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# UNIVERSITY OF MYSORE

Estd. 1916

VishwavidyanilayaKaryasoudha
Crawford Hall, Mysuru- 570 005

No.AC2(S)/151/2020-21

Dated:10.10.2022

## Notification

**Sub:-** Syllabus and Examination Pattern of Environmental Science (UG) (III & IV Semester) with effective from the Academic year 2022-23 as per NEP-2020.

**Ref:-** 1. Decision of Board of Studies in of Environmental Science (UG) Meeting held on 01-08-2022.
2. Decision of the Faculty of Science & Technology Meeting held on 15-09-2022.
3. Decision of the Academic Council meeting held on 23-09-2022.

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The Board of Studies in Environmental Science (UG) which met on 01-08-2022 has recommended & approved the syllabus and pattern of Examination of Environmental Science Course (III & IV Semester) with effective from the Academic year 2022-23 as per NEP -2020.

The Faculty of Science & Technology and Academic Council at their meetings held on 15-09-2022 and 23-09-2022 respectively has also approved the above said syllabus and hence it is hereby notified.

The syllabus and Examination pattern is annexed herewith and the contents may be downloaded from the University Website i.e., www.uni-mysore.ac.in.

**Draft Approved by the Registrar**

**DeputyRegistrar(Academic)**
Deputy Registrar (Academic)
University of Mysore
Mysore-570 005

**To:-**

1. All the Principal of affiliated Colleges of University of Mysore, Mysore.
2. The Registrar (Evaluation), University of Mysore, Mysuru.
3. The Chairman, BOS/DOS, in Environmental Science, Manasagangothri, Mysore.
4. The Dean, Faculty of Science & Technology, DoS in Earth Science, MGM.
5. The Director, Distance Education Programme, Moulya Bhavan, Manasagangotri, Mysuru.
6. The Director, PMEB, Manasagangothri, Mysore.
7. Director, College Development Council , Manasagangothri, Mysore.
8. The Deputy Registrar/Assistant Registrar/Superintendent, Administrative Branch and Examination Branch, University of Mysore, Mysuru.
9. The PA to Vice-Chancellor/ Registrar/ Registrar (Evaluation), University of Mysore, Mysuru.
10. Office Copy.

# PREAMBLE

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. Many formal and informal meetings were held with a number of colleagues from the universities and colleges, who helped with crucial inputs as to the content of the course. This curriculum is a fresh exercise, but also represents a continuous effort of deliberations with the University and College teachers.

As enshrined in the National Education Policy-2020 vision of introducing course curriculum for undergraduate studies under Choice Based Credit System (CBCS), 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.

There is need to strengthen the students to understand essential aspects of environmental science in diverse subject areas such as ecology, environmental chemistry, environmental pollution, environmental geoscience, atmospheric sciences, biodiversity, natural resources management, global warming, climate change and waste management. The curriculum lays focus on creating new knowledge, acquiring new skills and capabilities in Environmental Science producing an intelligent human resource serving the Environment and society, focusing on problem solving critical thinking, team work and collaboration. There

is also an additional emphasis in providing opportunities to understand the integration of modern disciplines such as environmental modelling, geographical information systems and remote sensing, environmental sustainability, corporate governance and their applications to environmental sciences. Students would be encouraged to go beyond the classroom and conduct active action-research, research projects, technology based learning and internships in industry/ private/government/manufacturing and service sectors based on suitability. Lectures and classroom sessions are accompanied with on-field visits, industrial visits, seminars, laboratory experiments and in-plant training. Educational visits are an integral part of teaching Environmental Science. These interventions are compulsory and essential aspects of the curriculum. There are optional subject that can be chosen by the students as per their desire and their professional choices.

It is hoped that a student with a four years B.Sc. Environmental Science (Hons.) degree, after having the rigor of the courses outlined here, will feel adequately equipped to meet the challenges of career development. At the same time, there is sufficient content for those who wish to continue academic life at the University beyond the under-graduate level. Due care has been taken to maintain necessary academic wholesomeness and depth in the course content so that the learning outcomes from these courses will lead to intellectual growth of a student. The need for a Basic/Hons. course in Environmental Sciences is necessitated by our country's requirement and also the acceptability of the subject by young students from the view point of career opportunity. There is a demand for the subject in our country and as Educationists we have a societal obligation to meet such aspirations of the youths. It is equally expected that Environmental Science graduates will significantly contribute to the vision of 'Zero Defect, Zero Effect' policy initiative of Government of India.

The course curriculum presented in the following table confirms to the general Guidelines of NEP-2020 scheme, semester schedule, evaluation criteria

and course credit structure of B.Sc. Environmental Science (Basic/Hons.) Programme, like all other undergraduate courses shall comprise of 184 credits spread over Thirty Seven (37) papers to be completed in four years/eight semesters.

| Sem | Theory | Practicals | Open Electives | Vocational Course | Internships | Discipline Specific Electives | Research Methodology | Project | Total Papers |
|---|---|---|---|---|---|---|---|---|---|
| I | 1 (4) | 1 (2) | 1 (3) | - | - | - | - | - | 3 |
| II | 1 (4) | 1 (2) | 1 (3) | - | - | - | - | - | 3 |
| III | 1 (4) | 1 (2) | 1 (3) | - | - | - | - | - | 3 |
| IV | 1 (4) | 1 (2) | 1 (3) | - | - | - | - | - | 3 |
| V | 2 (6) | 2 (4) | - | 1 (3) | - | - | - | - | 5 |
| VI | 2 (6) | 2 (4) | - | 1 (3) | 1 (2) | - | - | - | 6 |
| VII | 3 (9) | 2 (4) | - | - | - | 2 (6) | 1 (3) | - | 8 |
| VIII | 3 (9) | 1 (2) | - | - | - | 1 (3) | - | 1 (6) | 6 |
| Total Papers | 14 | 11 | 4 | 3 | 1 | 3 | 1 | 1 | 37 |

*#Numbers in parenthesis indicate credits - amounting to a total of 107 credits*

In addition to the subject of Environmental Science (details provided in the above table), another core paper with a similar credit pattern is to be chosen by the student.

Irrespective of the two core paper chosen, every under-graduate student needs to take up 2 Ability Enhancement Compulsory Courses (AECC), 2 languages, 4 Skill based courses and 8 Valued based courses.

