



**M. C. E. Society's**  
**Abeda Inamdar Senior College**  
Of Arts, Science and Commerce, Camp, Pune-1  
(Autonomous) Affiliated to Savitribai Phule Pune University  
NAAC accredited 'A' Grade

### **Program Objectives:**

1. To develop conscience towards social responsibility, human values and sustainable development through curriculum delivery and extra-curricular activities
2. To develop scientific temperament with strong fundamental knowledge of the subject
3. To develop analytical thinking and problem-solving skills needed for various entrance and competitive examinations and Post Graduate Studies
4. To train students in laboratory skills and handling equipment along with soft skills needed for placement
5. To inculcate the values of and scope of Ecology, Resource conservation and various green technologies as a part of sustainable development.

### **Program Outcomes:**

- 1) The students will graduate with holistic development.
- 2) The students will be qualified to continue higher studies in their subject.
- 3) The students will be eligible to appear for various competitive examinations and pursue higher education and will be able to apply for the jobs with a minimum requirement of B.Sc. Program.
- 4) The students will understand about various pollution control technologies, green technologies of recent as a part of sustainable development goal.
- 5) The students will acquire knowledge about new innovations for future scope

### **Program Specific Objectives and Outcomes**

#### **Program Specific Objectives:**

The B.Sc. Environmental Science Program will enable the students;

**PSOB-1.** To develop basic understanding of Fundamentals of Environmental Science as a discipline.

**PSOB-2.** To bring sensitization towards the environment and also increase student competency and employability.

**PSOB-3.** To inculcate a sense of responsibility among students about various principles and laws of environment

**PSOB-4.** To encourage students about applicability of knowledge and Interdisciplinary approach in day today's life.

**Program Specific Outcomes:**

After successful completion of B.Sc. Environmental Science Course, student will have:

**PSOC-1.** Fundamental and Advanced knowledge of theory and practical courses in Environmental science.

**PSOC-2.** Students will understand about how the subject knowledge helps in solving various social, economic, environment related problem and circular economy.

**PSOC-3.** Knowledge about various Environmental laws, ISO series, EMS, Standards and Ethics required to pursue higher education in the field.

**PSOC-4.** Knowledge about Environmental (Resource, Energy) Management, Monitoring, introductory aspects of Environmental Biotechnology and Microbiology

**PSOC-5.** Skills in laboratory techniques and experience in instrument handling



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**FACULTY OF SCIENCE**

**Name of BOS -- Life science**

**To be implemented from Academic Year 2024-25**

**B.Sc. Program Structure (Choice Based Credit System, Under NEP Guidelines)**

**S.Y.B.Sc. Environmental Science Program structure and Syllabus**

Sr. no.	Program	Sem.	Offered as	Course Code	Course title	Number of Credits
1.	S.Y.B.Sc.	III	Major-Theory	23SBEV31MM	Ecological Studies	2
2.	S.Y.B.Sc	III	Major-Theory	23SBEV32MM	Natural Resource Management and Sustainability	2
3.	S.Y.B.Sc	III	Major-Theory	23SBEV33MM	Green Technologies for Sustainable Future	2
4.	S.Y.B.Sc	III	Major-Practical	23SBEV34MM	Practical Course on Ecological studies and Resource Conservation	2
5.	S.Y.B.Sc	III	Major	23SBEV3FP	Field Projects	2
6.	S.Y.B.Sc	IV	Major-Theory	23SBEV41MM	Biological Diversity and Conservation	2
7.	S.Y.B.Sc	IV	Major-Theory	23SBEV42MM	Environmental Pollution Control Technologies	2
8.	S.Y.B.Sc	IV	Major-Practical	23SBEV43MM	Practical Course in Biodiversity and Pollution Control Technology	2
9.	S.Y.B.Sc	IV	Major-Practical	23SBEV44MM	Practical Course in Soil and Noise Analysis	2
10.	S.Y.B.Sc	III	Major	23SBEV4CEP	Community Engagement Program	2



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### **Syllabus for Ecological Studies**

**S.Y.B.Sc. 2024-25 (CBCS – Autonomy 21 Pattern)**

<b>Course Title</b>	<b>Ecological Studies</b>	
<b>Course Code: 23SBEV31MM</b>		<b>No. of Credits: 02</b>
<b>Course Type: Major (MM)</b>		<b>Total Teaching Hours: 30</b>

<b>Course Objectives</b>	
<b>1.</b>	To ensure 'well variedness' with the basic concepts of Ecology and to integrate ecological informatics with social science
<b>2.</b>	To integrate People-Planet-Profit and merging Ecological and Social sciences
<b>3.</b>	To bring sensitization towards the environment and also increase student competency and employability.
<b>4.</b>	To inculcate sense of environmental responsibility among students and trans-disciplinary approach
<b>5.</b>	To understand the concept of Carrying capacity of nature and the interrelationship of all forms of life with environment.

<b>Course Outcome</b>	
<b>1.</b>	Students will understand the multidisciplinary nature of the subject and thus the Scope of study
<b>2.</b>	Students will understand the importance of ecological studies
<b>3.</b>	Students will understand the various types of ecosystems with structural and functional characteristics

<b>4.</b>	Students will understand the levels of ecological organizations, Community and Population ecology, cycling of nutrients and the concept of flow of Energy
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## Syllabus

