &amp; protein synthesis.</li> </ul>		
<b>UNIT I:DNA Replication</b> <ul style="list-style-type: none"> <li>• Molecular details of DNA replication in prokaryotes and eukaryotes.</li> <li>• Assembly of raw DNA into nucleosomes.</li> <li>• DNA recombination, Holliday model for recombination.</li> </ul>		<b>1</b>
<b>Unit II: Transcription</b> <ul style="list-style-type: none"> <li>• Transcription, RNA synthesis, classes of RNA and the genes that code for them.</li> <li>• Transcription of protein coding genes, prokaryotes and eukaryotes, mRNA molecule.</li> <li>• Transcription of other genes, ribosomal RNA, and ribosomes, tRNA.</li> </ul>		<b>1</b>
<b>Unit III:RNA processing</b> <ul style="list-style-type: none"> <li>• Capping, polyadenylation, splicing, introns and exons.</li> <li>• SnRNA - Types, snRNA in spliceosome, significance of snRNA</li> <li>• Non coding RNAs, ribozyme, riboswitches, RNA localization.</li> </ul>		<b>1</b>
<b>Unit IV: Translation</b> <ul style="list-style-type: none"> <li>• Protein structure, nature of genetic code, translation of genetic message.</li> <li>• Post translational modifications, localization, chaperons.</li> </ul>		<b>1</b>

**Practical**

SIPSBOTP31	<u>Instrumentation and Techniques</u>	2	4
<ul style="list-style-type: none"> <li>• Hypothesis testing, Normal deviate test.</li> <li>• Application of analysis of variance (ANOVA) 1way &amp; 2way</li> <li>• Randomized block Design and Latin square</li> <li>• Multiple alignments – phylogenetic tree.</li> <li>• BLAST</li> <li>• Motif finding pH and buffers</li> <li>• Preparation of Buffers –Phosphate &amp; Acetate</li> <li>• Determination of pKa</li> </ul>			

<b>SIPSBOTP32</b>	<b><u>Molecular Biology</u></b>	<b>2</b>	<b>4</b>
<ul style="list-style-type: none"> <li>• Aseptic techniques, safe handling of microorganisms</li> <li>• Establishing pure cultures, streak plate method- T streak, pentagon method, pour plate spread plate</li> <li>• Maintenance of cultures - Paraffin embedding, Lyophilisation.</li> <li>• Preparation of culture medium, stock solutions</li> <li>• Determination of cell number, viable count method (using pour plate and serial dilution technique).</li> <li>• Separation of seed proteins using PAGE.</li> <li>• Analysis of proteins by one and two dimensional gel electrophoresis.</li> <li>• Genomic DNA isolation and quantification.</li> </ul>			

### Special Papers

#### Specialisation: Molecular Biology, Cytogenetics and Biotechnology (MCB)

Course Code	Topic		Credit
<b>SIPSBOTCP33</b>	<b>Plant Biotechnology</b>		
	<p><b>LEARNING OBJECTIVES</b> The students will be able to-</p> <ul style="list-style-type: none"> <li>❖ Study somaclonal variations &amp; Plant cell cultures as chemical factories.</li> <li>❖ Understand mechanism of <i>Agrobacterium</i> mediated transformed root cultures.</li> <li>❖ Learn method of Biotransformation &amp; protein synthesis &amp; quest for commercial products.</li> </ul>		
	<p><b><u>UNIT I: Plant Tissue Culture I</u></b></p> <ul style="list-style-type: none"> <li>• Micropropagation of floricultural and medicinal plants using organogenesis and embryogenesis.</li> <li>• Factors responsible for <i>in vitro</i> and <i>ex vitro</i> hardening.</li> <li>• Plant improvement through somaclonal variations.</li> </ul>		
	<p><b><u>Unit II: Plant Tissue Culture II</u></b></p> <ul style="list-style-type: none"> <li>• Plant cell cultures as chemical factories: Cell suspension, enhancement of product formation using biotic and abiotic elicitors, immobilization, permeabilization and product recovery.</li> <li>• Problems in plant tissue culture: contamination, phenolics and recalcitrants.</li> <li>• In vitro storage of germplasm, Cryopreservation</li> </ul>		
	<p><b><u>Unit III: Biotransformation</u></b></p> <ul style="list-style-type: none"> <li>• Biotransformation using: Freely suspended plant cells and Immobilized plant cells,</li> <li>• Biotransformation for Vanillin production from Capsicum cell cultures.</li> <li>• In vitro storage of germplasm, cryopreservation.</li> <li>• Studies on <i>Agrobacterium</i> mediated transformed root cultures.</li> </ul>		