A candidate with a minimum qualification of M**.Sc. in Environmental Science subject only** is qualified to teach B.Sc. (Basic/Hons.) Environmental Science at under-graduate level in all the Universities, Deemed Universities, Autonomous Institutions, Government, Aided and Private Colleges in the State of

Karnataka. Preference may be given to candidates with UGC-NET/K-SET/Ph.D in Environmental Science following the government directives.

Further, the existing number of UGC-NET Fellowships in the field of Environmental Sciences is highly inadequate; it is advisable to increase the number of Fellowships in this area.

An Environmental Science programme at the under-graduate level will be successful only when independent Departments of Environmental Sciences are established at under-graduate colleges. It is important to avoid existing problems of co-ordination in teaching carried out through participatory approach. NEP- 2020 Environmental Science Subject Expert Committee urges Universities/ Colleges to take necessary steps in this direction.

## EXIT OPTIONS AND CREDIT REQUIREMENTS

Progressive Certificate in Science, Diploma in Science, Bachelor of Science Degree or Bachelor of Science Degree with Honours in Environmental Science is awarded at the completion of every progressive year.

| Exit with | Credit requirements |
|---|---|
| **CERTIFICATE IN SCIENCE** at the successful completion of First year (Two Semesters) of the Four Years Multidisciplinary Undergraduate Degree Programme. | 50 credits |
| **DIPLOMA IN SCIENCE** at the successful completion of Second year (Four Semesters) of the Four Years Multidisciplinary Undergraduate Degree Programme. | 100 credits |
| **BACHELOR OF SCIENCE DEGREE** at the successful completion of Three year (Six Semesters) of the Four Years Multidisciplinary Undergraduate Degree Programme. | 142 credits |
| **BACHELOR OF SCIENCE DEGREE WITH HONOURS IN ENVIRONMENTAL SCIENCE** at the successful completion of Four year (Eight Semesters) of the Four Years Multidisciplinary Undergraduate Degree Programme. | 184 credits |

A student will be allowed to enter/re-enter only at the ODD semester and can only exit after EVEN semester. Re-entry at various as lateral entrants in academic programmes based on the above mentioned earned credits and proficiency test records.

The validity of the earned credit will be for a maximum period of seven years or as specified by the Academic Bank of Credits (ABC).

Emphasis is given on Continuous Internal Assessment (CIA) with Higher order thinking skills (40%:60% - 40% CIA and 60% End Semester Examination) for theory course and 50%:50% - End Semester Examination and CIA for Laboratory work, Field works, Project,

Internship and Educational visits.

# 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 | **40** | **60** |
| Practical | **25** | **25** |
| Project/Experiential Learning (Internship etc.) | **Report = 50**<br>- Relevance of the topic=05<br>- Robustness of literature review =10<br>- Appropriateness of Methodology=10<br>- Results, Discussion and Interpretation=20<br>- Referencing and citation=05 | **Viva-voce = 50**<br>- Presentation skills=25<br>- Question answer=25 |

# 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) | VALUEBASED (credits) (L+T+P) | | |
| I | Env. Science A1 (4+2)<br>Other Core B1 (4+2) | Open Elective - 1 (3) | L1-1 (3)<br>L2-1 (3)<br>(4 hours each) | Environmental Studies (2) | SEC-1 Digital Fluency (2) (1+0+2) | Physical Education for fitness (1) (0+0+2) | Health & Wellness (1) (0+0+2) | 25 |
| II | Env. Science A2 (4+2)<br>Other Core B2 (4+2) | Open Elective - 2 (3) | L1-2(3),<br>L2-2(3),<br>(4 hours each) | | | Physical Education – Yoga (1) (0+0+2) | NCC/NSS/R&R (S&G)/Cultural (1) (0+0+1) | 25 |
| Exit option with Certificate in Science (50 credits) | | | | | | | | |
| III | Env. Science A3 (4+2)<br>Other Core B3 (4+2) | Open Elective - 3 (3) | L1-3 (3)<br>L2-3 (3)<br>(4 hours 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) | 25 |
| IV | Env. Science A4 (4+2)<br>Other Core B4 (4+2) | Open Elective - 4 (3) | L1-4 (3)<br>L2-4 (3)<br>(4 hours each) | Constitution of India (2) | - | Physical Education – Games (1) (0+0+2) | NCC/NSS/R&R (S&G)/Cultural (1) (0+0+1) | 25 |
| Exit option with Diploma in Science (100 credits) OR Choose any one of the core subjects as Major and other as Minor | | | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **V** | Env. Science A5 (3+2) Env. Science A6 (3+2) Other Core B5 (3+2) | Vocational course-1 (3) | - | - | SEC-3: SEC such as Cyber Security (2) (1+0+2) | - | - | **20** |
| **VI** | Env. Science A7 (3+2) Env. Science A8 (3+2) Other Core B6 (3+2) | Vocational course-2 (3) Internship (2) | - | - | SEC-4: Professional communication (2) | - | - | **22** |
| **Exit option with Bachelor of Science, B.Sc. Degree in Environmental Science (142 credits) OR continue studies with Major in the fourth year** | | | | | | | | |
| **VII** | Env. Science A9 (3+2) Env. Science A10 (3+2) Env. Science A11 (3) | Env. Science Elective-1 (3) Env. Science Elective-2 (3) Research Methodology (3) | - | - | - | - | - | **22** |
| **VIII** | Env. Science A12 (3+2) Env. Science A13 (3) Env. Science A14 (3) | Env. Science Elective-3 (3) Research project (6)* | - | - | - | - | **-** | **20** |
| **Award of Bachelor of Science Honors Degree, B.Sc. (Hons.) Degree in Environmental Science (184 credits)** | | | | | | | | |

Note: *L+T+P= Lecturing in Theory + Tutorial + Practicals.

*In lieu of the research project, two additional elective papers/ Internship may be offered Numbers in the parenthesis refer to credits.

