



**Bangalore University**  
**Department of Environmental Science**  
Jnanabharathi Campus  
Bengaluru – 560 056

**Syllabus for**  
**I & II Semester Environmental Science Papers**  
**Under-Graduate (UG) Program**  
**Framed according to the National Education Policy (NEP 2020)**

**September 21, 2021**

**Board of Studies (UG) members present and approved the Syllabus**

<b>SI No</b>	<b>Name and Association</b>	<b>Designation</b>
<b>1</b>	Dr. B. C. Nagaraja Department of Environmental Science, Bangalore University, Bangalore	Chairperson
<b>2</b>	Prof. N. Nandini Department of Environmental Science, Bangalore University, Bangalore	Member
<b>3</b>	Dr. K.L. Prakash Department of Environmental Science, Bangalore University, Bangalore	Member
<b>4</b>	Dr. Helen Roseline, Associate Professor, Department of Environmental Science, Mount Carmel College, Bangalore	Member
<b>5</b>	Dr. Alkananda J Adur Assistant Professor Department of Environmental Science, Surana College, Bangalore	Member
<b>6</b>	Dr. Kavitha K R Associate Professor, Department of Botany Government Science College, Bangalore	Member
<b>7</b>	Dr. P. Anitha, Associate Professor, Department of Botany, BMS College for Women, Bangalore	Member
<b>8</b>	Dr. Rinku Verma Associate Professor, Department of Forestry & Environmental Science, University of Agriculture Science, Bangalore	Member

**BANGALORE UNIVERSITY**  
**DEPARTMENT OF ENVIRONMENTAL SCIENCE**

Jnanabharathi Campus, Bangalore – 560056

**Proceedings of the Board of Studies (UG) meeting held on 20<sup>th</sup> & 21<sup>st</sup> September, 2021 in the Department of Environmental Science, Bangalore University, Bangalore – 560056.**

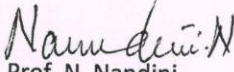
A meeting of BOS (UG) was convened on 20<sup>th</sup> & 21<sup>st</sup> September, 2021 in the Department of Environmental Science, JB campus, Bangalore University, Bangalore.

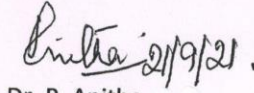
The Chairperson welcomed all the members of the BOS (UG) in the beginning and then the members were invited to discuss on the agenda of the meeting.

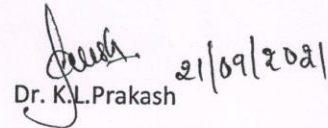
- a) Approval of Under graduate first year syllabus (I & II Semester) for implementation from the academic year of 2021-22 as per New National Education Policy.
- b) Approval of the Ability Enhancement Compulsory Course "Environmental Studies" for implementation in the Academic year of 2021-22.
- c) Course Pattern and Scheme of Examination, 2021-22

Members gone through the scheme and syllabus submitted by Expert committee constituted by Government of Karnataka. The committee members have discussed and approved the scheme and syllabus for first and second semester UG course for implementation from Academic year 2021-22. The meeting ended with vote of thanks by the Chairperson.

Members Present

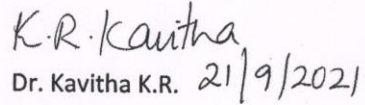
  
Prof. N. Nandini

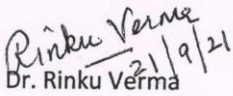
  
Dr. P. Anitha,

  
Dr. K.L. Prakash

  
Dr. Helen Roseline

  
Dr. Alakahanda J Adur

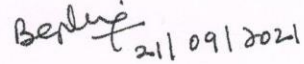
  
Dr. Kavitha K.R. 21/9/2021

  
Dr. Rinku Verma

Members Absent

Dr. Nagaraja Parisara

Dr. Abdul Khayum

  
21/09/2021

(B.C. Nagaraja)

**Dr. B.C. NAGARAJA** Ph.D.  
Chairman  
Dept. of Environmental Science  
Bangalore University  
Bengaluru - 560056

## **Introduction**

The course curriculum for undergraduate studies under choice based credit system (CBCS) for B.Sc. in Environmental Science (Basic/Hons.) is framed in this document. This exercise was undertaken as part of the nationwide curriculum restructuring initiative by the National Education Policy-2020. The main objective of framing this curriculum of B.Sc. (Basic/Hons.) in Environmental Science is to impart the students a holistic understanding of the subject giving substantial weightage to the core contents, skill, value-based and ability enhancement. The syllabus has given due importance on the main streams of the body of knowledge on 'Environment' with due recognition of its wide spectrum. The ultimate goal of the syllabus is to enable the students to have an in-depth knowledge on the subject and enhance their scope of employment at every level of exit. Adequate emphasis has been given on the new and emerging techniques and understanding of the subject under the changing regime and global context.

### **Graduate attributes in Environmental Science**

Some of the characteristic attributes a graduate in Environmental Science should possess are:

- Multidisciplinary competence catering to environmental sustainability
- Skilled communication
- Team work and collaboration
- Systemic and critical thinking with reference to environment-people- economic-development attributes
- Problem identification skills and sustainable solution provisioning
- Analytical reasoning and appropriate interpretation skills:
- Project Management Skills
- Digital and ICT efficiency
- Ethical awareness / reasoning
- Self-directed learning efficiencies leading to a productive lifelong learning process
- Reflective thinking
- Research-related skills such as review of literature, design of experiments, statistical competence, report writing and prepare target specific communication packages

## **Flexibility**

- The programmes are flexible enough to allow liberty to students in designing them according to their requirements. Students may choose a single Major, one Major with a Minor, and one Major with two Minors. Teacher Education or Vocational courses may be chosen in place of Minor/s. Below listed are the various options students may choose from.
- One Major subject/discipline, Two Languages, Generic Electives, Ability Enhancement, Skill Development and Vocational courses including Extracurricular Activities.
- One Major and one Minor subject/discipline along with Languages, Generic Electives, Ability Enhancement, Skill Development and Vocational courses including Extracurricular Activities
- Two Major subject/disciplines along with Languages, Generic Electives, Ability Enhancement, Skill Development and Vocational courses, including Extracurricular Activities (subject to fulfilling the requirements as stated in 3.i and 3.ii)
- One Major subject/discipline and one Vocational course along with Languages, Generic Electives, Ability Enhancement and Skill Development and courses including Extracurricular Activities.
- One Major Discipline and One Education Discipline along with Languages, Generic Electives, Ability Enhancement and Skill Development Courses including Extracurricular Activities.

**Progressive Certificate, Diploma, Bachelor Degree or Bachelor Degree with Honours provided at the end of each year of exit of the Four-year Undergraduate Programme/Five-year Integrated Master's Degree Programme.**

<b>EXIT OPTIONS</b>	<b>Credit required</b>
<b>CERTIFICATE</b> upon the successful completion of the First year (Two Semesters) of the Multidisciplinary Four-Year Undergraduate Programme/ Five-year Integrated Master's Degree Programme.	50 credits
<b>DIPLOMA</b> upon the successful completion of Second year (Four Semesters) of the Multidisciplinary Four-Year Undergraduate Programme/ Five-year Integrated Master's Degree Programme.	100 credits
<b>BASIC BACHELOR DEGREE</b> at the successful completion of Three year (Six Semesters) of the Multidisciplinary Four Year Undergraduate Programme/ Five-year Integrated Master's Degree Programme.	142 credits
<b>BACHELOR DEGREE WITH HONOURS</b> in a Discipline at the successful completion of Four years (Eight Semesters) of the Multidisciplinary Four Year Undergraduate Programme/ Five-year Integrated Master's Degree Programme.	184 credits
<b>MASTER'S DEGREE IN A DISCIPLINE</b> at the Successful completion of the Fifth Year (Ten Semesters) of the Five-year Integrated Master's Degree Programme.	