Unit No.	Title with contents	No. of lectures
<b>I</b>	<p><b>1. Introduction to basics of Ecology</b> Basic concepts, Principals, Scope Definitions: Ecology, Landscape, Habitat, Ecozones, Biosphere, Ecosystems, Ecosystem stability, Autecology, Synecology, Population, Community, Biome and Ecosystem Ecology</p> <p><b>2. Levels of Organisation –</b> i. Biological / Ecological Spectrum. ii. Ecological Hierarchy by Baret et al.</p> <p><b>3. Ecological Classification based on –</b> i. Taxonomic Affinity (From Kingdom to Species Level Ecology). ii. Habitat Types (Terrestrial and Aquatic Ecology).</p> <p><b>4. Ecology of Individuals</b> Ecological niche; types of niche -- Eltonian niche, Hutchinsonian niche, Fundamental niche, Realized niche, Multidimensional niche , Trophic niche</p>	<b>04</b>
<b>II</b>	<p><b>1. Concept of the Ecosystem</b></p> <p><b>2. Macro ecosystems</b>—Forest, Grassland, Desert, Ocean, Pond</p> <p><b>3. Micro-ecosystems</b>—River, Streams, Estuary</p> <p><b>4. Ecosystem Structural attributes –</b> Abiotic and Biotic Components.</p> <p><b>5. Ecosystem Function : Functional attributes-</b> i. Food Chain – Grazing and Detritus. ii. Food Web and Ecosystem Stability <b>a. Ecological Energetics –</b> i. Energy Input.</p>	<b>06</b>

	<p>ii. Energy Flow – Single Channel and Y shaped models.</p> <p><b>b. Productivity of Ecosystem –</b></p> <p>i. Primary Production – GPP and NPP.</p> <p>ii. Secondary Production.</p> <p>iii. Standing Crop (Biomass).</p> <p><b>c. Ecological Pyramids –</b> of Number, Biomass and Energy with examples</p>	
<p><b>III</b></p>	<p><b>1. Ecosystem Nutrient Cycling and Ecological Succession</b></p> <p><b>i. Concept of –</b></p> <p>a) Macro and Micro-nutrients, deficiency syndromes, Functions</p> <p>b) Nutrient Cycling—Biogeochemical Cycles –</p> <ul style="list-style-type: none"> <li>• <b>Gaseous Cycles –</b> Hydrological, Carbon and Nitrogen Cycles.</li> <li>• <b>Sedimentary Cycles –</b> Phosphorus and Sulphur Cycles.</li> </ul> <p><b>2. Human Impact on Biogeochemical Cycles.</b></p> <p><b>3. Ecological succession</b></p> <p>i. <b>Causes</b> of Succession.</p> <p>ii. <b>Basic Types –</b> Primary, Secondary, Autogenic, Allogenic ...etc.</p> <p>iii. <b>Mechanism</b> of Succession –</p> <p>a) Nudation.</p> <p>b) Invasion.</p> <p>c) Competition, Co-action and Reaction.</p> <p>d) Stabilisation (Climax).</p> <p>iv. <b>Models</b> of succession –Hydrosere and Lithosere.</p>	<p><b>06</b></p>

<p><b>IV</b></p>	<p><b>1. Population Ecology</b></p> <ul style="list-style-type: none"> <li>i. Introduction and Basic Concepts.</li> <li>ii. Population Characteristics – <ul style="list-style-type: none"> <li>a) Size and Density.</li> <li>b) Dispersion – Random, Aggregate and Uniform.</li> <li>c) Natality (Potential and Realised).</li> <li>d) Fecundity</li> <li>e) Mortality (Potential and Realised).</li> <li>f) Survivorship Curves.</li> <li>g) Age and Sex Structure.</li> <li>h) Life Table and Viability analysis</li> </ul> </li> </ul> <p><b>2. The Concept of Carrying Capacity.</b></p> <p><b>3. Population Growth –</b></p> <ul style="list-style-type: none"> <li>a) Growth Curves – Exponential and Logistic.</li> <li>b) Population Fluctuation.</li> <li>c) Biotic Potential and Environmental Resistance.</li> </ul>	<p><b>06</b></p>
<p><b>V</b></p>	<p><b>1. Community Ecology and Relationships</b></p> <ul style="list-style-type: none"> <li>i. <b>Characteristics of Community</b> - Species Diversity, Growth form and Structure, Dominance, Succession, Trophic Structure, Eco tone and Edge Effect.</li> </ul> <p><b>2. Characters used in Community Structure-</b></p> <ul style="list-style-type: none"> <li>i. Analytical Characters – Quantitative and Qualitative.</li> <li>ii. Synthetic Characters.</li> </ul> <p><b>3. Inter-specific Relationships---</b> Commensalism, Parasitism, Mutualism, Symbiosis, Predation, Amensalism, Neutralism</p> <p><b>4. Intra-specific Relationships---</b> Association, Aggregation, Social Life, Territoriality</p>	<p><b>08</b></p>

<b>Suggested Readings</b>	
1.	Understanding Environment; Chokkar K. B., Pandya M. and Raghunathan M.; Centre for Environment Education; Sage Publication, New Delhi.
2.	Ecology – Principles and Applications; Chapman J. L. and Reiss M. J.; Cambridge University Press.
3.	Fundamentals of Ecology; Odum P.E.; Natraj Publishers; Dehradun; 3 Edt..
4.	Ecology, Environment and Resource Conservation; Singh J.S., Singh S.P. and Gupta S.R.; Annamaya Publishers; New Delhi.
5.	Ecology and Environment; Sharma P.D.; Rastogi Publication; Meerut; 11 Rev. Edt..
6.	Environment Science; Tyler M.G.; Wadsworth Publishing Co.; 1997.
7.	Perspective in Environmental Studies; Kaushik and Kaushik; New Age International Pvt. Ltd. Publishers.
8.	Environmental Science; Santra S.C.; New Central Book Agency (P) Ltd.; 2 Edt..
9.	Manual for Field Ecology; Mishra R.
10.	Gurevitch, J., Scheiner, S. M., and Fox, G. A. 2002. The Ecology of Plants. Sinauer associates incorporated
11.	Odum, E.P. 1971. Fundamentals of Ecology. W.B. Saunders.