## 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

| Semester | Title /Name of the course | Programme outcomes that the course addresses (not more than 3 per course) | Pre-requisite course (s) | Pedagogy | Assessment |
|---|---|---|---|---|---|
| 1 | **ES 1T1 - DIVISIONS OF ENVIRONMENT (4)** | 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) - 40%. End Semester Examination (Summative assessment) - 60% |
| | **ES 1P1 - WATER QUALITY ANALYSIS (2)** | Be able to analyze the vital physicochemical parameters of water, interpret and suggest suitable treatment methods. | | Hands-on-training | |
| | **ES 1OE1 - ENVIRONMENTAL CONSERVATION MOVEMENTS (3) OR ES 1OE1 - ENVIRONMENTAL POLLUTION (3)** | 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 /Name of the course | Programme outcomes that the course addresses (not more than 3 per course) | Pre-requisite course (s) | Pedagogy | Assessment |
|---|---|---|---|---|---|
| 2 | **ES 2T1 - ECOLOGY - THEORY AND PRACTICE (4)** | Have developed sound knowledge of Basic and Applied Ecology. | - | Theory, case studies and course projects | Continuous Internal Assessment (Formative assessment) - 40%. End Semester Examination (Summative assessment) - 60% |
| | **ES 2P1 - ECOLOGICAL ANALYSIS (2)** | Be able to Identify and Enumerate Planktons, Estimate the Primary Productivity of an Aquatic Ecosystem, study the characteristics of a Biotic Community; Be able to Compute Carbon Sequestration of trees. | | Hands-on-training | |
| | **ES 2OE2 - CLIMATE CHANGE AND ITS IMPLICATIONS (3) OR ES 2OE2 - ENVIRONMENT AND PUBLIC HEALTH IN CONTEMPORARY SOCIETY (3)** | 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 | |

**Exit option with Certificate in Science (50 credits)**

**Job opportunities for the Exit option with Certificate**

- Sampling Assistant in wastewater treatment plants
- Analytical Assistant/Intern analyst in water testing laboratories
- Laboratory instructor in in educational institutions
- Field Technician in mobile environmental laboratories
- Field Technician in Research institutions/NGOs involved in environmental monitoring/carbon credit establishment/productivity studies.
- Sampling and execution assistant in environmental auditing
- Garden/nursery Supervisor/Entrepreneurship
- NGOs/Consultancy firms
- Self-employment

| Semester | Title /Name of the course | Programme outcomes that the course addresses (not more than 3 per course) | Pre-requisite course (s) | Pedagogy | Assessment |
|---|---|---|---|---|---|
| 3 | **ES 3T1 –NATURAL RESOURCES AND MANAGEMENT (4)** | 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) -40%. End Semester Examination (Summative assessment) -60% |
| | **ES 3P1 – MINERALOGY, PETROLOGY, ENERGY RESOURCES AND MEDICINAL PLANTS (2)** | Be able to Identify Major Rock forming Minerals and Rocks. Learn basic skills of mapping and cartography. | | Hands-on-training and field studies | |
| | **ES 3OE3 –WOMEN AND ENVIRONMENT (3) OR ES 3OE3 – ENVIRONMENTAL DISASTERS AND MANAGEMENT (3)** | 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 /Name of the course | Programme outcomes that the course addresses (not more than 3 per course) | Pre-requisite course (s) | Pedagogy | Assessment |
|---|---|---|---|---|---|
| 4 | **ES 4T1 – BIODIVERSITY, WILDLIFE AND CONSERVATION (4)** | 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) - 40%. End Semester Examination (Summative assessment) - 60% |
| | **ES 4P1 – BIODIVERSITY ASSESSMENT AND ECOSYSTEM SERVICES (2)** | Be able to analyse the behaviour of local weather patterns by monitoring meteorological parameters. Develop wind and pollution roses; analyse climate maps and make interpretations.<br>Be able to execute sampling and data collection skills with reference to biodiversity and wildlife.<br>Will have an exposure to wildlife monitoring techniques such as quadrats, line transects and mark-release-recapture methods. | | Data handling and Hands-on-training | |
| | **ES 4OE4 – ENVIRONMENT AND SUSTAINABLE AGRICULTURE (3)**<br>**OR**<br>**ES 4OE4 – INITIATIVES FOR ENVIRONMENTAL MANAGEMENT (3)** | 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 | |

**Exit option with Diploma in Science (100 credits) OR Choose any one of the core subjects as Major and other as Minor**

**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

| Semester | Title /Name of the course | Programme outcomes that the course addresses (not more than 3 per course) | Pre-requisite course (s) | Pedagogy | Assessment |
|---|---|---|---|---|---|
| 5 | **ES 5T1 – ENVIRONMENTAL MICROBIOLOGY, ENVIRONMENTAL BIOTECHNOLOGY, ENVIRONMENTAL STATISTICS (3)** | Have developed knowledge and understanding of Environmental Microbiology, Environmental Biotechnology and Environmental Statistics. | Diploma in Science with Environmental Science asasubjectand atotalcredit score of100 | Theory and statistical practices | Continuous internal assessment (Formative assessment) - 40%. End Semester Examination (Summative assessment) - 60% |
| | **ES 5P1 – ENVIRONMENTAL MICROBIOLOGY, ENVIRONMENTAL BIOTECHNOLOGY, ENVIRONMENTAL STATISTICS (2)** | 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 ableto apply Statistical methods. | | Hands-on-training and statistical practices | |
| | **ES 5T2 – AIR POLLUTION, WATER POLLUTION AND ENVIRONMENTAL ENGINEERING (3)** | Have developed knowledge and understanding of Air, Water and Land Pollution and Application of Control Measures. | | Theory, Self-study and Case studies | |

| | | | | | |
|---|---|---|---|---|---|
| | **ES 5P2 – AIR AND WASTEWATER ANALYSIS (2)** | Beable to analyze vital parameters of Wastewater, interpret and suggest suitable treatment methods, analyze vital Air Pollutants, interpret and suggest suitable control methods. | | Hands-on-training | |
| | **ES 5V1 – ENVIRONMENTAL CHEMISTRY AND INSTRUMENTATION (3)**<br><br>**OR**<br><br>**ES 5V1 – URBAN WASTE AND HAZARDOUS WASTE MANAGEMENT (3)** | 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, Flamephotometry and atomic absorption spectroscopy.<br>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, Flamephotometry and atomic absorption spectroscopy.<br>**OR**<br>Have developed knowledge of quantification and characteristics of urban and hazardous waste and their management. Beable to understand the handling techniques and legislations governing wastes. | | Theory and seminar/term paper | |