	<p><b><u>Unit IV: Commercial aspects</u></b></p> <ul style="list-style-type: none"> <li>• The quest for commercial production from plant cell: scaling up of cell cultures,</li> <li>• Bioreactors: factors for bioreactor design, pneumatically agitated bioreactors, comparison of bioreactors, operating mode, batch, fed-batch, semicontinuous, two stage operation, continuous cultivation.</li> <li>• Factors for growth in Bioreactors.</li> <li>• Shikonin production by <i>Lithospemum erythrorhizon</i> cell cultures.</li> </ul>
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Course Code	Topic	Credits
<b>SIPSBOTCP34</b>	<b>Molecular Biology and Cytogenetics</b>	<b>4</b>
<p><b>LEARNING OBJECTIVES</b> The students will be able to-</p> <ul style="list-style-type: none"> <li>❖ Study Cell membrane and permeability, also Organization and function of mitochondrial and chloroplast genomes.</li> <li>❖ Understand Characteristics, causes, spread, Course of cancer cell formation &amp; treatment.</li> <li>❖ Learn Phylogeny of immune system &amp; Genetic disorders, genetic counseling and gene therapy.</li> </ul>		
<p><b><u>UNIT I: Cytology</u></b></p> <ul style="list-style-type: none"> <li>• Cell membrane and permeability: Molecular models of cell membrane, cell permeability. Differentiation of cell membrane, intercellular communications and gap junctions. Cell coat and cell recognition, cell surface.</li> <li>• Cell Cycle and Apoptosis: Mechanism of Cell division; Regulation, Roles of Cyclins and Cyclin dependent kinases, Cell Plate formation, PCD.</li> <li>• Organization and function of mitochondrial and chloroplast genomes.</li> </ul>		<b>1</b>
<p><b><u>Unit II: Cancer Biology</u></b></p> <ul style="list-style-type: none"> <li>• Cancer cells: Characteristics, division, spread, treatment. Course of cancer cell formation, Carcinogens: radiations, chemicals, oncogenic virus.</li> <li>• Cancer and mutations, reproductive properties of transformed animal cell in culture, oncogenes, proto-oncogenes and their conversion. Oncogenes and growth factors.</li> </ul>		<b>1</b>
<p><b><u>Unit III: Immune System</u></b></p> <ul style="list-style-type: none"> <li>• Phylogeny of immune system, innate and acquired immunity, nature and biology of antigens, major histocompatibility complex cells of immune system, regulation of immune responses. Production of antibodies by plant cells and organs.</li> <li>• Immunity in Health and Disease: Immunodeficiency and AIDS</li> </ul>		<b>1</b>
<p><b><u>Unit IV: Genetic Diseases</u></b></p> <ul style="list-style-type: none"> <li>• Genetic disorders, genetic counselling and gene therapy</li> <li>• Biochemical disorders, sex linked disorders, cardiovascular disorders.</li> </ul>		<b>1</b>

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<b>SIPSBOTPCP33</b>	<b><u>Plant Biotechnology</u></b>	<b>2</b>	<b>4</b>
<ul style="list-style-type: none"> <li>• Preparation of stock solutions and MS medium.</li> <li>• Callus induction and regeneration.</li> <li>• Isolation of bioactive compounds from callus and plant source using TLC.</li> <li>• Types of Bioreactors.</li> </ul>			
<b>SIPSBOTPCP34</b>	<b><u>Molecular Biology &amp; Cytogenetics</u></b>	<b>2</b>	<b>4</b>
<b>Project</b>			

### Specialisation: Environmental Botany

Course Code	Topic	Credits: 4
<b>SIPSBOTE33</b>	<b><u>Ecology and Environmental Botany</u></b>	
<p><b>LEARNING OBJECTIVES</b> The students will be able to-</p> <ul style="list-style-type: none"> <li>❖ Learn various Bio-geochemical Cycle &amp; their impact on environment and health.</li> <li>❖ Understand basic ecological concepts &amp; types of ecosystems.</li> <li>❖ Study natural resources w.r.t. use and over-exploitation.</li> </ul>		
<p><b><u>UNIT I: Basic Ecological Concept</u></b></p> <ul style="list-style-type: none"> <li>• Ecosystem: Definition, Components of Ecosystems, Trophic Levels, Food Chains, Food Webs, Ecological Pyramids, Ecosystem Energetics, Laws of Thermodynamics, Energy Flow Models in Terrestrial Ecosystem</li> <li>• Concept of Productivity, Principles of Limiting Factor, Liebig's Law, Shelford Law of Tolerance, Basic Concepts in Ecology</li> <li>• Branches of Ecology: Autecology; Aims, Aspects: General Account of Seed, Seed Output, Seed Dispersal, Seed Viability, Seed Dormancy, Reproductive Capacity, Growth Regulators and Seed Germination</li> <li>• Synecology: Plant Community, Ecological Amplitude, Population Characteristics: Association, Consociation, Faciation, Society</li> </ul>		<b>1</b>
<p><b><u>Unit II: Ecosystem</u></b></p> <ul style="list-style-type: none"> <li>• Succession; Causes, Types, Steps, Migration, Ecesis, Aggregation, Competition, Invasion, Hydrosere, Xerosere, Climax, Disclimax, Sub Climax</li> <li>• Plant and Plant Communities as Indicators: Forests as Indicators, Grassland, Soil types, Salinity, Grazing, Indicators of Forests.</li> <li>• Types of Habitat: Marine, Freshwater, Estuarine</li> <li>• Seaweeds: their uses, maintenance and control.</li> </ul>		<b>1</b>