**Aim of UG programme in Environmental Science**

The aims and objectives of our UG educational programs in sciences in general and Environmental Science in particular should be structured to:

- Create the facilities and environment in all educational institutions to consolidate the knowledge acquired at +2 level and to motivate and inspire the students to create deep interest in Environmental Science, to develop knowledge and understanding of environmental concepts, principles and theories of Environmental Science.

- Understanding and essential aspects of Environmental Science in diverse subject areas such as ecology, chemistry, environmental pollution, environmental geology, atmospheric sciences, biodiversity and natural resources management, global warming, climate change and waste management.
- Learn, design and perform experiments in lab and field to demonstrate the concepts, principles and theories learnt in the classroom.
- Develop the ability to focus on problem solving, critical thinking, team work and collaboration.
- Emphasize the importance of Environmental Protection in present time of unprecedented environmental degradation.

The progressive curriculum proposed shall position knowledge and skills required on the transformation of novice problem solvers (at entry level of the program) to expert problem solvers (by the time of graduation) as given below:

- At the end of first year – Ability to solve well defined problems.
- At the end of second year – Ability to solve broadly defined problems.
- At the end of third year – Ability to solve complex problems that are ill-structure that require multi-disciplinary skills to solve them.
- During fourth year – Experience of workplace problem solving in the form of internship or Research Experience preparing for higher education or Entrepreneurship and employment.

# MODEL CURRICULUM

Name of the Degree Programme: **B.Sc. (Basic/Hons.)**

Discipline Core: **Environmental Science**

Total Credits for the Programme: **184**

Starting year of implementation: **2021-22**

## Programme Outcomes:

By the end of the Programme the students will be able to develop:

1. Disciplinary knowledge in fields related to Environmental Science
2. Systemic and critical thinking with reference to environment-people-economic-development attributes
3. Problem identification skills and sustainable solution provisioning
4. Analytical reasoning and appropriate interpretation skills
5. Self-directed learning efficiencies leading to a productive lifelong learning process
6. Research-related skills such as review of literature, design of experiments, statistical competence, report writing and prepare target specific communication packages
7. Cooperation/Team work
8. Reflective thinking
9. Multidisciplinary competence catering to environmental sustainability

## Assessment:

### Weightage for assessments (in percentage)

Type of Course	Formative Assessment/IA	Summative Assessment
Theory	<b>30</b>	<b>70</b>
Practical	<b>15</b>	<b>35</b>
Projects/Experiential Learning (Internship etc.)	<b>Viva-voce = 30</b>	<b>Report = 70</b>



**PROPOSED CURRICULUM STRUCTURE FOR UNDERGRADUATE ENVIRONMENTAL SCIENCE DEGREE  
PROGRAMME**

**II A. Model Programme structure for Bachelor of Science (Basic/Hons.) with practicals with one major and one minor**

Semester	Discipline Core (DSC)(Credits) (L+T+P)	Discipline Specific Elective (DSE)/Open Elective (OE) (Credits)(L+T+P)	Ability Enhancement Compulsory Course (AECC) (L+T+P)		Skill Enhancement Course(SEC)			TOTAL CREDITS
					SKILL BASED (Credits) (L+T+P)	VALUE BASED (credits) (L+T+P)		
<b>I</b>	ES A1 (4+2) Other subject B1(4+2)	OE-1 (3)	L1-1(3), L2-1(3), (4hrs. each)	-	SEC-1 Digital Fluency(2) (1+0+2)	Physical Education for fitness (1) (0+0+2)	Health & Wellness (1) (0+0+2)	<b>2</b> <b>5</b>
<b>II</b>	ES-A2 (4+2) Other subject B2(4+2)	OE-2 (3)	L1-2(3), L2-2(3), (4hrs. each)	Environmental Studies (2)	-	Physical Education – Yoga (1) (0+0+2)	NCC/NSS/R &R(S&G)/ Cultural (1) (0+0+1)	<b>2</b> <b>5</b>
<b>Exit option with Certificate in Science (50 credits)</b>								
<b>III</b>	ES A3 (4+2) Other subject B3(4+2)	OE-3 (3)	L1-3 (2) L2-3 (2) (4hrs. each)	--	SEC-2: Artificial Intelligence (2) (1+0+2)	Physical Education – Sports (1) (0+0+2)	NCC/NSS/R &R(S&G)/ Cultural (1) (0+0+1)	<b>2</b> <b>5</b>
<b>IV</b>	ES-A4 (4+2) Other subject B4(4+2)	OE-4 (3)	L1-4(3) L2-4(3) (4hrs. each)	Constitution of India (2)	-	Physical Education – Games (1) (0+0+2)	NCC/NSS/R &R(S&G) Cultural (1) (0+0+1)	<b>2</b> <b>5</b>
<b>Exit option with Diploma in Science (100 credits) OR choose any one of the core subjects as Major and other as Minor</b>								

<b>V</b>	ES A 5 (3+2)	Vocational - 1 (3)	-	-	SEC - 3: SEC suchas Cyber Security(2) (1+0+2)	-	-	<b>2</b>
	ES A 6 (3+2)							<b>0</b>
<b>VI</b>	ES A 7 (3+2)	Vocational - 2 (3)	-	-	SEC-4: Professional communication (2)	-	-	<b>2</b>
	ES A 8 (3+2)							<b>2</b>
Other subject B5(3+2)								
Other subject B6(3+2)								
<b>Exit option with Bachelor of Science, B.Sc. Degree in Environmental Science (142 credits) OR continue studies with Major in the fourth year</b>								
<b>VII</b>	ES A 9 (3+2)	ES E1 (3)	-	-	-	-	-	<b>2</b>
	ES A 10 (3+2)							ES E2 (3)
	ES A 11 (3)	Research Methodology (3)	-	-	-	-	-	<b>2</b>
<b>VIII</b>	ES A 12 (3+2)	ES E3 (3)	-	-	-	-	-	<b>2</b>
	ES A 13 (3+2)							Research project (6)*
	ES A 14 (3)							
<b>Award of Bachelor of Science Honors Degree, B.Sc. (Hons.) Degree in Environmental Science (184 credits)</b>								

\*L+T+P= Lecturing in Theory + Tutorial + Practicals. Numbers in the parenthesis refer to credits.