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**Syllabus for 2023-24 (CBCS – Autonomy 21 Pattern)**

<b>Course Title</b>	<b>Natural Resource Management and Sustainability</b>	
<b>Course Code: 23SBEV32MM</b>		<b>No. of Credits: 02</b>
<b>Course Type: Major (MM)</b>		<b>Total Teaching Hours: 30</b>

<b>Course Objectives</b>	
<b>1.</b>	To understand the Concept of Natural Resources and its Importance in Day to day Life
<b>2.</b>	To understand Generation, Extraction and impacts of Natural Resources by Human activities on the Earth's Environment
<b>3.</b>	To encourage Sustainable Management of Natural Resources and Minimize depletion of Natural Resources
<b>4.</b>	To understand Management Techniques of Natural Resources using Case studies

<b>Course Outcome</b>	
<b>1.</b>	To Understand effective and efficient Natural Resource Management strategies
<b>2.</b>	To inculcate values for Conservation Natural Resources among students
<b>3.</b>	To understand Sustainable Management of Resources in everyday life
<b>4.</b>	To understand Renewable energy resources and their Future scope and application

## Syllabus

Unit No.	Title with Contents	No. of Lectures
<b>I</b>	<p><b>Introduction to Natural Resources</b></p> <ol style="list-style-type: none"> <li>1. Definition and Classification of Natural Resources</li> <li>2. Importance and Scope of Natural Resources</li> <li>3. Man’ s interaction with Natural Resources               <ol style="list-style-type: none"> <li>i. As important resource</li> <li>ii. Waste sink</li> <li>iii. Cultural significance</li> </ol> </li> <li>4. Problems and Degradation of Natural Resources</li> <li>5. Management Techniques of Natural Resources</li> </ol>	<b>04</b>
<b>II</b>	<p><b>Forest Resources and Wildlife Resources</b></p> <p>Forest Resources</p> <ol style="list-style-type: none"> <li>1. Functions and importance of Forest resources</li> <li>2. Human Interaction with Forest – Over exploitation, Deforestation (Causes and Effects)</li> <li>3. Forest Management in India and Case studies</li> </ol> <p><b>Wild Life Resources</b></p> <ol style="list-style-type: none"> <li>1. Definition of Wild life and Importance of Wildlife</li> <li>2. Causes and Threat to Wildlife</li> <li>3. Protection and Conservation of Wild life</li> </ol>	<b>08</b>
<b>III</b>	<p><b>Food Resources and Water Resources</b></p> <p><b>Food Resources</b></p> <ol style="list-style-type: none"> <li>1. World Food Problems</li> <li>2. Changes caused by Agriculture and over-grazing, effects of Modern agriculture, Fertilizer-Pesticide problems, Water logging, Salinity, Case-studies- Green Revolution in India –Concept, Impact in India, Concept of GMO and HYV -Advantages and Disadvantages</li> <li>3. Concept of Sustainable Agriculture</li> </ol> <p><b>Water Resources</b></p> <ol style="list-style-type: none"> <li>1. Surface Water and Ground Water, Use and over-</li> </ol>	<b>08</b>

	<p>utilization and Pollution, Water Crisis</p> <ol style="list-style-type: none"> <li>2. Conflicts over water in World and India</li> <li>3. Conservation and Management of Water Resources- Rain-water Harvesting, Watershed Management, Traditional Water Harvesting Technique etc</li> </ol>	
<b>IV</b>	<p><b>Land and Mineral Resources</b></p> <p>Land Resources</p> <ol style="list-style-type: none"> <li>1. Soil Erosion –Causes and Consequences of Soil Erosion</li> <li>2. Soil Degradation and Soil Pollution Causes and effects</li> <li>3. Soil Conservation Methods</li> </ol> <p><b>Mineral Resources</b></p> <ol style="list-style-type: none"> <li>1. Types of Minerals, Importance, and application of Mineral Resources</li> <li>2. Mining types and its impact on Ecosystem</li> <li>3. Conservation of Mineral Resources</li> </ol>	<b>04</b>
<b>V</b>	<p><b>Energy Resources</b></p> <ol style="list-style-type: none"> <li>1. Classification of Energy Resources</li> <li>2. Conventional Energy Resources –Coal, Oil, Natural Gas, Nuclear Energy and their impacts on Environment</li> <li>3. Non-Conventional Energy Resources – Solar energy, Wind Energy, Hydroelectricity, Tidal energy, Ocean Thermal energy, Wave energy, Bioenergy- Biomass and Biomass Programme, Biogas, Bio -Ethanol, Biodiesel</li> <li>4. Renewable energy resources and India</li> <li>5. Current information on Central and State Government Policies related to Renewable energy</li> </ol>	<b>06</b>

<b>Suggested Readings</b>	
<b>1.</b>	Owen , O .S Chiras ,D.D and Reganold, J.P ,1988 .Natural Resource Conservation – Management for Sustainable Future (7 <sup>th</sup> Edition ).Prentice Hall
<b>2.</b>	Craig ,J.R ,Vaughan .D.J and Skinner .B.J. 1996 .Resources of the Earth :Origin, Use, and Environmental impacts (2nd Edition), Prentice Hall, New Jersey
<b>3.</b>	Freeman, A.M .2001.Measures of value and Resources : Resources for Future .Washington DC.
<b>4.</b>	Freeman, A.M 2003. Millennium Ecosystem Assessment : Conceptual Framework .Island Press
<b>5.</b>	Ginley , D.S and Cahen ,D.2011 .Fundamentals of Materials for Energy and Environmental Sustainability ,Cambridge University Press
<b>6.</b>	Miller, T.G ,2012, Environmental Science , Wadsworth Publishing Co.
<b>7.</b>	Tiwari ,G.N and Ghosal .M.K , 2005, Renewable Energy Resources: Basic Principles and Applications ,Narosa Publishing House