<p><b><u>Unit III: Bio-Geochemical Cycle</u></b></p> <ul style="list-style-type: none"> <li>• <b>Gaseous Cycle:</b></li> <li>• Nitrogen Cycle: Role of Nitrogen in Plant Metabolism and Biosphere. Nitrogen Cycle change due to human activity – Agricultural Nitrogen Fixation, Industrial Emissions, Transportations. Impact in terms of Eutrophication of Environment and Health.</li> <li>• Carbon Cycle: Forms and places of occurrence of Carbon. Photosynthetic Sequestration of Carbon. Role of Carbon in Forest Ecosystems. Cycling of Carbon in Biosphere. Role of carbon in Global Warming Problem and its possible implication.</li> <li>• <b>Sedimentary Cycle:</b></li> <li>• Sulphur Cycle: Forms of Sulphur in biosphere and geosphere, in fossil fuels and its release with industrialization, Sulphur cycling in Soil Bacterial Metabolism.</li> <li>• Phosphorus Cycle: Ecological Function, Biological Function and process of cycle</li> </ul>	<b>1</b>
<p><b><u>Unit IV: Natural Resources</u></b></p> <ul style="list-style-type: none"> <li>• Forest Resources: Use And Over-Exploitation</li> <li>• Biome types of India</li> <li>• Biocitation of Tropical, Temperate, Alpine And Desert Biomes</li> <li>• Gap Dynamics in Tropical Forests and Parameters Of Gap Dynamics, Importance of gap dynamics</li> </ul>	<b>1</b>

Course Code	Topic	Credits: 4
SIPSBOTEB34	<b><u>Recent Trends &amp; Applied Environmental Botany</u></b>	
<p><b>LEARNING OBJECTIVES</b>  The students will be able to-</p> <ul style="list-style-type: none"> <li>❖ Learn various conservation techniques &amp; Role of national and international organizations in conservation.</li> <li>❖ Understand Biodiversity w.r.t. concept, levels, Status, role in ecosystem function and stability.</li> <li>❖ Study Renewable and Non-renewable sources of Energy.</li> </ul>		
<p><b><u>UNIT I: Conservation Ecology –I</u></b></p> <ul style="list-style-type: none"> <li>• Role of National and International Organisations in Conservation and Some relevant terms UNDP, WWF, World Bank, BNHS, MoEF, DST,DBT, CSIR, CPCB, Municipal Corporation Agenda 21, NGOS, IBGP, TRIPS.</li> <li>• Legislation Aiming at Conservation (Objectives and penalties), Environment Protection act 1986, Forest Conservation Act 1980, Wildlife protection Act 1972</li> <li>• Conventions: Earth summit, Vienna Convention, Ramsar Convention, Protocol: Montreal protocol, Cartagena protocol</li> <li>• Case studies: Tuvalu -A sinking nation, Basmati patent issue, Chernobyl Disaster.</li> </ul>		<b>1</b>