| Semester | Title /Name of the course | Programme outcomes that the course addresses (not more than 3 per course) | Pre-requisite course (s) | Pedagogy | Assessment |
|---|---|---|---|---|---|
| 6 | **ES 6T1 – NOISE, LAND, RADIATION POLLUTION AND SOLID WASTE MANAGEMENT (3)** | Have developed knowledge and understanding of Noise, Land, Radiation Pollution and Solid Waste Management | - | Theory, Self-study and Case studies | Continuous internal assessment (Formative assessment) - 40%. End Semester Examination (Summative assessment) - 60% |
| | **ES 6P1 – SOIL ANALYSIS, NOISE MEASUREMENT AND SOLID WASTE (2)** | 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 | |
| | **ES 6T2 – ENVIRONMENTAL IMPACT ASSESSMENT AND ENVIRONMENTAL RISK ASSESSMENT (3)** | Have developed knowledge and understanding of various process involved in Environmental Impact Assessment, be able to employ assessment techniques and analyse the reports. Have developed knowledge to enable identification of risk perception and implement assessment protocols. | | Theory, Self-study and Case studies | |
| | **ES 6P2 – METHODS OF ENVIRONMENTAL IMPACT AND RISK ASSESSMENT (2)** | 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 | |
| | **ES 6V1 – INDUSTRIAL WASTEWATER TREATMENT (3)**<br>**OR**<br>**ES 6V1 – DISASTER MANAGEMENT (3)** | 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.<br>**OR**<br>Have developed knowledge and understanding of natural and 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 | |

| Exit option with Bachelor of Science, B.Sc. Degree in Environmental Science (142 credits) or continue studies with Major in the Fourth year |
|---|
| **Job opportunities for the Exit option with Bachelor of Science Degree** |
| • Assistants in Central and State Pollution Control Boards<br>• Environmental Health and Safety Assistant in industries<br>• Occupational Health and Safety Assistant in industries/theme parks<br>• Public Health/Waste Management Officers in Municipalities<br>• Wastewater Treatment Plant Managers<br>• Environmental/Production Quality Assurance Executive - Junior<br>• Environmental Analyst (Validation)<br>• Research Assistant/Staff<br>• R&D Lab Assistant<br>• Water testing labs or chemical suppliers/ Entrepreneurship<br>• Liaison Officer<br>• Watershed Management Assistant<br>• Mineral/Energy Resource Exploration Assistant<br>• Solar energy/alternate energy Executives<br>• Micro irrigation Executives<br>• Organic Farming Executives/Entrepreneurship<br>• NGOs/Consultancy firms<br>• Teachers in Schools<br>• Self-employment |

| Semester | Title /Name of the course | Programme outcomes that the course addresses (not more than 3 per course) | Pre-requisite course (s) | Pedagogy | Assessment |
|---|---|---|---|---|---|
| 7 | **ES 7T1 – ENVIRONMENTAL TOXICOLOGY (3)** | 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) – 40%. End Semester Examination (Summative assessment) - 60% |
| | **ES 7P1 – BIOASSAY, ACUTE AND SUB-ACUTE TOXICITY TESTS (2)** | Be able to setup simple bioassay test procedures leading to LD50, LC50 assessments. | | Hands-on-training | |
| | **ES 7T2 – APPLICATIONS OF REMOTE SENSING AND GEOGRAPHICAL INFORMATION SYSTEMS (3)** | 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 | |
| | **ES 7P2 – CARTOGRAPHY AND GEOGRAPHICAL INFORMATION SYSTEMS (2)** | 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 | |
| | **ES 7T3 – OCCUPATIONAL HEALTH AND SAFETY (3)** | Have developed knowledge of work environments, understand exposure risks and have an exposure to legal requirements. | | Theory, Self-study and Case studies | |
| | **ES 7E1 – LANDSCAPE ECOLOGY AND URBAN PLANNING (3)** | 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/term paper | |
| | **ES 7E2 – ENVIRONMENTAL CONTAMINATION AND REMEDIATION TECHNOLOGIES (3)** | Have developed knowledge and understanding of the types and dynamics of environmental contamination. Be able to choose and employ appropriate remediation technologies from the available physical, chemical and biological remediation technologies. | | Theory and seminar/term paper | |
| | **ES 7R1 – RESEARCH METHODOLOGY (3)** | 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/term paper | |

| Semester | Title /Name of the course | Programme outcomes that the course addresses (not more than 3 per course) | Pre-requisite course(s) | Pedagogy | Assessment |
|---|---|---|---|---|---|
| 8 | **ES 8T1 - CLIMATE CHANGE AND MITIGATION (3)** | Havedevelopedknowledgeandunderstandingof meteorology, climatology and understand dynamics of factors leading to climate change and related knowledge systems. Be able to critically analyse various climate mitigation and adaptation measures. | - | Theory, Self-study and Case studies | Continuous internal assessment (Formative assessment) - 40%. EndSemesterExamination(Summativeassessment) -60% |
| | **ES 8P1 - CLIMATE CHANGE ANALYSIS (2)** | Have developed knowledge, understanding and skills of handling globaland regional climate data. Be able to collate, analyse and interpret using appropriate tools. | | Hands-on-training | |
| | **ES 8T2 - ENVIRONMENTAL ECONOMICS, SUSTAINABLE DEVELOPMENT, BUSINESS AND ENTREPRENEURSHIP (3)** | 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-study and Case studies | |
| | **ES 8T3 - ENVIRONMENTAL POLICY, LAW AND ENVIRONMENTAL MANAGEMENT SYSTEMS (3)** | Have developed knowledge and understanding legal implications of environmental protection legislations of India. Get anexposuretoenvironmentalauditand Environmental Management Systems. | | Theory, Self-study and Case studies | |
| | **ES 8E3 – QUALITY ASSURANCE AND QUALITY CONTROL IN ENVIRONMENTAL ANALYSIS (3)** | Have developed knowledge of total quality management protocols and develop skills of monitoring and interpreting industrial reporting procedures. | | Theory and seminar/term paper | |
| | **ES 8R1 - RESEARCH PROJECT (6)** | 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, researchethics,useofreference organizing softwareandanti-plagiarismdatabases. | | Hands-on training | |

| Award of Bachelor of Science Honors Degree, B.Sc. (Hons.) Degree in Environmental Science (184 credits) |
|---|
| **Job opportunities for the B.Sc. (Hons.) Degree in Environmental Science** |
| • Scientific Assistant in Research institutions<br>• Scientists in Central and State Pollution Control Boards<br>• Environment Health and Safety Officer in industries<br>• Environmental auditor I/Auditor II<br>• Environmental/Production Quality Assurance Officer<br>• Wastewater Treatment Plant Managers<br>• Sanitary landfill and Hazardous Waste Handling Experts<br>• Toxicology specialist<br>• Forensic Scientist<br>• Quality Control Executive<br>• Regulatory Affairs/Liaison Officer<br>• NGOs/Consultancy firms<br>• Project and Planning and Development Departments<br>• Watershed Management Professional<br>• Teachers in Schools<br>• Self-employment |