\*In lieu of the research project, two additional elective papers/ Internship may be offered

**CURRICULUM STRUCTURE FOR THE UNDERGRADUATE DEGREE PROGRAMME - B.Sc.**

**(BASIC/HONS.)**

Total Credits for the Programme: **184**

Starting year of implementation: **2021-2022**

Name of the Degree Programme: **B.Sc. (Basic/Hons.)**

Discipline/Subject: **Environmental Science**

**Programme Articulation Matrix**

<b>Semester</b>	<b>Title / Name of the course</b>	<b>Programme outcomes that the course addresses (not more than 3 per course)</b>	<b>Pre-requisite course(s)</b>	<b>Pedagogy</b>	<b>Assessment</b>
<b>1</b>	<b>ES 1T1</b> – Divisions of Environment	Have developed knowledge and understanding of the Divisions of the Environment and able to appreciate the holistic relationship between them.	PUC or equivalent in Science subjects	Theory and course projects	Continuous internal assessment (Formative assessment) - 30%. End Semester Examination (Summative assessment) - 70%
	<b>ES 1P1</b> – Water quality analysis	Be able to analyze the vital physicochemical parameters of water, interpret and suggest suitable treatment methods.		Hands-on-training	
	<b>ES OE1</b> – Environmental Conservation Movements <b>OR</b> <b>ES OE1</b> Environment and Sustainable Agriculture <b>OR</b> <b>ES OE1</b> – Environmental Pollution	Be able to get an introductory account of the chosen open elective paper and use the acquired knowledge in decision making and hence add to quality of life.		Theory, case studies and self-study	

Semester	Title /Nameof the course	Programme outcomes that the course addresses (notmore than 3 per course)	Pre-requisite course (s)	Pedagogy	Assessment
2	<b>ES 2T1</b> – Ecology – Theory and Practice	Have developed sound knowledge of Basic and AppliedEcology.	-	Theory, case studies and courseprojects	Continuous internal assessment (Formative assessment) - 30%. End Semester Examination (Summative assessment) - 70%
	<b>ES 2P1</b> – Ecological analysis	Be able to Identify and Enumerate Planktons, Estimate the Primary Productivity of an Aquatic Ecosystem, studythe characteristics of a Biotic Community; Be able to Compute Carbon Sequestration of trees.		Hands-on-training	
	<b>ES OE2</b> – Climate Change and Its Implications <b>OR</b> <b>ES OE2</b> – Environment and Public Health in ContemporarySociety <b>OR</b> <b>ES OE2</b> – Wildlife and Conservation	Be able to get an introductory account of the chosen open elective paper and use the acquired knowledge indecision making and hence add to quality of life.		Theory, Case studies and Self-study	
<b>Exit option with Certificate in Science (50 credits)</b>					
<b>Job opportunities for the Exit option with Certificate</b>					
<ul style="list-style-type: none"> <li>• Sampling Assistant in wastewater treatment plants</li> <li>• Analytical Assistant/Intern analyst in water testing laboratories</li> <li>• Laboratory instructor in in educational institutions</li> <li>• Field Technician in mobile environmental laboratories</li> <li>• Field Technician in Research institutions/NGOs involved in environmental monitoring/carbon credit establishment/productivitystudies.</li> <li>• Sampling and execution assistant in environmental auditing</li> <li>• Garden/nursery Supervisor/Entrepreneurship</li> <li>• NGOs/Consultancy firms</li> <li>• Self-employment</li> </ul>					

Semester	Title /Nameof the course	Programme outcomes that the course addresses (not more than 3 per course)	Pre-requisite course (s)	Pedagogy	Assessment
3	<b>ES 3T1</b> – Natural Resources and Management	Have developed a sound knowledge and understanding of Natural Resources and Application of various management practices.	Certificate in Science with Environmental Science as a subject and a total credit score of 50	Theory, case studies and problem solving methods	Continuous internal assessment (Formative assessment) -30%. End Semester Examination (Summative assessment) -70%
	<b>ES 3P1</b> – Mineralogy, Petrology, Energy Resources and Medicinal Plants	Be able to Identify Major Rock forming Minerals and Rocks. Learn basic skills of mapping and cartography.		Hands-on-training and field studies	
	<b>ES OE3</b> – Women and Environment <b>OR</b> <b>ES OE3</b> – Food Adulterants and Safety <b>OR</b> <b>ES OE3</b> – Environmental Disasters of India	Be able to get an introductory account of the chosen open elective paper and use the acquired knowledge in decision making and hence add to quality of life.		Theory, Case studies and Self-study	

<b>Semester</b>	<b>Title /Nameof the course</b>	<b>Programme outcomes that the course addresses (notmore than 3 per course)</b>	<b>Pre-requisite course (s)</b>	<b>Pedagogy</b>	<b>Assessment</b>
<b>4</b>	<b>ES 4T1</b> – Biodiversity, Wildlifeand Conservation	Have developed an understanding of the biodiversity resources, status of wildlife, the pressures faced by wildlife areas and cultivate an insight into the conservation practices.	-----	Theory, case studies and field studies	Continuous internal assessment (Formative assessment) - 30%. End Semester Examination (Summative assessment) - 70%
	<b>ES 4P1</b> – Meteorology, Biodiversity Assessment, Ecosystem Services and conservation case studies	Be able to analyze the behaviour of local weather patterns by monitoring meteorological parameters. Develop wind and pollution roses; analyze climate maps and make interpretations. Be able to execute sampling and data collection skills with reference to biodiversity and wildlife. Will have an exposure to wildlife monitoring techniques such as quadrats, line transects and mark-release-recapture methods.		Data handling and Hands-on-training	
	<b>ES OE4</b> – Environmental Education <b>OR</b> <b>ES OE4</b> – Environment and Green Marketing <b>OR</b> <b>ES OE4</b> – Modern Technologies for Environmental Management	Be able to get an introductory account of the chosen open elective paper and use the acquired knowledge in decision making and hence add to quality of life.		Theory, Case studies and Self-study	
<b>Exit option with Diploma in Science (100 credits) OR Choose any one of the core subjects as Major and other as Minor</b>					

**Job opportunities for the Exit option with Diploma in Science**

- Procurement, processing, value addition and Marketing of NTFPs - Executive/Entrepreneurship
- Procurement of Medicinal Plants - Marketing/Entrepreneurship
- Lab assistant in educational institutions
- Wildlife and Ecotourism guides
- Public Health/Waste Management Assistants in Municipalities
- Incinerator operators in small establishments
- NGOs/Consultancy firms
- Self-employment

<b>Semester</b>	<b>Title /Nameof the course</b>	<b>Programme outcomes that the course addresses (notmore than 3 per course)</b>	<b>Pre-requisite course (s)</b>	<b>Pedagogy</b>	<b>Assessment</b>
<b>5</b>	<b>ES 5T1</b> – Environmental Microbiology, Environmental Biotechnology, Environmental Statistics	Have developed knowledge and understanding of Environmental Microbiology, Environmental Biotechnology and Environmental Statistics.	Diploma in Science with Environmental Science as a subject and a total credit score of 100	Theory and statistical practices	Continuous internal assessment (Formativeassessment) - 30%. End Semester Examination (Summativeassessment) - 70%
	<b>ES 5P1</b> – Environmental Microbiology, Environmental Biotechnology, Environmental Statistics	Be able to culture and identify Bacteria and Fungi; be able to detect the fecal contamination drinking water; have knowledge and understanding of the Plant-Microbial Symbiosis and able to Apply Statistical methods.		Hands-on-training and statistical practices	
	<b>ES 5T2</b> – Air Pollution, Water Pollution and EnvironmentalEngineering	Have developed knowledge and understanding of Air, Water and Land Pollution and Application of Control Measures.		Theory, Self-study and Case studies	



	<p><b>ES 5P2</b> – Air and Wastewater Analysis</p>	<p>Be able to Analyze vital parameters of Wastewater, interpret and suggest suitable treatment methods, analyze vital Air Pollutants, interpret and suggest suitable control methods.</p>		<p>Hands-on-training</p>	
	<p><b>ES 5V1</b> – Environmental Chemistry and Instrumentation  <b>OR</b>  <b>ES 5V1</b> – Urban Waste and Hazardous Waste Management</p>	<p>Have developed knowledge and skills on chemistry of environmental pollution, principles of chemistry employed in treatment and mitigation mechanisms. Be able to understand the governing principles of analytical procedures like titrimetry, gravimetry, spectrophotometry, Flame photometry and atomic absorption spectroscopy.</p> <p>Have developed knowledge and skills on chemistry of environmental pollution, principles of chemistry employed in treatment and mitigation mechanisms. Be able to understand the governing principles of analytical procedures like titrimetry, gravimetry, spectrophotometry, Flame photometry and atomic absorption spectroscopy.</p> <p><b>OR</b></p> <p>Have developed knowledge of quantification and characteristics of urban and hazardous waste and their management. Be able to understand the handling techniques and legislations governing wastes.</p>		<p>Theory and seminar/term paper</p>	