<p><b><u>Unit II: Conservation Ecology II</u></b></p> <ul style="list-style-type: none"> <li>• EIA- Environmental Impact Assessment-Types, Benefits, Process Monitoring and Evaluation, Risk Management. Role or Contribution of Botanist in EIA And EMP</li> <li>• Environmental Impact Assessment for Physical, Chemical, Biological and Socio-Economic Factors; Legislative Implications of EIA, Environmental Impacts Assessment and Environmental Auditing.</li> <li>• Watershed Management: Economics Assessment of Watershed Development Vis-A-Vis Ecological and Environmental Protection.</li> <li>• Soil Conservation - Definition, Causes For Erosion; Types - Wind And Water Erosion; Conservation And Management Of Eroded Soils/Areas, Wind Breaks, Shelter Belts; Sand Dunes; Reclamation Of Saline And Alkaline Soils, Water Logged And Other Waste Lands</li> </ul>	<p><b>1</b></p>
<p><b><u>Unit III: Biodiversity Studies</u></b></p> <ul style="list-style-type: none"> <li>• Biodiversity: Concepts and Levels, National &amp; Global Status, Role of Biodiversity in Ecosystem Function And Stability, Speciation And Extinction, IUCN Categories Of Threats, Distribution And Global Pattern</li> <li>• Biodiversity Hotspots, Inventory. Types Of Resources., Conservation, In-Situ, Ex-Situ; Biosphere reserves, National Parks, Sanctuaries, Forest Conservation Chipko Movement</li> <li>• Biodiversity Management Approaches: Measures of Maintaining Biodiversity, Need For Preservation of Biodiversity With Special Reference to Tropical Forest Biodiversity Centers of Origin of Crops, Species Concept; Significance of Biodiversity; Plant Genetic Resources, Exploration and Collection; Crop Domestication, Plant Introductions; Migration and Utilization; IUCN Clauses and Concept of Threatened and Endangered species</li> <li>• Endemism, Endemic and Exotic Plants Of India, PAN</li> </ul>	<p><b>1</b></p>
<p><b><u>Unit IV: Renewable and Non-Renewable Sources of Energy</u></b></p> <ul style="list-style-type: none"> <li>• Concept and Demand of Energy, Growing Energy Needs, Renewable and Non-Renewable Sources, use of Alternate Energy Sources, Wind Energy, Solar Energy.</li> <li>• Water as Source of Energy.</li> <li>• Biofuels Production, Use and Sustainability, Use and Over Exploitation of Energy Sources and Associated Problems. □Nuclear and geothermal energy.</li> </ul>	<p><b>1</b></p>

## PRACTICAL

<b>SIPSBOTPEB33</b>	<b><u>Ecology and Environmental Botany</u></b>	<b>2</b>	<b>4</b>
<ol style="list-style-type: none"> <li>1. Comparison of Primary Productivity by I) Chlorophyll Method, II) Harvest Method And III) Light And Dark Bottle Method in Polluted and Unpolluted Regions.</li> <li>2. Determination of pH, Electrical Conductivity and Water Holding Capacity of Different Soil types using Gooch crucible.</li> <li>3. Determination of Total Organic Carbon of the Soil</li> <li>4. To Study the Quantitative Characters of Plant Community by Quadrat Method. (Density Frequency Abundance)</li> <li>5. To Determine Diversity Indices in Plant Communities.</li> <li>6. Preparation of maps of Biosphere Reserves of India.</li> <li>7. Preparation of location maps of National parks and Sanctuaries in India.</li> </ol>			
<p>Prepare a document of endemic and exotic species of plants for a selected protected area network (PAN).(Field Exercise-Report To Be Submitted along with Journal).</p>			
<b>SIPSBOTPEB34</b>		<b>2</b>	<b>4</b>
<b>Project Synopsis</b>			

### SYLLABUS SEMESTER IV General Papers

Course Code	Title	Credits
<b>SIPSBOT41</b>	<b>Techniques and Instrumentation</b>	<b>4</b>
<p><b>LEARNING OBJECTIVES</b> The students will be able to-</p> <ul style="list-style-type: none"> <li>❖ Study chromatography &amp; centrifugation.</li> <li>❖ Understand principles and application of Nanotechnology &amp; IPR.</li> <li>❖ Learn principle and application of tracer techniques in biology.</li> </ul>		
<p><b><u>UNIT I: Centrifugation</u></b></p> <ul style="list-style-type: none"> <li>• Basics principle of Sedimentation</li> <li>• Types of rotors</li> <li>• Differential &amp; density gradient centrifugation</li> <li>• Preparative centrifugation &amp; Applications; Analytical centrifugation &amp; applications.</li> </ul>		<b>1</b>

<p><b><u>Unit II: Chromatography</u></b></p> <ul style="list-style-type: none"> <li>• General Principle of chromatography.</li> <li>• Techniques and applications of Ion exchange, Affinity Chromatography &amp; HPLC</li> <li>• Application of HPTLC &amp; HPLC in validation of herbal drugs</li> </ul>	<b>1</b>
<p><b><u>Unit III: Tracer techniques &amp; PCR</u></b></p> <ul style="list-style-type: none"> <li>• Pattern and rate of radioactive decay, Units of radioactivity, Stable Isotopes</li> <li>• Principle, instrumentation &amp; technique: Geiger-Muller counter, Liquid scintillation counters &amp; Autoradiography</li> <li>• Applications of isotopes in biology: Tracer techniques &amp; Autoradiography</li> <li>• PCR and its applications</li> </ul>	<b>1</b>
<p><b><u>Unit IV: Nanotechnology &amp; IPR</u></b></p> <ul style="list-style-type: none"> <li>• Synthesis of nanoparticles using biological samples.</li> <li>• Characterization of nanoparticles (FTIR, SEM, TEM, STEM, Scanning Tunnelling Microscope, Atomic Force Microscope, UV-Vis.).</li> <li>• IPR: Objectives, process &amp; scope</li> </ul>	<b>1</b>