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### **Syllabus for Green Technologies for Sustainable Future**

**S.Y.B.Sc. 2024-25 (CBCS – Autonomy 21 Pattern)**

<b>Course Title</b>	<b>Green Technologies for Sustainable Future</b>		
<b>Course Code: 23SBEV33MM</b>		<b>No. of Credits: 02</b>	
<b>Course Type: Major (MM)</b>		<b>Total Teaching Hours: 30</b>	

<b>Course Objectives</b>	
<b>1.</b>	To learn the concept and advantages of green technology for better future
<b>2.</b>	To develop the ability towards environmental and sustainable development
<b>3.</b>	To gain knowledge about innovations in various sectors of development
<b>4.</b>	To aware about the circular economy and its importance in environmental protection

<b>Course Outcome</b>	
<b>1.</b>	To understand the importance and need of green technology for sustainable future
<b>2.</b>	To better analyze the types of green technologies and the future scope
<b>3.</b>	To Aware and Acquire knowledge about new innovations in various fields for the betterment of Environment

## Syllabus

Unit No.	Title with Contents	No. of Lectures
<b>I</b>	<b>Introduction to Green Technology</b> <ul style="list-style-type: none"><li>• Concept of Green technology</li><li>• Need of Green technology with reference to Sustainable Future</li><li>• Role of Green technology in sustainable development</li><li>• Goals of Green technology</li></ul> Advantages and Characteristics of Green technology	<b>08</b>
<b>II</b>	<b>Types of Green technologies</b> <ul style="list-style-type: none"><li>• Green Technology in Automobile sector--Electric vehicles, Hydrogen- fueled cars, Solar energy</li><li>• Green architecture in Construction sector</li><li>• Solid Waste Management and 3R's Principle</li><li>• Biodegradable plastic</li><li>• Biofuels</li><li>• Vertical and Terrace Gardening</li><li>• Importance of Green Spaces in Urban and Rural areas</li><li>• Rain water Harvesting and Watershed Management</li></ul>	<b>12</b>
<b>III</b>	<b>Types of Agricultural Activities</b> <ul style="list-style-type: none"><li>• Organic Farming and its advantages</li><li>• Biological Fertilizers and Pest Management</li><li>• Use of Agricultural and Livestock Waste</li><li>• Sustainable Agricultural methods</li><li>• Introduction to Hydroponics and Micro propagation</li></ul>	<b>10</b>

<b>Suggested Readings</b>	
<b>8.</b>	Green Technology: An A-to-Z Guide, SAGE publications, Dustin Mulvaney
<b>9.</b>	<a href="https://sustainability-success.com/green-technology-examples/">https://sustainability-success.com/green-technology-examples/</a>
<b>10.</b>	<a href="https://ied.eu/blog/7-green-technologies-for-a-sustainable-future/">https://ied.eu/blog/7-green-technologies-for-a-sustainable-future/</a>
<b>11.</b>	<a href="https://sustainabilitymag.com/top10/top-10-green-technology-innovations">https://sustainabilitymag.com/top10/top-10-green-technology-innovations</a>
<b>12.</b>	<a href="https://www.ripublication.com/ijaes17/ijaesv12n5_18.pdf">https://www.ripublication.com/ijaes17/ijaesv12n5_18.pdf</a>
<b>13.</b>	Green Building Fundamentals: Practical Guide to Understanding and Applying Fundamental Sustainable Construction Practices and the Leed System Paperback – Illustrated, 10 February 2010, by Mike Montoya (Author



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## Syllabus for Practical Course on Ecological studies and Resource Conservation

**S.Y.B.Sc. 2024-25 (CBCS – Autonomy 21 Pattern)**

<b>Course Title</b>	<b>Practical Course in Ecological studies and Resource Conservation</b>	
<b>Course Code: 23SBEV34MM</b>	<b>No. of Credits: 02</b>	
<b>Course Type: Major (MM)</b>	<b>Total Teaching Hours: 30</b>	

<b>Sr. No.</b>	<b>Objectives</b>
<b>1.</b>	To understand the concept like Rain water harvesting, Watershed management, water and energy audit.
<b>2.</b>	To understand the importance of social media for dissemination of information about various current environmental issues.
<b>3.</b>	To know the importance of practical's from ecological point of view.

<b>Sr. No.</b>	<b>Learning Outcome</b>
<b>1.</b>	To know the importance of Shannon- Simpsons diversity index in understanding the phytosociology
<b>2.</b>	To learn about vegetation sampling methods.
<b>3.</b>	To create awareness about current environmental issues and their socio-economic aspects/impacts
<b>4.</b>	Students will get practical hands on training while preparing compost pits and Biogas plants

Sr. No.	Title with Contents	Practical Sessions
1	To measure the Primary Productivity of grassland by Harvest Method.	Field + Laboratory.
2	To estimate the Total Chlorophyll from plants in Clean and Polluted Environment.	Laboratory.
3	To study grassland vegetation by List Count Quadrat Method to determine the Frequency, Density and Abundance.	Field + Laboratory
4	To determine Frequency and Abundance of Species across terrestrial – aquatic transitional zone, by Line Transect Method.	Field + Laboratory
5	To determine Density of species across terrestrial – aquatic transitional zone by Belt Transect Method.	Field + Laboratory
6	Field visit to study Watershed Mgmt. Techniques.	Visit.
7	Visit to Nature Interpretation / Information Centre.	Visit.
8	Visit to National Park / Wildlife Sanctuary to study Wildlife and various Inter-specific and Intra-specific Relations.	Visit.
9	Continuation of the use of Social Media for e-networking and dissemination of ideas on Environmental Issues pertaining to the Course.	---
10	To identify the advanced cultivars in the Local market	Visit.
11	Field visit to study Rain water Harvesting technique	Visit.
12	To determine the minimum area and number of quadrates for vegetation	Field + Laboratory
13	To determine Shannon Diversity Index of a vegetation (Data sheet)	Laboratory.
14	To estimate Importance Value Index from collected vegetation data.	Field + Laboratory
15	To determine Simpson Diversity Index of a vegetation (Data sheet)	Laboratory.
16	Visit to Soil Survey Department.	Visit.
17	Study of Soil sampling techniques	Visit.