Semester	Title /Nameof the course	Programme outcomes that the course addresses (not more than 3 per course)	Pre-requisite course (s)	Pedagogy	Assessment
6	<b>ES 6T1</b> – Noise, Land, Radiation Pollution and Solid Waste Management	Have developed knowledge and understanding of Noise, Land, Radiation Pollution and Solid Waste Management	-	Theory, Self-study andCase studies	Continuous internal assessment (Formative assessment)-30% . End Semester Examination (Summative assessment) -70%
	<b>ES 6P1</b> – Soil analysis, Noise measurement and Solid waste	Be able to Analyze noise levels, identify and categories land pollution and be capable of developing a solid waste management plan for urban areas.		Hands-on-training	
	<b>ES 6T2</b> – Environmental Impact Assessment and Environmental Risk Assessment	Have developed knowledge and understanding of various process involved in Environmental Impact Assessment, be able to employ assessment techniques and analyze the reports. Have developed knowledge to enable identification of risk perception and implement assessment protocols.		Theory, Self-study andCase studies	
	<b>ES 6P2</b> – Methods of Environmental Impact and Risk Assessment	Be able to make appropriate choices of impact identification methodologies such as checklist and matrices. Be able to compile the collected data, suggest suitable amelioration measures and develop monitoring protocols.		Hands-on-training	
	<b>ES 6V1</b> – Industrial Wastewater Treatment <b>OR</b> <b>ES 6V1</b> – Disaster Management	Have developed knowledge and managerial skills of industrial wastewater treatment facilities. Be able to understand the legal stipulations of pollution control boards and develop abilities to handle regular reporting protocols. <b>OR</b> Have developed knowledge and understanding of naturaland man-made disasters, reasons for their occurrence, prevention and management techniques. Be aware of emergency response protocols and be available in case of emergencies.		Theory and seminar/term paper	
<b>Exit option with Bachelor of Science, B.Sc. Degree in Environmental Science (142 credits) or continue studies with Major in theFourth year</b>					

**Job opportunities for the Exit option with Bachelor of Science Degree**

- Assistants in Central and State Pollution Control Boards
- Environmental Health and Safety Assistant in industries
- Occupational Health and Safety Assistant in industries/theme parks
- Public Health/Waste Management Officers in Municipalities
- Wastewater Treatment Plant Managers
- Environmental/Production Quality Assurance Executive - Junior
- Environmental Analyst (Validation)
- Research Assistant/Staff
- R&D Lab Assistant
- Water testing labs or chemical suppliers/ Entrepreneurship
- Liaison Officer
- Watershed Management Assistant
- Mineral/Energy Resource Exploration Assistant
- Solar energy/alternate energy Executives
- Micro irrigation Executives
- Organic Farming Executives/Entrepreneurship
- NGOs/Consultancy firms
- Teachers in Schools
- Self-employment

Semester	Title /Nameof the course	Programme outcomes that the course addresses (not more than 3 per course)	Pre-requisite course (s)	Pedagogy	Assessment
7	<b>ES 7T2</b> – Environmental Toxicology	Have developed knowledge on the behaviour of environmental contaminants and xenobiotics. Have an understanding of bioassay test procedures/experimental designs of toxicity studies.	B.Sc. in Science with Environmental Science as major subject and a total credit score of 142	Theory, Self-study and Case studies	Continuous internal assessment (Formative assessment) -30%. End Semester Examination (Summative assessment) -70%
	<b>ES 7P2</b> – Bioassay, Acute and Sub-acute toxicity tests	Be able to setup simple bioassay test procedures leading to LD50, LC50 assessments.		Hands-on-training	
	<b>ES 7T3</b> – Occupational, Health and Safety	Have developed knowledge of work environments, understand exposure risks and have an exposure to legal requirements.		Theory, Self-study and Case studies	
	<b>ES 7T1</b> – Applications of Remote Sensing and Geographical Information Systems	Have understood the techniques involved in remote data collection, their applications in land-use, resource distribution, pollution and wildlife studies. Get an introduction to select GIS software.		Theory, Self-study and Case studies	
	<b>ES 7P1</b> – Cartography and Geographical Information Systems	Have developed knowledge, understanding and skills of handling cartographic and remote sensing data. Be able to digitize basic environmental data using GIS tools.		Hands-on-training	
	<b>ES 7E1</b> – Landscape Ecology and Urban Planning	Have developed knowledge and understanding of landscape ecology and urban planning. Be able to develop need based and dynamic urban planning protocols to reduce energy demands, waste generation and facilitate smart city initiatives.		Theory and seminar/termpaper	
	<b>ES 7R1</b> – Research Methodology	Have enhanced knowledge and understanding of various research techniques leading to applied research. Will develop skills of handling statistical and data interpretation tools.		Theory and seminar/termpaper	

<b>Semester</b>	<b>Title /Nameof the course</b>	<b>Programme outcomes that the course addresses (not more than 3 per course)</b>	<b>Pre-requisite course(s)</b>	<b>Pedagogy</b>	<b>Assessment</b>
<b>8</b>	<b>ES 8T1</b> – Environmental Economics, Sustainable Development and Business	Have developed knowledge and understanding of Environmental Economics, Sustainable Development and SDGs. Get an exposure to the characteristics of an entrepreneur, understand green business models and the details of Corporate Social Responsibility (CSR).	-	Theory, Self-studyand Case studies	Continuous internal assessment (Formative assessment) -30%. End Semester Examination (Summative assessment) - 70%
	<b>ES 8T2</b> – Environmental Law and Environmental ManagementSystems	Have developed knowledge and understanding legal implications of environmental protection legislations of India. Get an exposure to environmental audit and Environmental Management Systems.		Theory, Self-studyand Case studies	
	<b>ES 8T3</b> – Climate Change and Mitigation	Have developed knowledge and understanding of meteorology, climatology and understand dynamics of factors leading to climate change and related knowledge systems. Be able to critically analyze various climate mitigation and adaptation measures.		Theory, Self-studyand Case studies	
	<b>ES 8E3</b> – Quality Assurance andQuality Control in Environmental Analysis	Have developed knowledge of total quality management protocols and develop skills of monitoring and interpreting industrial reporting procedures.		Theory and seminar/termpaper	
	<b>ES 8R1</b> – Research Project	Have developed skills in Research Methodology, able to frame research query, develop methodology, Analyze the data, interpret the results and suggest suitable solutions and recommendations. Also will develop report writing skills, research ethics, use of reference organizing software and anti-plagiarism databases.		Hands-on training	
<b>Award of Bachelor of Science Honors Degree, B.Sc. (Hons.) Degree in Environmental Science (184 credits)</b>					