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

| Semester | Title /Name of the course | Programme outcomes that the course addresses (not more than 3 per course) | Pre-requisite course(s) | Pedagogy | Assessment |
|---|---|---|---|---|---|
| 9 | **MES 1T1** – Ecology and Ecosystem services | Provides a holistic knowledge of ecology and sustainability for a student who has a Science degree. Emphasise their interrelatedness and significance. | 1. B.Sc. (Hons.) with total credit score of 184<br>2. B.Sc. in Agriculture/Forestry/Horticulture/Life Science<br>3. B.E/B.Tech in Environmental/ Civil Engineering<br>4. B.E/B.Tech in Architecture<br>5. B.E/B.Tech in Urban/Regional Planning | Theory, Self-study and Case studies | Continuous internal assessment (Formative assessment) - 40%.<br>End Semester Examination (Summative assessment) - 60% |
| | **MES 1P1** – Ecology and Sustainability Studies | Introduces ecological methods, ecosystem services and sustainability evaluation methods | | Hands-on-training | |
| | **MES 1T2** – 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 | |
| | **MES 1P2** – Pollution analysis | Develops the skills of identifying specific pollution parameters and their analysis | | Hands-on-training | |
| | **MES 1T3** – Climate Change Impacts and Resilience | Emphasises the role of lifestyles towards developing a climate resilient population and economy | | Theory, Self-study and Case studies | |
| | **MES 1P3** – Climate Change Assessments | Develops the skill of identifying, prioritising and assessing climate change parameters | | Hands-on-training | |
| | **MES 1T4** – Waste Management and Sustainability | Introduces the waste scenario with reference to economic and social paradigms. Provides methods of managing the resources sustainably. | | Theory, Self-study and Case studies | |
| | **MES 1P4** – Waste management methods | Develop skills required for managing different kinds of wastes. | | Hands-on-training | |
| | **MES OE1** – Global Environmental Concerns<br>**OR**<br>**MES OE1** – 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 | |

| Semester | Title /Name of the course | Programme outcomes that the course addresses (not more than 3 per course) | Pre-requisite course (s) | Pedagogy | Assessment |
|---|---|---|---|---|---|
| 10 | **MES 2T1** – 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) - 40%. End Semester Examination (Summative assessment) - 60% |
| | **MES 2P1** – Case studies | Provides the real life perspective of smart cities, resource management patterns leading to empowerment in decision making. | | Situational analysis and interpretation | |
| | **MES 2T2**–Environmental Modelling | Introduces the concept of environmental modelling involving resource utilization modelling and pollution modelling. | | Theory, Self-study and Case studies | |
| | **MES 2P2** – Computational analysis and Environmental Modelling | Develops skills of environmental modeling and provides a hands-on exposure of modeling software. | | Hands-on-training | |
| | **MES 2T3** – Corporate Environmental Sustainability and Environmental Social Governance | Provides a corporate/ industrial view of environment and sustainability. Helpsin understanding the corporate pressures yet emphasizing on sustainable Development. | | Theory, Self-study and Case studies | |
| | **MES 2P2** – Case studies | Provides the real life perspective of smart cities, resource management patterns leading to empowerment in decision making. | | Suitability and Feasibility analysis | |
| | **MES 2T4** – 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 | |
| | **MES OE2** – Environmental Pollution and Sustainable Development **OR** **MES OE2** – 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 | |

## B.Sc. (Basic/Hons.) Semester 3

Title of the Course: **ES 3T1 – NATURAL RESOURCES AND MANAGEMENT**

| Number of Theory Credits | Number of lecture hours/semester | Number of practical Credits | Number of practical hours/semester |
|---|---|---|---|
| **4** | **52** | **2** | **52** |

| **Programme Specific Objectives** | |
|---|---|
| PSO 1 | To develop the understanding of role of natural resources in economic and ecological development. |
| PSO 2 | To instill a knowledge of quantifying and evaluating contribution of natural resources management in human development. |
| PSO 3 | To motivate and inspire to acquire contemporary understanding and skills leading to issue identification and management of natural resources. |
| PSO 4 | To inculcate creativity and innovative spirit in the domain of human- development and natural resource utilisation efficiency. |

| **Programme Outcomes** | |
|---|---|
| PO 1 | Demonstrate competence in understanding the significance of natural resources in economic/ecological development. |
| PO 2 | Demonstrate the ability to carry out the process of identification of, data procurement and interpretation with reference to natural resources. |
| PO 3 | Ability to understand and appreciate the role of quantification of resource use pattern in contemporary/sustainable development paradigms. |
| PO 4 | Be able to understand the demands of data analysis and reporting in natural resource management domain. |

| **Content of Theory Course 3** | **52 Hours** |
|---|---|
| **Unit - 1** | **14** |
| Introduction and Definition.<br>Functional theory of resource and dynamic theory of resource.<br>Classification of resources - Organic and inorganic; exhaustible and inexhaustible; International, National and Individual; Ubiquitous and localised resources.<br>Factors influencing resource availability, distribution and utilization patterns. | |

| | |
|---|---|
| Resources scarcity: types of resources scarcity - Demand- induced, supply-induced, and structural.<br>Conservation of resources: Methods of conservation - Refuse, reduce, reuse, recycle and recovery - Methods of waste reduction. Case studies on energy and paper conservation.<br>Natural Resources: Definition, Classification of natural resources based on utility potential. Depletion trends of Natural resources. | |
| **Unit - 2** | **14** |
| Water Resources: Sources of water and distribution pattern: Fresh water - Water budget of India - Dams: Impact on environment–Droughts and Floods: Causes and Control Strategies – Watershed Management; Rain Water Harvesting; River linking – pros and cons.<br>Marine water – Ocean as a resource<br>- Fisheries, aquaculture – prawns and oysters<br>- Transportation–Shipping (people, goods and oil) and its impacts<br>- Desalinisation – Importance and impacts<br>- Coastal erosion and reclamation<br>Ground Water resources: Open wells and Bore wells – Groundwater exploitations and Recharge.<br>Water and agriculture: Irrigated and rain-fed cultivation; Types of irrigation. Irrigation and drainage. Nutrient delivery through irrigation. Environmental implications of Conventional Agriculture – Soil degradation, surface and ground water pollution, loss of natural biodiversity, water logging and soil salinity. Hydroponics –Soil-water conservation practices in agriculture. | |
| **Unit - 3** | **14** |
| Forest Resources: Importance of Forestry – Types of Forests of India and Karnataka – Pressures on forest areas – *encroachments, forest fires, land use change (allocation for agriculture, industry and housing)* and over utilisation of forest resources (harvesting of NTFPs, overgrazing, other anthropogenic pressures).<br>Impacts of Deforestation: - Forest Fires and their Control; Forest conservation: Sacred Groves – Chipko and Appiko Movements; Joint Forest Management; Afforestation and Deforestation (Social forestry, Agro forestry, Urban forestry), Major and Minor Forest Products; Forest based industries (Plywood, Pulp and Paper and Cottage industries).<br>Ecotourism and its impacts. | |