<b>18</b>	To prepare Biogas unit in laboratory	Field + Laboratory
<b>19</b>	To Prepare a composting unit at home	Project based

- **Any other relevant practical's related**
- **Report of visits must be submitted along with journal.**

<b>Suggested Readings</b>	
1.	Manual for Field Ecology; Mishra R.
2.	Handbook of Methods in Environmental Studies, Vol-I and II; Mailti S.K.; ABD Publishers; Jaipur



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**Syllabus for Biological Diversity and Conservation**

**S.Y.B. Sc., 2024-25 (CBCS – Autonomy 21 Pattern)**

<b>Course Title</b>	<b>Biological Diversity and Conservation</b>	
<b>Course Code: 23SBEV41MM</b>		<b>No. of Credits: 02</b>
<b>Course Type: Major (MM)</b>		<b>Total Teaching Hours: 30</b>

**Course Objectives**

<b>1.</b>	To introduce ethical values for protection, preservation and sustainable management of biological diversity
<b>2.</b>	To encourage incitation of sustainable use of the components of biodiversity in students
<b>3.</b>	To bring sensitization towards the biodiversity but also increase Student competency and employability
<b>4.</b>	To share the benefits arising from the commercial and other utilization of biodiversity in a fair and equitable way
<b>5.</b>	To impart knowledge about endemic, endangered and rare species for conservation
<b>6.</b>	To embrace the implications of new technological forces for the future of biodiversity, science and management

**Course Outcome**

<b>1.</b>	Students will explore the complexity of biodiversity.
<b>2.</b>	Students will come to know the importance of the subject in day today's life, thus understanding the basics of threats and importance of biodiversity

3.	Students will learn about certain species' roles in an ecosystem and how life on earth is intrinsically related with conservation of biodiversity.
4.	Students will understand about how the subject knowledge helps in solving various social, economic and environment related problems

## Syllabus

Unit No.	Title with Contents	No. of Lectures
<b>I</b>	<p><b>Introduction to Biological Diversity---</b></p> <ol style="list-style-type: none"> <li>1. The Concept, Definition</li> <li>2. Levels – Ecosystem, Species and Genetic.</li> <li>3. Methods of assessment of Biological diversity</li> </ol> <p><b>Ecosystem Diversity</b></p> <ol style="list-style-type: none"> <li>1. <b>Classification of Ecosystem –</b> <ol style="list-style-type: none"> <li>a) Udvardy's Classification.</li> <li>b) Bailey's Classification.</li> <li>c) Olsen's Classification.</li> <li>d) Holdridge's Classification.</li> </ol> </li> <li>2. <b>Major Ecosystem types of India</b> with their physical and biological characteristics.</li> <li>3. <b>Major Ecosystem types of the World</b> with their physical and biological characteristics.</li> </ol> <ul style="list-style-type: none"> <li>• <b>Importance of Ecosystem in maintaining Ecological balance</b></li> </ul>	<b>04</b>
<b>II</b>	<p><b>Species diversity</b></p> <ol style="list-style-type: none"> <li>1. <b>Species Diversity</b> at Local , National and International Level</li> <li>2. Special features and Latest estimates for major groups of Plants, Animals and Microbes.</li> <li>3. <b>Measuring Species Diversity –</b> Species Richness, Species Abundance and Species Evenness.</li> <li>4. <b>Factors</b> affecting global distribution of</li> </ol>	<b>06</b>

	<p>Species Richness – Latitudinal, Altitudinal, Rainfall gradients, temperature...etc.</p> <p>5. <b>Endemism</b> –</p> <p>a) The Concept.</p> <p>b) Types with Examples</p> <p>c) Endemism in India</p> <p>6. <b>Centers of Diversity</b> –</p> <p>a) The Concept.</p> <p>b) Centers of Diversity : Analyses at Global Level –</p> <p>7. <b>Concept of hotspot</b></p> <p>4. Myer’s Hot-spots.</p> <p>5. Mega-diversity Centers / Countries.</p> <p>6. Western Ghat and North eastern Himalayas as a Hot-spot.</p> <p>8. <b>India as a Mega-diversity Country</b></p>	
<b>III</b>	<p><b>Genetic Diversity</b></p> <p>1. <b>Definition and Introduction</b> to Genetic Variations in Species</p> <p>2. <b>Nature and Origin</b> of Genetic Variations</p> <p>3. <b>Factors</b> affecting Genetic Diversity</p> <p>4. <b>Measurement of Genetic Diversity</b> –</p> <p>a) Based on DNA and Chromosomes.</p> <p>b) Molecular Marker Techniques.</p> <p>5. <b>Transgenic Organisms.</b></p> <p>6. <b>Diversity in Domesticated Species</b> –</p> <p>a) Variations since the first domestication to the present.</p> <p>b) Land Races,</p> <p>c) Advanced Cultivars,</p> <p>d) Wild Relatives of Cultivated Plants and Feral Plants.</p>	<b>06</b>
<b>IV</b>	<p><b>Significance and Threat to Biodiversity</b></p> <p><b>(Significances)</b></p> <p>1. Ecological Significances – Contribution of Biodiversity to various Eco- Services.</p>	<b>06</b>