**Job opportunities for the B.Sc. (Hons.) Degree in Environmental Science**

- Scientific Assistant in Research institutions
- Scientists in Central and State Pollution Control Boards
- Environment Health and Safety Officer in industries
- Environmental auditor I/Auditor II
- Environmental/Production Quality Assurance Officer
- Wastewater Treatment Plant Managers
- Sanitary landfill and Hazardous Waste Handling Experts
- Toxicology specialist
- Forensic Scientist
- Quality Control Executive
- Regulatory Affairs/Liaison Officer
- NGOs/Consultancy firms
- Project and Planning and Development Departments
- Watershed Management Professional
- Teachers in Schools
- Self-employment

## ONE YEAR M.Sc. DEGREE FOR STUDENTS WITH B.Sc. (Hons.) DEGREE

Semester	Title /Nameof the course	Programme outcomes that the course addresses (not more than 3 per course)	Pre-requisite course(s)	Pedagogy	Assessment
<b>9</b>	<b>MES 1T1</b> – Ecology andSustainability	Provides a holistic knowledge of ecology and sustainability for a student who has a Science degree. Emphasize their interrelatedness andsignificance.	1. B.Sc. (Hons.) with total credit score of 184 2. B.Sc. in Agriculture/ Forestry/ Horticulture/Life Science 3. B.E/B.Tech in Environmental/ Civil Engineering 4. B.E/B.Tech in Architecture 5. B.E/B.Tech in Urban/RegionalPlanning	Theory, Self-study and Case studies	Continuous internal assessment (Formative assessment)- 30%.End Semester Examination (Summative assessment) -70%
	<b>MES 1P1</b> – Ecology and Sustainability Studies	Introduces ecological methods, ecosystem services and sustainability evaluation methods		Hands-on-training	
	<b>MES 1T2</b> – Environmental Sustainability and Pollution Prevention	Introduces problems of pollution and their impacts on sustainability. Exposes to real life situations in the form of case studies.		Theory, Self-study and Case studies	
	<b>MES 1P2</b> – Pollution analysis	Develops the skills of identifying specific pollution parameters and their analysis		Hands-on-training	
	<b>MES 1T3</b> – Climate Change Impacts and Resilience	Emphasizes the role of lifestyles towards developing a climate resilient population andeconomy		Theory, Self-study and Case studies	
	<b>MES 1P3</b> – Climate ChangeAssessments	Develops the skill of identifying, prioritizing and assessing climate change parameters		Hands-on-training	
	<b>MES 1T4</b> – Waste Managementand	Introduces the waste scenario with reference to economic and social paradigms. Provides methodsof		Theory, Self-study and Case studies	

	Sustainability	managing the resources sustainably.		
	<b>MES 1P4</b> – Waste management methods	Develop skills required for managing different kinds of wastes.		Hands-on-training
	<b>MES OE1</b> – Global Environmental Concerns <b>OR</b> <b>MES OE1</b> – Natural Resources Management	Be able to get an introductory account of the chosen open elective paper and use the acquired knowledge in decision making and hence add to quality of life		Theory, Case studies and Self-study



<b>Semester</b>	<b>Title /Nameof the course</b>	<b>Programme outcomes that the course addresses(not more than 3 per course)</b>	<b>Pre-requisite course (s)</b>	<b>Pedagogy</b>	<b>Assessment</b>
<b>10</b>	<b>MES 2T1</b> – Smart Cities and Sustainability	Introduces the concept of smart cities, their viability and their role in establishing sustainable economies.	-	Theory, Self-study and Case studies	Continuous internal assessment (Formative assessment)-30%. End Semester Examination (Summative assessment) -70%
	<b>MES 2P1</b> – Case studies	Provides the real life perspective of smart cities, resource management patterns leading to empowerment in decision making.		Situational analysis and interpretation	
	<b>MES 2T2</b> – Environmental Modelling	Introduces the concept of environmental modelling involving resource utilization modelling and pollution modelling.		Theory, Self-study and Case studies	
	<b>MES 2P2</b> – Computational analysis and Env. Modelling	Develops skills of environmental modeling and provides a hands-on exposure of modeling software.		Hands-on-training	
	<b>MES 2T3</b> – Corporate Environmental Sustainability	Provides a corporate/ industrial view of environment and sustainability. Helps in understanding the corporate pressures yet emphasizing on sustainable development.		Theory, Self-study and Case studies	
	<b>MES 2P2</b> – Case studies	Provides the real-life perspective of smart cities, resource management patterns leading to empowerment in decision making.		Suitability and Feasibility analysis	
	<b>MES 2T4</b> – Research Project	Have developed skills in Research Methodology, able to frame research query, develop methodology, Analyze the data, interpret the results and suggest suitable solutions and recommendations. Also will develop report writing skills, research ethics, use of reference organizing software and anti-plagiarism databases.		Hands-on training	
	<b>MES OE2</b> – Env. Pollution and Sustainable Development <b>OR</b> <b>MES OE2</b> – Wildlife Management and Eco-tourism	Be able to get an introductory account of the chosen open elective paper and use the acquired knowledge in decision making and hence add to quality of life.		Theory, Case studies and Self-study	

# **SYLLABUS - Theory and Practicals**

**B.Sc. (Basic/Hons.) Semester 1**

Title of the Course: **ES 1T1 - DIVISIONS OF THE ENVIRONMENT**

<b>Number of Theory Credits</b>	<b>Number of lecturehours/ semester</b>	<b>Number of Practical Credits</b>	<b>Number of practical hours/ semester</b>
<b>4</b>	<b>52</b>	<b>2</b>	<b>52</b>

<b>Programme specific objectives</b>	
PSO 1	To develop competency in understanding the interrelatedness of the divisions of the Environment.
PSO 2	To instill an introductory knowledge of the divisions of Environment and develop necessary analytical skills to characterize their variations.
PSO 3	To motivate and inspire to acquire contemporary understanding and skills leading to issue identification.
PSO 4	To inculcate creativity and innovative spirit in the domain of human-environment interface leading to vocation/entrepreneurial opportunities.

<b>Programme outcomes</b>	
PO 1	Demonstrate an entry level competence in understanding the environmental divisions and associated processes.
PO 2	Demonstrate the ability to carry out water quality analysis in the laboratory and interpret the results.
PO 3	Ability to understand and appreciate the role of environmental parameters in specific day-to-day activities.
PO 4	Be able to understand the demands and function in work environment dealing with environmental systems