| | |
|---|---|
| Captive plantations and Energy plantations<br>Forest and wildlife conservation - Protected areas – Sanctuaries - National Parks – Biosphere Reserves. | |
| **Unit - 4** | **14** |
| Land resources: Land-use patterns in India. Agro-climatic zones of India and Karnataka. Types of agriculture and cropping patterns. Implications of agriculture on soil - Soil erosion – causes, types, impacts, control measures. Desertification: causes, impacts and control measures.<br>Mineral resources**:** Mining and Quarrying and their impacts; Ecological conflicts of mineral extraction; Deep sea mining and off shore oil exploration. Case studies on Coal and stone quarries.<br>Energy Resources: Definition. Conventional, non-conventional and alternative energy resources. Energy sources and their impacts: Biomass burning (Fuelwood, Agriculture residue, Cow dung), Fossil fuels, Hydel, Geothermal, Nuclear energy; Solar (Thermal and Photovoltaic), Wind, Tidal, Microhydel. Briquettes, Wood gas, Energy from waste (Pyrolysis and Biogas), Agri-based fuels (*Biodiesel, Gasohal*), Hydrogen fuels.<br>Cogeneration. | |

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| Formative Assessment – Continuous Internal Assessment = 40% (40 Marks) | |
|---|---|
| Assessment Occasion/ type | Weightage in Marks |
| End Semester Examination | 60% (60 Marks) |
| Total | 100% (100 Marks) |

Nandini .N.

Date Course Co-ordinator Subject Committee Chairperson

## Content of Practical Course 3: List of Experiments to be conducted

## ES 3P1 - MINERALOGY, PETROLOGY, ENERGY RESOURCES AND MEDICINAL PLANTS

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

1. Mineralogy: Description of Minerals
2. Identification of Minerals based on their properties
3. Petrology: Description of Rocks
4. Identification of Rocks – Igneous, Sedimentary and Metamorphic
5. Introduction to Mapping - Direction, scale and conventional signs and symbols
6. Latitude & Longitude; Grid references
7. Representation of Relief
8. Study of drainage pattern and settlement pattern
9. Geolocation of resources - Mineral, ore, petroleum and energy resources
10. Characteristics and delineation of watershed using topo sheets
11. Identification of medicinal plants of Karnataka
12. Identification of locally available NTFP's
13. Introduction to agro climatic zones of Karnataka and mapping of local agricultural diversity (District level)

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| Formative Assessment – Practical Internal Assessment = 50% (25 Marks) | |
|---|---|
| Assessment Occasion/ type | Weightage in Marks |
| End Semester Examination | 50% (25 Marks) |
| Total | 100% (50 Marks) |

Nandini .N.

Date Course Co-ordinator Subject Committee Chairperson

## ES 3OE3: WOMEN AND ENVIRONMENT

| Number of Theory Credits | Numberoflecturehours/semester |
|---|---|
| **3** | **42** |

| Content of OPEN ELECTIVE Theory Course 3 | 42Hrs |
|---|---|
| **Unit - 1** | **14** |
| Ecology and Environment: Definitions, meaning and significance. Ecosystem: Structure and function. Natural resources – definition, their local availability, harvest and utility.<br><br>Gender ideology, Gender inequality and gender justice in India. Women studies: Concept, Objectives of women studies. Nature and Feminine principle - basic human needs from rural and urban environment. Interaction of women with the local ecosystems for household water collection, fuelwood, fodder, medicinal plants, livestock management, food security and non-timber forest produce.<br><br>Rural women: Role in agriculture sector – Soil-water conservation, chemical free food and food storage. Role in social forestry (Achieving the 5F objectives – Food, Fodder, Firewood, Fiber and Fertiliser). Conservation of indigenous species.<br><br>Urban women: Role in urban climate management, lifestyle choices and resource conservation – water, electricity, food, fuel resources and development of conservation culture among young generation.<br><br>Sustainable Development Goals: Goal No. 5 - Gender equality. | |
| **Unit - 2** | **14** |
| Eco-feminism: Meaning and concept, Emergence and branches of Eco- feminism, Eco-feminism in the global economy, Eco-feminist power, politics and resistance to war and violence.<br><br>Women and resource scarcity: Impacts of Natural resource depletion, Climate change and environmental degradation on women.<br><br>Impacts of commonly used chemicals on Women and Environment: Endocrine-disrupting chemicals (EDCs), household chemicals, pesticides, cosmetics, food additives, food preservatives, organic pollutants, Volatile Organic Compounds (VOC's) and indoor air pollution from cooking activities.<br><br>Climate change and women's health: Vector borne diseases, poor air quality and extreme variance in climatic temperatures (*Anemia, malnutrition and food insecurity - reduced cognitive skills, poor attention span, reduced working memory and poor education outcomes. Respiratory distress, cardiovascular disease, negative birth outcomes and reduced mental health in* | |

| | |
|---|---|
| *children*).<br><br>Post-disaster impacts on women: Higher risk of physical, sexual, and domestic violence in the aftermath of disasters. Increased stress due to forced migration, mood disorders and poor economic recovery. | |
| **Unit - 3** | **14** |
| Women response to environmental degradation: Case studies of collective empowerment – The Chippko Movement (Gaura Devi - Mahila Mangal Dal), Silent Valley Conservation Movement (Sugathakumari), Neem Patent Victory (World's First Case Against Biopiracy), Narmada Bachao Andolan (NBA).<br><br>Women and Environmental Conservation: Joint Forest Management (JFM), Social Forestry, Agroforestry, Agriculture, Community nurseries and seed banks, Household Solid Waste Management, Home gardens/rooftop gardening, United Nations Clean Development Mechanism (CDM).<br><br>Women empowerment through Ecotourism, Cottage industries (NTFP and forest produce processing and value addition), Eco-entrepreneurship (Handicrafts, Case studies of Desi-Charaka and Hasiru Dala).<br><br>Prominent women environmentalists: Rachel Carson, Wangari Maathai, Gro Harlem Brundtland, Elinor Ostrom, Amritha Devi Bishnoi, Medha Patkar, Sunita Narain, Tulsi Gowda and Saalumarada Thimmakka. | |