Course Code	Topic	Credits: 4
<b>SIPSBOT42</b>	<b>Molecular Biology</b>	
<p><b>LEARNING OBJECTIVES</b></p> <p>The students will be able to-</p> <ul style="list-style-type: none"> <li>❖ Study Regulations of gene expression in bacteria &amp; bacteriophage.</li> <li>❖ Understand control of gene expression in eukaryotes &amp; <i>Drosophila</i>.</li> <li>❖ Learn concepts involved in Cell signalling.</li> </ul>		
<p><b><u>UNIT I: Gene Regulation I</u></b></p> <ul style="list-style-type: none"> <li>• Regulations of gene expression in bacteria – trp operon, ara operon, histidine operon.</li> <li>• Regulation of gene expression in bacteriophage <math>\lambda</math>.</li> </ul>		<b>1</b>
<p><b><u>Unit II: Gene Regulation II</u></b></p> <ul style="list-style-type: none"> <li>• Control of gene expression in eukaryotes, Transcriptional control, RNA processing control, mRNA translocation control, mRNA degradation control, protein degradation control</li> </ul>		
<p><b><u>Unit III: Gene Regulation III</u></b></p> <ul style="list-style-type: none"> <li>• Genetic regulation of development in <i>Drosophila</i></li> <li>• Developmental stages in <i>Drosophila</i> – embryonic development, imaginal discs, homeotic genes</li> </ul>		<b>1</b>
<p><b><u>Unit IV: Cell signalling</u></b></p> <ul style="list-style-type: none"> <li>• Hormones and their receptors, cell surface receptor, , intracellular receptor, signalling through G-protein coupled receptors, signal relay pathways-signal transduction pathways, second messengers, regulation of signalling pathways, bacterial and plant two-component systems, light signalling in plants, bacterial chemotaxis and quorum sensing.</li> <li>• Forms of signalling (paracrine, synaptic, autocrine, endocrine, cell to cell contact)</li> </ul>		<b>1</b>

### Practical

<b>SIPSBOTP41</b>	<b><u>Techniques And Instrumentation</u></b>	<b>2</b>	<b>4</b>
<ul style="list-style-type: none"> <li>• Separation of proteins by Ion exchange chromatography.</li> <li>• Separation of amino acids by two dimensional chromatography.</li> <li>• Viscosity studies of proteins: standard BSA and varying concentrations of urea</li> <li>• Synthesis of nanoparticles.</li> <li>• Characterization of nanoparticles by UV spectroscopy.</li> <li>• Filing a patent.</li> <li>• Industrial visit and report submission.</li> </ul>			
<b>SIPSBOTP42</b>	<b><u>Molecular Biology</u></b>	<b>2</b>	<b>4</b>
<ul style="list-style-type: none"> <li>• Isolation of plasmid DNA</li> <li>• Quantification of plasmid DNA</li> <li>• Agarose gel electrophoresis separation of plasmid DNA</li> <li>• Restriction enzyme digestion and separation of fragments</li> <li>• Southern blot transfer technique</li> <li>• Transformation of <i>E. coli</i> cell by plasmid DNA</li> <li>• <math>\beta</math>-galactosidase expression and assay.</li> </ul>			