Title of the Course: **ES 1T1 - DIVISIONS OF THE ENVIRONMENT**

Content of Theory Course 1	52Hrs
<b>Unit - 1</b>	
Environmental Science: Definition, concept & Scope. Approaches of studying Environmental Science. Division of the Environment: Definitions of Atmosphere, Hydrosphere, Lithosphere and Biosphere - their complex interactions and significance.	<b>08</b>
<b>Unit - 2</b>	
Atmosphere & Climatology: Evolution of the atmosphere, Structure of the atmosphere on the basis of temperature and chemical composition. Formation and significance of ozone layer. Depletion of ozone layer, effects and control measures. Weather and climate: Earth's Albedo and Heat budget of the earth. Tropical monsoon climate – Tropical cyclones and their impacts. Weather forecasting and modification. El-Nino and La-Nina effect. Global warming, effects and control measures; Global dimming - Definition, causes and implications; Urban Heat Islands.	<b>16</b>
<b>Unit - 3</b>	
Hydrosphere: Classification - surface water, sub-surface water, ground water. Hydrological cycle – Definition and process involved – Evaporation, Transpiration, Condensation, Precipitation, infiltration and runoff. Types of lifting and precipitation - Bergeron process and Collision and coalescence theory. Types of clouds, forms of precipitation. Artificial rainfall – Cloud seeding. Limnology: Definition and concept. Lotic – Springs, Stream, Rivers, Potomom and Rhithron. Lentic environment - Ponds, lakes & their classification. Stratification of lake – thermal and photic. Ground water Zonation: Aquifer, Aquitard, Aquiclude; Types of wells. Status of Groundwater in Karnataka. Marine Environment: Zonation, Salinity status of marine environment, biotic communities, ocean acidification and coral bleaching; ocean currents and tides – significance; Polymetallic nodules, Brackish water of estuaries and deltas.	<b>14</b>
<b>Unit - 4</b>	
Lithosphere: Definition. Internal Structure of the earth – crust, mantle, core. Endogenic processes: Plate Tectonics, folds, faults – Earthquake and Volcanism – Causes, Effects, and Management. Exogenic processes: River, Sand dunes, Glaciation, Avalanches and Landslides. Land forms – Mountains, plateau, plains. Mineralogy: Definition. Outline classification of minerals. Petrology: Definition. Rock Cycle. Classification - Igneous, Sedimentary and Metamorphic rocks – their formation – types – applications. Pedology: Soil – definition – formation – soil profile – physical and chemical characteristics. Types of soils – Alluvial; Black; Red and Laterite; Arid and Desert; Saline and Alkaline; Peaty and Marshy; Grassland, Forest and Mountain Soils. Soil biota. Soil weathering and erosion – Types, effects and management.	<b>14</b>

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## **Content of Practical Course 1: List of experiments to be conducted**

### **ES 1P1: WATER QUALITY ANALYSIS**

**(Total Teaching Hours = 52; Total Credits = 2)**

1. Sampling technique of water.
2. Determination of pH and Electrical Conductance (pH metric method and Conductivity meter method).
3. Estimation of Turbidity (Nephelometric method) and TS, TSS & TDS (Gravimetric and Filtration method).
4. Estimation of Acidity – Alkalimetric method / CO<sub>2</sub> – NaOH titration method.
5. Estimation of Alkalinity – Acidimetric method.
6. Estimation of Hardness – EDTA Complexometric method.
7. Estimation of Chlorides – Argentometric method.
8. Estimation of Dissolved Oxygen – Modified Winkler's method.
9. Estimation of Nitrates – Phenol disulphonic Acid method.
10. Estimation of Fluorides – Fluoride meter method/SPADNS Reagent method.
11. Estimation of Sulphates – Barium chloride method.

### **References**

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- Zhang, C. (2007). Fundamentals of environmental sampling and analysis. JohnWiley & Sons.

## ES OE1: ENVIRONMENTAL MOVEMENTS

<b>Number of Theory Credits</b>	<b>Number of lecture hours/ semester</b>
<b>3</b>	<b>42</b>

<b>Content of OPEN ELECTIVE Theory Course 1</b>	<b>42Hrs</b>
<b>Unit – 1</b>	<b>14</b>
Environment: Definition, role of environment in shaping civilizations. Interrelations between civilization and environment – ecological economic and socio-cultural. Industrial revolution and environmental pollution. Modern agriculture and environmental degradation. Development: Definition, Growth and development. Population growth and its impact on natural resources, causes for industrialization, changing life styles, regulatory aspects of industrialization, impact of industrialization on quality of human life.	
<b>Unit - 2</b>	<b>14</b>
Sustainable Development: Definition. Sustainable development – Need, relevance in contemporary society. Principles of Sustainable Development: History and emergence of the concept of Sustainable Development, Environmental issues and crisis, Resource degradation, desertification, invasive species, wildlife depletion and social insecurity. United Nations Sustainable Development Goals and their implementation. Sustainable development through - trade, economic growth, carrying capacity and public participation.	
<b>Unit - 3</b>	<b>14</b>
People movements: Types – Concept of environmental movements, Definition, levels of collective action, the local grassroots movement level; the social movement level; a cycle of protest. International Summits: United Nations Conference on Human Environment, 1972 – 'Limits to Growth'. The Brundtland Commission, 1987 – 'Our Common Future'. The United Nations Conference on Environment and Development, 1992. Environmental Movements of India: Bishnoi Movement, The Chipko Movement, Appiko Movement, Silent Valley Movement, Narmada Bachao Andolan, Jungle Bachao Andolan, Beej Bachao Andolan. Urban-based Environmental Movements – Local case studies.	

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## ES OE1: ENVIRONMENT AND SUSTAINABLE AGRICULTURE

<b>Number of Theory Credits</b>	<b>Number of lecture hours/ semester</b>
<b>3</b>	<b>42</b>

<b>Content of OPEN ELECTIVE Theory Course 1</b>	<b>42Hrs</b>
<b>Unit – 1</b>	<b>14</b>
Agroecology - Definition, scope and significance. Global, national and regional scenario. Agroclimatic zones of India. Socio-economic pressures on agriculture. Food security and food scarcity. Agricultural biodiversity: Crop diversity – Definition and significance. Evolution of agricultural practices. Types of agriculture – rain-fed cultivation and irrigation – water intensive agriculture – Reservoirs and ground water exploitation. Conventional and mechanized agriculture. Natural and chemical agriculture. Subsistence and commercial agriculture. Environmental effects of land use and landscape changes.	
<b>Unit - 2</b>	<b>14</b>
Environmental determinants of agriculture – role of rainfall, temperature, humidity, wind, topography and edaphic factors in crop selection. Soil types and nutrients. Animal husbandry – Dairy and poultry – role of transboundary species of cattle in Indian scenario. Pisciculture – Environmental effects of intensive pisciculture. Agricultural biodiversity: Crop diversity, Definition and significance. Agroforestry. Poly culture and mono culture. Influences of green revolution on modern agricultural practices of India – Loss of agrobiodiversity – Influence of transboundary crops. Agricultural biotechnology – Genetically Modified Crops – Influence on environment. Pollinator crisis. Integrated pest management.	
<b>Unit - 3</b>	<b>14</b>
Environmental impacts of agriculture – Loss of biodiversity – soil salinity – fertilizer and pesticide pollution, Climate change and global warming. Erosion and siltation in irrigation systems. Desertification. Biomagnification – Case studies. Contemporary issues and management – Farmer distress – market mechanisms – natural farming methods/organic farming. Urban agriculture and hydroponics. Data distribution of rainfall, intensity of rainfall and cyclones. Ecological principles of farming – Sustainable agriculture – Significance of indigenous crops and cattle varieties. Watershed management. Agricultural policies of India.	