	<p>2. Non Ecological Significances – Nutritional, Medicinal, Aesthetic, Cultural, Commercial Values ...etc.</p> <p>3. Optional Values, Use of microorganism in remediation of pollution</p> <p><b>(Threats)</b></p> <p>4. Threats with suitable Examples –</p> <p>a) Large Scale Dev. Projects – Habitat Destruction and Fragmentation.</p> <p>b) Changing Agriculture and Forestry Practices.</p> <p>c) Invasion by Introduced Species.</p> <p>d) Over-exploitation.</p> <p>e) Environment Pollution.</p> <p>f) Global Climate Change.</p> <p>g) Loss of Traditional Knowledge.</p> <p>h) Nature of Legal and Mgmt. System – Human Wildlife Conflict.</p>	
<p><b>V</b></p>	<p><b>1. Conservation Methods</b> – In-situ and Ex-situ methods with Examples</p> <p><b>2. National Conservation Efforts</b> –</p> <p>a) The laws – Environment Protection Act 1986, Forest Act 1927, Wildlife Act 1972, The Biodiversity Act 2002</p> <p>b) Involving People’s Participation – NBSAP, PBR</p> <p>c) Involving Community Participation – JFM, EDP</p> <p>d) People’s Movement – Silent Valley Movement, Beej Bachao Andolan</p> <p><b>3. International Conservation Efforts</b> –</p> <p>a) IUCN – The World Conservation Union.</p> <p>b) CBD.</p> <p>c) CITES.</p> <p><b>4. Traditional Methods of Conservation</b> – Sacred Groves / Ponds / Species</p> <p><b>5. Ethics of Conservation</b> – Values of Biodiversity</p>	<p><b>08</b></p>

	<p>(Economic and Legal), Biopiracy, Hybridized plants, GM crops (benefits and criticism), , Ethical and Conservation issues related to uses of biodiversity, Global Conservation Issues</p> <p><b>6. National Biodiversity Authority</b></p> <p><a href="http://nbaindia.org/">http://nbaindia.org/</a></p> <p>National Biodiversity Portal</p> <p><a href="https://indiabiodiversity.org/">https://indiabiodiversity.org/</a></p> <p>MoEFCC <a href="https://moef.gov.in/moef/about-the-ministry/organisations-institutions/authorities-tribunal/national-biodiversity-authority/index.html">https://moef.gov.in/moef/about-the-ministry/organisations-institutions/authorities-tribunal/national-biodiversity-authority/index.html</a></p>	
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<b>Suggested Readings</b>	
1.	Gaston, K J. and Spicer, J.I. 1998. Biodiversity: An Introduction. Blackwell Science, London, UK.
2.	Krishnamurthy, K.V. 2004. An Advanced Text Book of Biodiversity - Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi.
3.	Pandit, M.K. and Grumbine R.E. 2012. Ongoing and proposed hydropower development in the Himalaya and its impact on terrestrial biodiversity. Conservation Biology 26:1061-1071.
4.	Primack, R.B. 2002. Essentials of Conservation Biology (3rd edition). Sinauer Associates, Sunderland, USA.
5.	Singh, J. S. and Singh, S. P. 1987. Forest vegetation of the Himalaya. The Botanical Review 53: 80-192
6.	Singh, J. S., Singh, S.P. and Gupta, S. 2006. Ecology, Environment and Resource Conservation. Anamaya Publications, New Delhi.
7.	Sodhi, N.S. and Ehrlich, P.R. (Eds). 2010. Conservation Biology for All. Oxford University Press.
8.	Sodhi, N.S., Gibson, L. and Raven, P.H. 2013. Conservation Biology: Voices from the Tropics. Wiley-Blackwell, Oxford, UK.
9.	Understanding Environment; Chokkar K. B., Pandya M. and Raghunathan M.; Centre for Environment Education; Sage Publication, New Delhi.
10.	An Advanced Textbook on Biodiversity – Principles Practice; Krishnamurthy K.V.; Oxford and IBH Publishing Co. Pvt. Ltd.; New Delhi.
11.	Ecology – Principles and Applications; Chapman J. L. and Reiss M. J.; Cambridge University Press.
12.	Fundamentals of Ecology; Odum P.E.; Natraj Publishers; Dehradun; 3 Edt..
13.	Ecology, Environment and Resource Conservation; Singh J.S., Singh S.P. and Gupta S.R.; Annamaya Publishers; New Delhi.
14.	Ecology and Environment; Sharma P.D.; Rastogi Publication; Meerut; 11 Rev. Edt..
15.	Environmental Science; Santra S.C.; New Central Book Agency (P) Ltd.; 2 Edt..



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**Syllabus for S.Y.B. Sc. Environmental Science**  
**2023-24 (CBCS – Autonomy 21 Pattern)**

<b>Course Title</b>	<b>Environmental Pollution Control Technologies</b>	
<b>Course Code: 23SBEV42MM</b>	<b>No. of Credits: 02</b>	
<b>Course Type: Major (MM)</b>	<b>Total Teaching Hours: 30</b>	

<b>Course Objectives</b>	
<b>1.</b>	To understand various Environmental Pollution Monitoring and Management Techniques with respect to Air, Water, Soil, Solid waste Management and Noise Pollution
<b>2.</b>	To impart knowledge and skills in Management with respect to Air, Water, Soil, Solid waste Management and Noise Pollution
<b>3.</b>	To Study Different Aspects Of Environmental Contamination, which have adverse effects on Human Health
<b>4.</b>	Understanding mechanisms of pollutants impacting on human health.
<b>5.</b>	Developing an understanding of different types of pollutants, their sources and mitigation measures