### Special Papers

#### Specialisation: Molecular Biology, Cytogenetics and Biotechnology(MCB)

Course Code	Topic	Credits: 4
<b>SIPSBOTCP43</b>	<b>Plant Biotechnology</b>	
<b>LEARNING OBJECTIVES</b>		
The students will be able to -		
<ul style="list-style-type: none"> <li>❖ Study Environmental biotechnology &amp; processing bio waste</li> <li>❖ Understand synthesis of nanomaterials &amp; their applications in different fields.</li> <li>❖ Learn objectives IPR &amp; food biotechnology with applications.</li> </ul>		
<b><u>UNIT I: Environmental Biotechnology</u></b>		<b>1</b>
<ul style="list-style-type: none"> <li>• Biosorption: use of fungi, algae and biological components</li> <li>• Biomass for energy: Sources of biomass, advantages &amp; disadvantages, uses of biomass</li> <li>• Biogas production from food processing waste: vegetable canning waste flour, molasses, etc.</li> <li>• Ethanol from biomass and Lignocellulosic residue □ Risks of GMO</li> </ul>		
<b><u>Unit II: Traditional Knowledge &amp; IPR</u></b>		<b>1</b>
<ul style="list-style-type: none"> <li>• Different property rights &amp; IPR in India</li> <li>• TRIPS &amp; Patent laws: Introduction &amp; standards for patent protection</li> <li>• WTO &amp; Indian Patent Laws</li> <li>• Protection of traditional knowledge– objective, concept of traditional knowledge, holders, issue concerning, bio-prospecting and biopiracy; Advantages of IPR, some case studies</li> <li>• International Depository authority, Gene patenting, plant variety protection, trade secrets &amp; plant breeders right</li> </ul>		

<p><b><u>Unit III :Nanotechnology</u></b></p> <ul style="list-style-type: none"> <li>• Introduction, properties of nano-materials.</li> <li>• Green synthesis of nano-materials, biological methods, use of microbial system &amp; plant extracts, use of proteins &amp; templates like DNA</li> <li>• Application of nano-materials in food, cosmetics, agriculture, environment management and medicine</li> <li>• Risk of Nanomaterial to human health and Environment</li> </ul>	<b>1</b>
<p><b><u>Unit IV: Food Biotechnology</u></b></p> <ul style="list-style-type: none"> <li>• Factors affecting spoilage</li> <li>• Quality control of food</li> <li>• Enzyme immunoassays (ELISA)</li> <li>• Radioimmunoassay (RIA), Monoclonal antibodies and DNA probes.</li> </ul>	<b>1</b>

Course Code	Topic	Credits: 4
<b>SIPSBOTCP44</b>	<b>Cytogenetics and Molecular Biology</b>	
<p><b>LEARNING OBJECTIVES</b> The students will be able to-</p> <ul style="list-style-type: none"> <li>❖ Learn Aims and objectives of Plant Breeding &amp; different methods of plant improvements.</li> <li>❖ Understand various mechanism of production of transgenic plants.</li> <li>❖ Study Molecular Markers with their application in plant biotechnology.</li> </ul>		
<p><b><u>UNIT I:Plant Breeding I</u></b></p> <ul style="list-style-type: none"> <li>• Aims and objectives, plant introductions and acclimatization.</li> <li>• Selection – mass, pure line and clonal.</li> <li>• Hybridization techniques, hybridization in self -pollinated and cross pollinated plants.</li> <li>• Genetic control and manipulation of breeding systems including male sterility and apomixes</li> </ul>		<b>1</b>
<p><b><u>Unit II: Plant Breeding II</u></b></p> <ul style="list-style-type: none"> <li>• Distant hybridization: In nature ( plant breeding) – Barriers to the production of distant hybrids; Unreduced gametes in distant hybridization; Sterility in distant hybrids; Consequences of segregation in distant hybrids;</li> <li>• Applications and Achievements of distant hybridization in crop improvement; Limitations of distant hybrids.</li> </ul>		<b>1</b>
<p><b><u>Unit III: Molecular plant Breeding (Transgenic Crops)</u></b></p> <ul style="list-style-type: none"> <li>• Natural method of gene transfer (<i>Agrobacterium</i> and virus), selectable markers</li> <li>• Artificial methods of gene transfer: Direct DNA uptake by protoplast, electroporation, liposome mediated and particle gun transformation</li> <li>• Production of Transgenic plants :virus resistant &amp; Herbicide –resistant, plants, Bt-Cotton, Golden rice</li> </ul>		<b>1</b>



<b>Unit IV: Plant Genetic Engineering</b> <ul style="list-style-type: none"> <li>• Production of bio pharmaceuticals in transgenic plants.</li> <li>• Edible vaccines &amp; Plantibodies</li> <li>• DNA-based molecular marker aided breeding: RAPD, RFLP, AFLP, STS, ISSR, Microsatellites</li> </ul>	<b>1</b>
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**PRACTICAL**

<b>SIPSBOTPCP43</b>	<b><u>Plant Biotechnology</u></b>	<b>2</b>	<b>4</b>
<ol style="list-style-type: none"> <li>1. Identification of mutant genotype in Drosophila and Arabidopsis stocks maintained by the department.</li> <li>2. Field exploration for detection of male sterile plants and estimation of their pollen fertility in locally grown plants (Tomato, Brassica, Linum).</li> <li>3. Study of mitotic index.</li> <li>4. Culturing of Drosophila and study of genetic traits.</li> <li>5. Blood group testing.</li> <li>6. Identification of genetic diseases by chemical tests.</li> <li>7. Karyotypes of genetic disorders.</li> </ol>			
<b>SIPSBOTPCP44</b>	<b><u>Molecular Biology &amp; Cytogenetics</u></b>	<b>2</b>	<b>4</b>
<b>Project</b>			