## References


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| Formative Assessment – Continuous Internal Assessment = 40% (40 Marks) | |
|---|---|
| Assessment Occasion/ type | Weightage in Marks |
| End Semester Examination | 60% (60 Marks) |
| Total | 100% (100 Marks) |

Date Course Co-ordinator Subject Committee Chairperson

## ES 3OE3: ENVIRONMENTAL DISASTERS AND MANAGEMENT

| Number of Theory Credits | Numberoflecturehours/semester |
|---|---|
| **3** | **42** |

| Content of OPEN ELECTIVE Theory Course 3 | 42Hrs |
|---|---|
| **Unit - 1** | **14** |
| **Disasters:** Definition, History of disasters; Components of disasters.<br><br>Weather parameters: Concept, Definition, Units and measurements of Temperature, Pressure, Precipitation (Rain, snow, hail), Wind (Speed and direction) and Relative humidity.<br><br>Types of disasters: Natural disasters and Man-made disasters.<br><br>Natural disasters: Definitions and introduction to Earthquakes, Tropical cyclones, Cloud bursts, Floods, Drought, Land subsidence, Landslides, Mudslides, Volcanoes, Tsunami, Avalanches, Heat waves, Cold waves, Dust storms, and Locust attacks.<br><br>Man-made disasters: Definitions and introduction to Gas leaks, Toxic and Hazardous wastes, Nuclear and radiation accidents, Oil spills, Forest fires, Pandemics, Weather Extremes & Climate Change and Wars.<br><br>Definitions of Risk, Hazard, Exposure, Vulnerability, Response, Mitigation, Preparedness and Prevention.<br><br>Mitigation and Management techniques of Disaster: Basic principles of disaster management, Disaster Management cycle, Disaster management policy. Disaster Management Authority at National, State and District levels; Roles and responsibilities of Govt. Authorities including Local Self Govt. at various levels. | |
| **Unit - 2** | **14** |
| **Natural Disasters**<br><br>Earthquakes - types and causes, magnitude and intensity, seismic zones of India and Karnataka. Earthquake measurements (Richter Scale) and predications. Earthquake preparedness and management.<br><br>Tropical Cyclones - Types and causes. Cyclone naming. Cyclone prediction, warning, Preparedness and Management.<br><br>Floods - Types and causes, Flash floods. Cloud bursts, Floods warning, Preparedness and Management.<br><br>Land subsidence - Types and causes, Landslides and Mudslides and Avalanches. Land subsidence preparedness and management. | |

| | |
|---|---|
| Tsunami - types and causes. Tsunami prediction, warning, preparedness and management.<br>Heat waves and Cold waves – Causes and effects, Warning, preparedness and management.<br>Locust attacks – Causes and effects Preparedness and management. | |
| **Unit - 3** | **14** |
| **Man-made disasters**<br>Nuclear disaster: Chernobyl and Fukushima - Episode and effects. Exxon Valdez oil spill -Episode, effects and management.<br>Indonesia's land and forest fires – Episode, effects and management.<br>Bhopal Gas Tragedy - Episode, causative agent, effects and recovery. Damage and compensation.<br>Visakhapatnam gas leak - Episode, causative agent and effects. Damage and compensation.<br>Endosulfan disaster in Karnataka and Kerala - Episode and effects. Damage and compensation.<br>Ennore oil spill - Episode and effects.<br>Uttarakhand and Kerala floods - Episode, effects and management. Kodagu<br>Landslides/Recent/Local episodes, effects and management<br>Bandipura Forest fires/Recent/Local episodes, effects and management.<br>Bengaluru Urban floods/Recent/Local episodes, causes, effects, and management.<br>Epidemics, Pandemics and Zoonoses. | |

## References


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| FormativeAssessment–ContinuousInternalAssessment=40%(40Marks) | |
|---|---|
| Assessment Occasion/ type | Weightage inMarks |
| End SemesterExamination | 60% (60Marks) |
| Total | 100% (100Marks) |

Date Course Co-ordinator SubjectCommitteeChairperson

## B.Sc. (Basic/Hons.) Semester 4

Title of the Course: **ES 4T1 – BIODIVERSITY, WILDLIFE AND CONSERVATION**

| Number of Theory Credits | Number of lecture hours/semester | Number of practical Credits | Number of practical hours/ semester |
|---|---|---|---|
| **4** | **52** | **2** | **52** |

| **Programme Specific Objectives** | |
|---|---|
| PSO 1 | To develop competency in understanding biodiversity and wildlife. |
| PSO 2 | To instill a knowledge about human interactions with uncultivated varieties and develop necessary analytical skills to appreciate these interactions. |
| PSO 3 | To motivate and inspire to acquire contemporary understanding and skills leading to issue identification and conservation. |
| PSO 4 | To inculcate creativity and innovative spirit in identifying appropriate conservation tools and their timely implementation. |

| **Programme Outcomes** | |
|---|---|
| PO 1 | Demonstrate competence in understanding the ecological, social and legal dimensions of biodiversity and wildlife. |
| PO 2 | Demonstrate the ability to carry out data collection procedures and analysis in field conditions/laboratories and make appropriate interpretations. |
| PO 3 | Ability to understand and appreciate the role of biodiversity in specific natural habitats and agroecosystems. |
| PO 4 | Be able to develop competence and academic skills in contributing towards biodiversity and wildlife conservation. |

| **Content of Theory Course 4** | **52 Hours** |
|---|---|
| **Unit - 1** | **14** |
| Biodiversity: Definition: Levels of Biodiversity - genetic diversity, species diversity and ecosystem diversity. Values of Biodiversity: Direct uses - consumptive use value, productive use value; Non-consumptive values - social value, ethical value, aesthetic value, option values and ecosystem service value.<br>Biodiversity Hotspots: Global and Indian centers. Biogeography of India. Biodiversity profile of India: Forests and Grasslands; Wetlands and | |