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## ES OE1: ENVIRONMENTAL POLLUTION

Number of Theory Credits	Number of lecture hours/ semester
3	42

Content of OPEN ELECTIVE Theory Course 1	42Hrs
<p><b>Unit – 1</b></p> <p>Environmental pollution: Definition, Types. Environmental contaminants and environmental pollutants. Classification of pollutants – on the basis of physical properties and forms of their existence. Primary and secondary pollutants, organic and inorganic, point and non- point sources of pollution. Xenobiotics and persistent organic chemicals. Characteristics of pollution – Large production quantities, usage involving leakages, toxicity, persistence and accumulation. Air pollution: Definition, sources, types of air pollution, particulate matter and gaseous pollutants. Effects on flora, fauna, human-beings and materials. Indoor pollution and outdoor pollution, ozone depletion and recovery, global warming and climate change. London smog, Bhopal gas tragedy, Visakhapatnam gas leak and Endosulfan tragedy in Karnataka. Air quality standards – NAAQS, AQI, Bharat Stage - VI Emission standards. Air pollution control measures.</p>	<b>14</b>
<p><b>Unit - 2</b></p> <p>Water pollution: Definition, sources of water pollution and their effects on flora, fauna, human-beings and materials. Surface water pollution – Dissolved oxygen, biochemical oxygen demand and chemical oxygen demand. Agriculture runoff and detergents as pollutants. Eutrophication. Heavy metal pollution – Minamata episode. Ground water contamination – fluoride, nitrate, arsenic contamination and their control. Water quality criteria – specifications for drinking and inland surface waters. Water Quality Standards. Water pollution control measures. Soil pollution: Definition, sources and types. Soil pollutants – heavy metals, inorganic ions and salts; and organic substances. Effects of pollution on soil health and productivity. Effects of pesticides on soil. Soil erosion, types and control.</p>	<b>14</b>
<p><b>Unit - 3</b></p> <p>Noise pollution: Definition, types, sources and effects. Decibel scale. Noise control and abatement – active and passive methods. Impact of noise and vibration on human health. Noise dose and noise pollution standards. Solid waste disposal and impacts: Definition, origin, classification and characteristics of solid waste. Segregation, collection, transportation and disposal of solid waste. Solid waste treatment and disposal – Composting, open dumping, sanitary landfill, incineration, recycling and recovery. E-waste: Definition, sources, composition, recycling and disposal methods. Hazardous waste: Definition, sources, classification, effects and disposal methods.</p>	<b>14</b>

## References

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## B.Sc. (Basic/Hons.) Semester 2

### Title of the Course: ES 1T2 - ECOLOGY – THEORY AND PRACTICE

<b>Number of Theory Credits</b>	<b>Number of lecture hours/semester</b>	<b>Number of practical Credits</b>	<b>Number of practical hours/ semester</b>
<b>4</b>	<b>52</b>	<b>2</b>	<b>52</b>

<b>Programme specific objectives</b>	
PSO 1	To develop competency in understanding the ecological principles governing the biosphere.
PSO 2	To instill a knowledge of the Ecology and develop necessary analytical skills to understand the ecological systems.
PSO 3	To motivate and inspire to acquire contemporary understanding and skills leading to issue identification.
PSO 4	To inculcate creativity and innovative spirit in the domain of human-environment interface leading to vocation/entrepreneurial opportunities.

<b>Programme outcomes</b>	
PO 1	Demonstrate an entry level competence in understanding the ecological dynamics and their influence on humans and anthropogenic endeavours.
PO 2	Demonstrate the ability to carry out ecological analysis in field conditions/laboratories and make appropriate judgements.
PO 3	Ability to understand and appreciate the role of ecology and system dynamics in specific habitats/agroecosystems.
PO 4	Be able to understand the demands and function in work environment dealing with environmental systems.

**Title of the Course: ES 1T2 - ECOLOGY – THEORY AND PRACTICE**

<b>Content of Theory Course 2</b>	<b>52 Hrs</b>
<b>Unit – 1</b>	<b>13</b>
Ecology: Definition, Concept, sub-division, Levels of organization, approaches in studying Ecology. Ecosystems – Definitions. Classification of ecosystem – Terrestrial and Aquatic with their divisions. Structure and function of ecosystem - food chain – food web – bio-magnification. Ecological pyramids – Types. Biogeochemical cycles: Classification. Gaseous and Sedimentary cycles – anthropogenic influences on these cycles. Energy flow in an ecosystem – productivity - trophic levels; Study of pond and crop land ecosystems; Homeostasis and feedback mechanisms.	
<b>Unit – 2</b>	<b>13</b>
Community Ecology: Definition, Characteristics of a Community – Species diversity, growth form and structure, dominance, relative abundance, trophic structure. Population Ecology: Definition, Characteristics of Population: Density – Natality – Mortality – Age distribution – Growth form - Population Equilibrium – Biotic potential – Carrying capacity – Dispersal – Dispersion – Population fluctuations – Population regulation.	
<b>Unit - 3</b>	<b>13</b>
Ecological succession – Primary and Secondary succession – Natural and man-influenced succession, – Hydrarch and Xerarch - Climax vegetation and their theories; Ecotone and Edge effect; Ecological equivalents; Ecotypes and Ecophenes; Ecological indicators. Ecological Niche: Concept and Types of niches: Spatial, Trophic and Multidimensional – Niche parameters: Form, Position and Width – Niche Partitioning - Realized and Fundamental Niche. Biomes: Definition and concept. Classification of biomes.	
<b>Unit - 4</b>	<b>13</b>
Biotic factors and Abiotic factors: Influence Temperature, Wind and Water, Edaphic, Topographic on flora and fauna, Ecological interactions – Intra and Interspecific interactions Concept of Limiting Factors: Liebig’s Law of Minimum; Shelford’s Law of Tolerance and the combined concept. Evolution: Definition – Darwin’s postulates - Natural selection – Types – Industrial Melanism - Pesticide resistance. Co-evolution; Mimicry – Batesian and Mullerian mimicry, warning colouration, camouflage	

## References

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## **Content of Practical Course 2: List of Experiments to be conducted**

### **ES 2P1: ECOLOGICAL ANALYSIS**

**(Total Teaching Hours = 52; Total Credits = 2)**

1. Sampling technique for phytoplanktons and zooplanktons.
2. Quantitative estimation of phytoplankton – Sedgwick-Rafter method.
3. Quantitative estimation of zooplankton – Sedgwick-Rafter method.
4. Determination of organic pollution – Palmer's Algal Pollution index.
5. Estimation of primary productivity of a pond – Light and Dark bottle method.
6. Estimation of primary productivity of terrestrial vegetation – Chlorophyll method.
7. Estimation of primary productivity of grasses – Harvest method.
8. Study of plant community – Individual count method/Quadrat method.
9. Study of animal community – Line transect method.
10. Identification of ecological indicators – Hydrophytes, xerophytes, lichens.

### **References**

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- Rolan, R. G. (1973). Laboratory and Field Investigations in General Ecology. Macmillan Co.
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## ES OE2: CLIMATE CHANGE AND ITS IMPLICATIONS

<b>Number of Theory Credits</b>	<b>Number of lecture hours/ semester</b>
<b>3</b>	<b>42</b>

<b>Content of OPEN ELECTIVE Theory Course-2</b>	<b>42 Hrs</b>
<b>Unit – 1</b>	<b>14</b>
Atmosphere: Definition and scope. Origin and evolution of the earth’s atmosphere. Composition and thermal structure of atmosphere; Weather and climate; Meteorological parameters - temperature, pressure, precipitation, humidity, wind speed and direction. Introduction to the effects of various anthropogenic activities on earth’s atmosphere. Monsoons – Definition, Indian monsoons – seasons: Winter, pre-monsoon (Summer), monsoon (The rainy season) and post monsoon (The transition season). Indian Monsoon – South west monsoon, North east monsoon. Cyclones and droughts of the Indian region; Western disturbances, El-Nino, La- Nina and their impacts.	
<b>Unit - 2</b>	<b>14</b>
Atmospheric pollution and global warming: Definition, impacts, major greenhouse gases, sources and sinks of greenhouse gases; Urban Heat Islands; Ozone layer depletion and recovery, issues and remedies; ground level ozone and air pollution; global dimming. Carbon footprint. Impacts of climate change: Increased surface mean temperature, insect outbreaks, vector borne/zoonotic diseases, forest fire, reduced water availability, influence on agriculture, increase in floods and drought incidences, loss of biodiversity and extinction of species, sea level rise. Climate change and food security. Vulnerable populations – The Kiribati story.	
<b>Unit - 3</b>	<b>14</b>
Climate change negotiations – History of international climate change policies. United Nation Framework Convention on climate change (UNFCCC), The United Nations Conference on Environment and Development, Intergovernmental Panel on Climate Change (IPCC), Agenda 21, The Kyoto protocol, Paris agreement. Overview of Conference of Parties (CoP). Ministry of Environment, Forests & Climate Change (MoEF&CC), National Action Plan on Climate Change (NAPCC). Climate change adaptation and mitigation: Definition, scope and objectives. Linkages between development and climate change impacts, their mitigation and adaptation. Clean Development Mechanisms; Green Climate Fund, The Adaptation Fund. United Nations Sustainable Development Goals. Role of individuals in achieving Sustainable Development Goals.	