**Specialisation: Environmental Botany**

Course Code	Topic	Credits:4
<b>SIPSBOTE43</b>	<b><u>Ecology and Environment Botany</u></b>	
<p><b>LEARNING OBJECTIVES</b>                      The students will be able to-</p> <ul style="list-style-type: none"> <li>❖ Learn various types of pollution &amp; Climatic Changes w.r.t. their impact on ecosystem and productivity.</li> <li>❖ Understand characteristics &amp; measurements of Plant Population Dynamics.</li> <li>❖ Study methods used in Coastal Zone Management in India</li> </ul>		
<p><b><u>UNIT I: Pollution</u></b>  <b>Environmental Pollution:</b> Photochemical smog-Concept, London type smog, inhibition, adverse effect of photochemical smog. Types of particulate matter, removal of particulate matter from air.</p> <ol style="list-style-type: none"> <li>1. Radiation- Manmade and natural, biological effects of radiation. Maximum permissible doses. Abnormal exposures in emergencies and accidents. Nuclear fission and radiation hazards Radioactive waste management.</li> <li>2. Fossil fuels automobile emissions from vehicles. Alternate fuels- CNG, Propane and methanol.</li> <li>3. Environmental impact of petroleum products-Impact of crude oil on marine life.</li> </ol>		<b>1</b>
<p><b><u>Unit II: Climatic Change</u></b></p> <ul style="list-style-type: none"> <li>• Global Climate Change: Concept, Green House Gases, Their Major Sources, Ozone Layer</li> <li>• Consequences Of Climate Change (CO<sub>2</sub> Level, Global Warming, UV Radiation).</li> <li>• Kyoto Protocol: Major Recommendations,</li> <li>• Concept of Carbon Footprint, Carbon Credits, Importance Of Carbon Foot printing.</li> </ul>		<b>1</b>
<p><b><u>Unit III: Plant Population Dynamics</u></b></p> <ul style="list-style-type: none"> <li>• Population - Characteristics And Measurement; Communities - Habitats, Niches, Population Dynamics, Species And Individual in the Ecosystem.</li> <li>• <b>Allelopathy:</b> Concept, Allelochemicals, Leachates, Root Exudates, Weed – Crop Interactions, Weed Control, Herbicides From Natural Compunds, Methods For Determining Allopathy, Petriplate Experiments, Allelochemicals As Nematicides (Narwals Work)</li> <li>• <b>Stress ecology:</b> Stress and plant life stress due to temperature, radiation, water, salt and anthropogenic activity,</li> <li>• Bioindicators of stress.</li> </ul>		<b>1</b>
<p><b><u>Unit IV: Coastal Zone Management In India</u></b></p> <ul style="list-style-type: none"> <li>• Coastal Zone Management in India- Coastal Environment India, Coastal Issues, Land Use and Changes.</li> <li>• Coastal Zone Management, initiatives In India, Prohibited and Regulated activities in Coastal Areas, State Coastal Zone Management Authorities.</li> <li>• Mangrove: Habitat And Characteristics, Mangrove, Plantation-Establishment and Rehabilitation of degraded mangrove formations; silvicultural systems.</li> <li>• Mangrove protection of habitats against natural disasters.</li> </ul>		<b>1</b>