<b>Course Outcome</b>	
<b>1.</b>	Able to describe and solutions to address environmental issues including pollution
<b>2.</b>	To develop Environmentalist students and sensitize them towards Environmental issues
<b>3.</b>	Acquiring values and attitudes towards understanding complex environmental

	economic-social challenges, and participating actively in solving current environmental problems and preventing the future ones
4.	Adopting sustainability as a practice in life, society and industry

### Syllabus

Unit No.	Title with Contents	No. of Lectures
<b>I</b>	<b>Air Quality Monitoring</b> <ol style="list-style-type: none"> <li>1. Air Quality standards by WHO and National Standards</li> <li>2. Air Sampling Techniques, Monitoring Tool/ Instruments used and its working principle</li> <li>3. Plume Behavior</li> <li>4. Introduction to AQI and its significance</li> <li>5. Air Pollution Control Techniques used in Industries</li> <li>6. Control of Emissions from Automobiles</li> <li>7. Indoor Pollution- Causes and Control</li> </ol>	<b>04</b>
<b>II</b>	<b>Water Quality Monitoring</b> <ol style="list-style-type: none"> <li>1. Objectives /Purpose of Water Quality Monitoring</li> <li>2. Water Sample Collection and Preservation ( Types of sample, chain of custody, sampling method, number of samples, sample containers, sample volume etc)</li> <li>3. Waste Water Treatment               <ol style="list-style-type: none"> <li>i. Primary Treatment of Waste Water</li> <li>ii. Secondary Treatment -Aerobic and Anaerobic Treatment of Waste Water</li> <li>iii . Tertiary Treatment –Disinfection ( Chlorination ), Biogas</li> <li>iv. Advanced Treatment of Waste Water</li> </ol> </li> <li>4. WHO, BIS and ICMR National Standards for Water quality</li> </ol>	<b>06</b>
<b>III</b>	<b>Solid Waste Management Techniques</b> <ol style="list-style-type: none"> <li>1. Material Separation Techniques and Processing – Recovery, Reuse, Recycle</li> </ol>	<b>08</b>

	<p>2. Disposal/ Management Techniques- Sanitary Landfill, Composting, Incineration, Pyrolysis , Injection Well, Gasification, Ocean Dumping</p> <p>4 .Hazardous Waste Management – Waste Management Treatment , Storage and Disposal</p> <p>5. Bio-Medical Waste Management Categorization, Segregation , Packaging/ Colour coding and Treatment , Transport and Disposal</p>	
<b>IV</b>	<p><b>Soil Pollution Monitoring</b></p> <p>1. Objectives of Soil Monitoring</p> <p>2. Soil Sampling Techniques</p> <p>3. Biological Methods to control Soil Pollution - Use of Bio Fertilizers, Bio-Pesticides, Conservational Tillage, Mixed Cropping, Crop Rotation, Biological Pest Management, Organic Farming, Soil Conservational Methods, Bio/Phytoremediation of Contaminated Sites</p>	<b>06</b>
<b>V</b>	<p><b>Noise Pollution Monitoring</b></p> <p>1. Noise Measuring Methods and Instruments</p> <p>2. Noise Control Techniques</p> <p style="padding-left: 40px;"><b>S.</b> Sound Insulation</p> <p style="padding-left: 40px;">ii. Sound Absorption</p> <p style="padding-left: 40px;"><b>S.</b> Vibration Damping</p> <p style="padding-left: 40px;"><b>S.</b> Active Noise Control/ Cancellation</p> <p>3. Noise Control at Source</p> <p>I. Selection and Maintenance of Machines</p> <p>II. Control over Vibrations</p> <p>III. Installations of Barriers/Enclosures</p> <p>IV. Using Protective Equipment's</p> <p style="padding-left: 40px;">iv. Noise Proof Walls</p> <p>4. National Standards for Noise quality , Noise pollution (Regulation and control) Rules-2000 in India</p>	<b>06</b>

<b>Suggested Readings</b>	
1.	Environmental Chemistry, Dey A. K.; New Age International Publishers; 6 Edt..
2.	Air Pollution; Rao M.N. and Rao H.V.N.; Tata McGraw Hill; New Delhi; 1989.
3.	Environmental Pollution Control and Environmental Engineering; Rao C. S.; Tata McGraw Hill; New Delhi; 1994.
4.	Waste Water Engineering, Treatment, Disposal and Reuse; Metcalf and Eddy.
5.	Chemical and Biological Methods for Water Pollution Studies; Trivedi R.K. and Goel P.K.; Environmental Publications; Karad; 1986.
6.	Textbook of Noise Pollution and Its Control – S.C. Bhatia
7.	Advanced Air and Noise Pollution Control – L.K Wang and N.C Pereira
8.	Environmental Pollution Control and Environmental Engineering; Rao C. S.; Tata McGraw Hill; New Delhi; 1994.
9.	Physico-Chemical Examination of Water, Sewage and Industrial Effluents; Manivasakam N.; Pragati Prakashan; Meerut; 1984



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## Syllabus for Practical Course on Biodiversity and Pollution Control Technology

**S.Y.B.Sc., 2024-25 (CBCS – Autonomy 21 Pattern)**

<b>Course Title</b>	<b>Practical Course in Biodiversity and Pollution Control Technology</b>	
<b>Course Code: 23SBEV43MM</b>	<b>No. of Credits: 02</b>	
<b>Course Type: Major (MM)</b>	<b>Total Teaching Hours: 30</b>	

<b>Course Objectives</b>	
<b>1.</b>	To understand the concept like Nature Interpretation Centre, in-situ and Ex-situ conservation, Soil sampling techniques.
<b>2.</b>	To understand the importance of control measures of environmental components like air, soil, water etc.
<b>3.</b>	To know about the various parameters of water and noise pollution
<b>4.</b>	To know about biodiversity and related aspects by maintain the biodiversity register.