## References

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- Rajit Sengupta and Kiran Pandey. (2021). State of India's Environment 2021: In Figures. Centre Science and Environment, New Delhi.
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- Romm, J. (2018). Climate Change: What Everyone Needs to Know®. Oxford University Press.

**ES OE2: ENVIRONMENT AND PUBLIC HEALTH IN  
CONTEMPORARY SOCIETY**

<b>Number of Theory Credits</b>	<b>Number of lecture hours/semester</b>
<b>3</b>	<b>42</b>

<b>Content of OPEN ELECTIVE Theory Course 2</b>	<b>42 Hrs</b>
<p><b>Unit – 1</b></p> <p>Environment and public health: Definitions of health and disease. Perspectives on individual health: Nutritional, socio-cultural and developmental aspects, Dietary diversity for good health; Human developmental indices for public health. Effect of quality of air, water and soil on human health. Diseases in contemporary society: Need for good health - factors affecting health. Diseases caused due to pollution - allergies, respiratory, cardiovascular and cancer. Personal hygiene- food- balanced diet. Health effects of smoking, drugs and alcohol consumption.</p>	<b>14</b>
<p><b>Unit - 2</b></p> <p>Malnutrition: Vitamin deficiency diseases and Mineral deficiency diseases; Folic acid requirement during pregnancy; Food Safety- Adulterants and preservatives; Pesticide Toxicity: Endosulfan and DDT; Genetically Modified Food. Mineral deficiencies – Fluorosis, Goiter, Iron deficiency. Communicable diseases: Definition, mode of transmission – pandemic, epidemic and endemic diseases. Vector borne diseases: Plague and Malaria; emerging diseases: Dengue, Chikungunya, Zika, Ebola, Swine Flu, Bird Flu, Severe Acute Respiratory Syndrome (SARS), Middle East Respiratory Syndrome (MERS); Zoonosis- Leptospirosis; Kyasanur Forest Disease (KFD) Toxoplasmosis and Nipah. Non-communicable diseases and Lifestyle diseases – Diabetes, Hypertension and obesity.</p>	<b>14</b>
<p><b>Unit - 3</b></p> <p>Occupational health: Sick Building Syndrome; Noise and Radiation; Ergonomics - Stress and Fatigue; Carpal tunnel syndrome (CTS); Synergistic effect; Irritable bowel syndrome; Crohn’s disease. Environmental Sanitation and Hygiene: Safe disposal of human excreta; Solid waste disposal; Sanitation value chain. Drug safeties: Thalidomide Tragedy; Antibiotic stewardship; Antibiotic-Resistant superbug.</p>	<b>14</b>

## References

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- Rajit Sengupta and Kiran Pandey. (2021). State of India's Environment 2021: In Figures. Centre Science and Environment, New Delhi.
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- Walton, M. (2017). One Planet, One Health. Sydney University Press.

## ES OE2: WILDLIFE AND CONSERVATION

<b>Number of Theory Credits</b>	<b>Number of lecture hours/ semester</b>
<b>3</b>	<b>42</b>

<b>Content of OPEN ELECTIVE Theory - Course 2</b>	<b>42Hrs</b>
<b>Unit – 1</b>	<b>14</b>
Wildlife: Definition, significance – Values of wildlife: Ecological, Economic, Cultural, Aesthetic, Scientific, Recreational and Medicinal. Biogeographical zones of India. Significant wildlife of India. Causes and consequences of wildlife loss – HIPPO (Habitat destruction, Invasive species, Pollution, Population and Overharvesting). Forest fires and wildlife depletion. Effects of depletion of wildlife – Ecological, Economic Socio-cultural. Human-wildlife conflict and management. Conservation of Wildlife- IUCN Red list categories - Extinct, Extinct in wild, critically endangered, Endangered, Vulnerable, Near threatened, Least concerned, Data deficient, Not evaluated. IUCN Red data book. Keystone species, Flagship species, Umbrella species. Priority species, Indicator species.	
<b>Unit - 2</b>	<b>14</b>
Wildlife conservation: Need for conservation of wildlife. History of wildlife conservation in India. Protected areas - Biosphere reserves, National parks, Wildlife sanctuaries, community reserve, conservation reserve, sacred grooves, single species/single habitat-based conservation areas, Area of special scientific interest (ASSI). Conservation practices - <i>Ex-situ</i> and <i>in-situ</i> conservation. Case studies: Project tiger, Project elephant. People and conservation: Traditional ecological knowledge, Traditions and cultures, Women and people's participation in managing protected areas. Urban biodiversity and citizen science. Role of NGOs in conservation. Conservation Institutions – Bird Life International, GEF, UNEP, WCS, WWF; BNHS, WTI.	
<b>Unit - 3</b>	<b>14</b>
Wildlife tourism: Definition, scope and relevance. Role of Zoos and Botanical gardens in tourism, awareness creation and conservation. Positive and negative impacts of wildlife tourism. Conflicts related to wildlife tourism. Wildlife trade and legislation: Wildlife trade and impacts. The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). TRAFFIC. Salient features of Indian wildlife act 1972.	

## References

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COURSE PATTERN AND SCHEME OF EXAMINATION for B.Sc. / B.Sc. (Hons.)  
as per NEP (2021-22 and onwards)

**SUBJECT: ENVIRONMENTAL SCIENCE**

Sl. No.	Semester	Title of the Paper	Teaching Hours	Hours/ week		Examination Pattern Max. & Min. Marks /Paper						Duration of Exam (hours)		Total Marks / paper	Credits	
				Theory	Practical	Theory			Practical			Theory	Practical		Theory	Practical
						Max.	Min.	IA	Max.	Min.	IA					
1	I	ES 1T1: Divisions of the Environment	52	4	4	60	21	40	25	9	25	3	4	150	4	2
		ES OE 1 / ES OE 1/ ES OE 1	42	3	-	60	21	40	-	-	-	3	-	100	3	-
2	II	ES 1T2: Ecology - Theory and Practice	52	4	4	60	21	40	25	9	25	3	4	150	4	2
		ES OE 2 / ES OE 2/ ES OE 2	42	3	-	60	21	40	-	-	-	3	-	100	3	-

### Scheme of Internal Assessment Marks:

#### Theory:

Sl. No.	Particulars	IA Marks
1	Attendance	05
2	Internal Tests (Minimum of Two)	20
3	Assignments /Seminar / Case Study / Project work / Reports on - visits to industries/exhibitions/science centers /active participation in competitions, etc.	15
<b>TOTAL TheoryIAMarks</b>		<b>40</b>

#### Practicals:

Sl. No.	Particulars	IA Marks
1	Practical Test	15
2	Report on datasheet / Seminar on experiments, etc.	05
3	Active participation in practical classes	05
<b>TOTAL Practical IAMarks</b>		<b>25</b>