Course Code	Topic	Credits: 4
<b>SIPSBOTE44</b>	<b><u>Recent Trends &amp; Applied Environmental Botany</u></b>	
<p><b>LEARNING OBJECTIVES</b>  The students will be able to-</p> <ul style="list-style-type: none"> <li>❖ Learn various techniques involved in Restoration of Ecosystems.</li> <li>❖ Understand concept of construction &amp; application of Water Shed management.</li> <li>❖ Study the different methods of land restoration.</li> </ul>		
<p><b><u>UNIT I: Restoration Of Ecosystems I</u></b></p> <ul style="list-style-type: none"> <li>• Urban Forests. Role of Urban Forests. Study of Urban Health Through Surveys Of Urban Trees</li> <li>• Holistic approach to study- Industrial Areas, Population and their Habitats, water and Waste Disposal.</li> <li>• Transportation, Infrastructure, Education, Health, Sport and Entertainment. Amenities And Cultural Issues and Relationship of all these With Plants.</li> <li>• Urban Issues: Urban Challenges, Urban Transport System, Energy Demand</li> <li>• Case Study: Mumbai and Kolkata, with reference to: Air, Noise &amp; Water Pollution.</li> <li>• Restoration efforts Gardens, design of Waste Management, waste storage Transportation, reclamation.</li> <li>• Urban forestry and ecotourism</li> </ul>		<b>1</b>
<p><b><u>Unit II: Restoration Of Ecosystems II</u></b></p> <ul style="list-style-type: none"> <li>• Restoration of Mangrove Ecosystem- Mangroves of coastal Maharashtra, Selection and Treatment of Coastal Area with Reference to Tidal situation and Physical Properties.</li> <li>• Restoration of Mangroves: Choice of Species, Collection of Seeds and Seedling Material, Storage and Plantation.</li> <li>• Problems of Seed Dormancy, Tidal Forces, Predation Nutrient Supply and restoration methods.</li> <li>• Disaster management: Natural calamities and their impact, PEER – Program for enhancement of Emergency response and LCA –Life cycle assessment.</li> </ul>		<b>1</b>
<p><b><u>Unit III: Restoration of Land</u></b></p> <ul style="list-style-type: none"> <li>• Solid waste management: Classification of waste, waste generation, separation and processing, waste treatment and disposal, Factors governing the choice of technology.</li> <li>• Municipal solid waste management and handling rules 2013, Responsibilities of Municipal authorities, state and Central control Boards, Management of municipal solid waste (MSW act 2013).</li> <li>• Biological treatment of waste water from food processing Industry</li> <li>• Biopesticides and integrated pest management</li> <li>• Microbial transformation of heavy metals</li> </ul>		<b>1</b>
<p><b><u>Unit IV: Water Shed management</u></b></p> <ul style="list-style-type: none"> <li>• Concepts of watershed; role of mini-forests and forest trees in overall resource management, forest hydrology</li> <li>• Watershed development in respect of torrent control, river channel stabilization, avalanche and landslide controls, rehabilitation of degraded areas; hilly and mountain areas</li> <li>• Watershed management and environmental functions of forests;</li> <li>• Water-harvesting and conservation; ground water recharge and watershed management; role of integrating forest trees, horticultural crops, field crops, grass and fodders.</li> </ul>		<b>1</b>

**PRACTICAL**

<b>SIPSBOTPEB43</b>	<b><u>Recent Trends &amp; Applied Environmental Botany</u></b>	<b>2</b>	<b>4</b>
<ol style="list-style-type: none"> <li>1. Comparative study of Foliar Dust Capturing Capacity from Different Plant Species (minimum five) collected from polluted and unpolluted sites.</li> <li>2. Preparation of life form spectrum of a plant community (Field Exercise).</li> <li>3. Determination of Importance Value Index (IVI) – Relative frequency, Relative density and Relative dominance.</li> <li>4. Identification of Mangrove species</li> <li>5. Interpretation of satellite imagery, using recent images of familiar areas.</li> <li>6. Identification of some important plants along with their locations, for their importance viz. Conservation status (endangered, threatened, protected, ethnic significance etc).</li> <li>7. Study of mangrove: Field report</li> </ol>			
<b>SIPSBOTPEB44</b>		<b>2</b>	<b>4</b>
<b>Project</b>			

## Reference Books

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**SIES COLLEGE OF ARTS, SCIENCE AND COMMERCE, SION (W) – AUTONOMOUS STATUS**

**Three/Four Semester**

**Class: MSc**

**Sub: Botany**

**Paper: I/II/III/IV**

**Day:**

**Date:**

**Time:**

**Marks: 60**

- N.B.:**
- 1) All questions are Compulsory.**
  - 2) Figures to the right indicate marks.**
  - 3) Draw neat labelled diagrams wherever necessary.**

<b>Q.1</b>	Unit I: Long answer question	<b>(12)</b>
	<b>OR</b>	
	Unit I: Long answer question	
<b>Q.2</b>	Unit II: Long answer question	<b>(12)</b>
	<b>OR</b>	
	Unit II: Long answer question	
<b>Q.3</b>	Unit III: Long answer question	<b>(12)</b>
	<b>OR</b>	
	Unit III: Long answer question	
<b>Q.4</b>	Unit IV: Long answer question	<b>(12)</b>
	<b>OR</b>	
	Unit IV: Long answer question	
<b>Q. 5</b>	Write notes on <b>any three</b> of the following:	<b>(12)</b>
a.	Unit I	
b.	Unit II	
c.	Unit III	
d.	Unit IV	
e.	Unit I / Unit II	
f.	Unit III / Unit IV	

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