<b>Course Outcomes</b>	
<b>1.</b>	To know the importance of Shannon- Simpsons diversity index in understanding the phytosociology
<b>2.</b>	To learn about water and soil sampling methods.
<b>3.</b>	To create awareness about importance of various ecosystem form biodiversity point of view.
<b>4.</b>	To get hand on training during phytoremediation project

## Syllabus

Unit No.	Title with Contents	Practical Sessions
1	Sampling of Air by High Volume Sampler	Field + Laboratory
2	Determination of Optimum Dose of Alum (Coagulant) required for water.	Laboratory.
3	Determination of Turbidity of water. (Turbidimeter / Nephelometer)	Laboratory.
4	Determination of Residual Chlorine from treated water.	Laboratory.
5	Determination of Dissolved Oxygen in water by Winkler's method	Laboratory.
6	Determination of Nitrate from water ( Calorimeter)	Laboratory.
7	Determination of Phosphate from water. (Colorimeter)	Laboratory.
8	Determination of Soluble Salts from Soil.	Laboratory.
9	Determination of Available Nitrogen from soil.	Laboratory.
10	Study of Water Sampling and Preservation techniques	Field + Laboratory
11	Measurement of sounds by DB meter / SLM in silent, industrial, residential and commercial zones and Analysis	Field + Laboratory
12	Determination of Lime required for Acidic soil	Laboratory
13	Visit to Solid waste Dumping Site	Field
14	Estimation of NO <sub>x</sub> content of given samples	Laboratory.
15	Estimation of Sox content of given samples	Laboratory.
16	Study of wetland (source region visit) and its vegetation and seasonal bird diversity.	Field + Laboratory
17	Visit to a sacred grove/Forest / Grassland / Marine ecosystem to assess its biodiversity	Field + Laboratory
18	To prepare a Biodiversity (Flora and Fauna) register of the campus	Field

<b>19</b>	To set up Phytoremediation project at laboratory level *(Polluted Soil / waste water)	Field + Laboratory
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- **Any other relevant practical's related**
- **Report of visits must be submitted along with journal.**

<b>Suggested Readings</b>	
10.	Air Pollution; Rao M.N. and Rao H.V.N.; Tata McGraw Hill; New Delhi; 1989.
11.	Environmental Pollution Control and Environmental Engineering; Rao, C. S.; Tata McGraw Hill; New Delhi; 1994.
12.	Waste Water Engineering, Treatment, Disposal and Reuse; Metcalf and Eddy.
13.	Manual for Field Ecology; Mishra R.
14.	Handbook of Methods in Environmental Studies Vol-I andII; Maiti S.K.; ABD Publishers; Jaipur.
15.	Physico-Chemical Examination of Water, Sewage and Industrial Effluents; Manivasakam N.; Pragati Prakashan; Meerut; 1984.
16.	Chemical and Biological Methods for Water Pollution Studies; Trivedi R.K. and Goel P.K.; Environmental Publications; Karad; 1986
17.	Instrumental Methods of Analysis; Willard; cbspd; 7 Edt..
18.	Waste Water Engineering, Treatment, Disposal and Reuse; Metcalf and Eddy



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### **Syllabus for Lab Course in Soil and Noise Analysis**

**S.Y.B.Sc. 2024-25 (CBCS – Autonomy 21 Pattern)**

<b>Course Title</b>	<b>Practical Course in Soil and Noise Analysis</b>	
<b>Course Code: 23SBEV44MM</b>		<b>No. of Credits: 02</b>
<b>Course Type: Major (MM)</b>		<b>Total Teaching Hours: 30</b>

#### **Course Objectives**

<b>1.</b>	To study various Soil Sampling Techniques
<b>2.</b>	To understand various Soil analysis techniques and methods used to detect the pollutants present in soil
<b>3.</b>	To estimate the Noise Level in Residential and Commercial areas through Survey methods
<b>4.</b>	To understand the measures of Reducing Soil and Noise pollution levels

#### **Course Outcomes**

<b>1.</b>	To have hands on training on estimating Soil quality and Noise Levels in Residential, Commercial areas
<b>2.</b>	To have practical experience of Soil, irrigation techniques and Soil Management methods on Farm
<b>3.</b>	To understand the various Environmental Laboratory analysis techniques used for Soil and Noise level measurement

## Syllabus

Sr. No.	Title with Contents	Practical Sessions
1	To study various Soil sampling Techniques	Field + Laboratory
2	To determine Moisture Content from the given Soil sample	Laboratory
3	To determine the Water Holding Capacity from the given Soil sample	Laboratory
4	Study Visit to Soil Survey Department	Visit
5	Study Visit to Environmental Laboratory	Visit
6	Determination of pH and EC from the given Soil sample	Laboratory
7	To determine the Organic content from the given Soil sample	Laboratory
8	To determine Soil Texture , Temperature and Particle Size	Laboratory
9	To measure the Noise using Sound Level Meter	Laboratory /Field
10	To determine the Soil Bulk Density	Laboratory
11	Noise Level Survey related to effects on Human health in Residential and Commercial areas	Field
12	Study Visit to Farm and surrounding areas to understand Soil types, Irrigation practices and Crop yield	Field
13	Study of Macro, Micro nutrients and Heavy Metals found in Soil and their impacts	Laboratory
14	Study of Rocks and their properties	Laboratory
15	Study of Minerals and their properties	Laboratory
16	Study of Soil types found in India with respect to Climatic conditions	Laboratory

- Any other relevant practical's related

- **Report of visits must be submitted along with journal.**

<b>Suggested Readings</b>	
1.	Handbook of Methods in Environmental Studies Vol-II Air , Noise, Soil and Overburden analysis ; Maiti S.K: ABD Publishers Jaipur