| | |
|---|---|
| Riverine ecosystems; Marine and coastal diversity; Agrobiodiversity; Urban Biodiversity; Invasive Alien species.<br><br>Threats to biodiversity: Over exploitation, Habitat destruction, fragmentation, urbanisation, agriculture extension, river valley projects, industrialisation, deforestation, invasive species, pollution, acidification of soil and water, mining activities, desertification and climate change. Traditional Knowledge and ethics in conservationofbiodiversity. | |
| **Unit - 2** | **14** |
| Wildlife: Definition. Wildlife of India. Values of wildlife. Values<br><br>of wildlife:<br><br>- *Physical utility, economic/monetary value, recreational value, scientific value, ecological value, existence value.*<br><br>- *Wildlife damage, human animal conflict, loss of economic productivity, wildlife diseases to man and competition effect.*<br><br>Importance of wildlife: Ecological, economic, socio-cultural, investigatory, medicinal, conservation of biological diversities, importance in agriculture.<br><br>Threats to wildlife: Over exploitation, habitat loss, encroachment and fragmentation, disease, pollution, invasive and exotic species, Illegal trapping and poaching, agricultural/unrestricted/ over grazing, urbanisation and climate change.<br><br>Endangered species – Definition, characteristics and reasons for engendering. *Species with a narrow (or single) geographic range, Species with only one or few populations, Species with a small population size, Species with a declining population size, Species hunted or harvested by people, Species with low reproductive ability and/or germplasm-dispersal-ability, Species that require specialised habitat and niche conditions.* Endangeredspeciesof India.<br><br>Endemic species – Concept, types, characteristics, theories of endemism. Endemic Wildlife Species of India. | |
| **Unit - 3** | **14** |
| Ecosystem Services: Concept and Definition.<br><br>Regulating services: *Purification of water and air; Carbon sequestration and climate regulation; Waste decomposition and detoxification; Regulation of prey* | |

| | |
|---|---|
| *populations; Pollination; Biological pest and disease control; Disturbance regulation (Flood protection).*<br><br>Provisioning services: Food *(crops, wild foods and spices);* Raw materials *(Timber, fuelwood, organic matter, fodder, and fertiliser);* Genetic resources *(crop improvement genes, and health care);* Biogenic minerals; Medicinal resources *(Pharmaceuticals, chemical models, and bioassay organisms)*; Energy *(Hydropower, biomass fuels)*; Ornamental resources *(Fashion, handicrafts, jewelry, pets, worship, decoration, and souvenirs)*.<br><br>Cultural services: Cultural *(Nature motifs in books, film, painting, folklore, national symbols, advertising); Aesthetics,* spiritual and historical *(Art, religious and heritage value);* Recreational experiences *(Ecotourism, outdoor sports and recreation);* Science and education *(Academic excursions and scientific discovery);* Therapeutic *(Ecotherapy, social forestry and animal assisted therapy).*<br><br>Supporting services: Nutrient cycling, Soil formation, Primary production and Habitat provision. | |
| **Unit - 4** | **14** |
| Conservation (Biodiversity and Wildlife): Definition, need and significance. Conservation vs. Preservation. Conservation goals - Habitat conservation, Prevention of deforestation, Preventing species from extinction, Sustainable harvest of biological resources and climate change mitigation.<br><br>Terminologies of conservation significance: Keystone species, Foundation species, Umbrella Species and Flagship species, Edge species, Critical link species, Indicator species, Priority species and Rare species.<br><br>IUCN Red Listed species - Data Deficient, Least Concern, Near Threatened, Vulnerable, Endangered, Critically Endangered, Extinct in the Wild and Extinct.<br><br>In-situ conservation: Protected areas – Sanctuaries - National Parks – Biosphere Reserves - Project Tiger and Project Elephant; Ramadevarabetta Vulture Sanctuary. Community Conserved Areas – case studies on Black Buck, Snow leopard, Amur falcon and Sarus Crane.<br><br>Ex-situ conservation: Captive breeding (Botanical gardens, zoological parks, seed banks). Case study of *Ailuropoda melanoleuca* (Giant panda), *Ramosmania heterophylla* and *Madhuca insignis.* Cryopreservation, pollen storage, tissue culture, genetic engineering, field gene banks. Case study of Indian rhinoceros and black rhinoceros.<br><br>International conservation efforts - Ramsar Convention, Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), Convention on the Conservation of Migratory Species of Wild Animals (CMS), Trade Records Analysis of Flora and Fauna in Commerce (TRAFFIC). Reducing Emissions from Deforestation and Forest Degradation (REDD) and REDD$^{+}$. | |

## References


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Weathers, K. C., Strayer, D. L., & Likens, G. E. (Eds.). (2021). *Fundamentals of ecosystem science*. Academic Press.


| Formative Assessment – Continuous Internal Assessment = 40% (40 Marks) | |
|---|---|
| Assessment Occasion/ type | Weightage in Marks |
| End Semester Examination | 60% (60 Marks) |
| Total | 100% (100 Marks) |

Nandini. N.

Date Course Co-ordinator Subject Committee Chairperson

## Content of Practical Course 4: List of Experiments to be conducted

## ES 4P1 - BIODIVERSITY ASSESSMENT AND ECOSYSTEM SERVICES

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

1. Documentation and assessment of tree diversity – Census method/Point- centered quarter method
2. Documentation and assessment of avian faunal diversity – Line transect method
3. Documentation and assessment of winged insect fauna – Light trap/Sticky trap method. Documentation and assessment of Butterflies – Visual encounter /Photographic survey
4. Documentation and assessment of soil fauna – Pitfall trap method
5. Documentation and assessment of crop diversity – Sampling method
6. Identification and documentation of aquatic macroflora – Visual encounter survey
7. Estimation of animal population size – Mark, Release and Recapture method
8. Assessment of provisional services of wetland ecosystems – Questionnaire survey method.
9. Introduction to global biodiversity databases – Global Biodiversity Information Facility (GBIF), Integrated Biodiversity Assessment Tool (IBAT-alliance)
10. Hands-on experience with biodiversity assessment software - Paleontological Statistics Software Package for Education and Data Analysis (PAST). *Note: Data from experiment No 1 to 8 can be used for analysis.*

## References


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| Formative Assessment – Practical Internal Assessment = 50% (25 Marks) | |
|---|---|
| Assessment Occasion/ type | Weightage inMarks |
| End SemesterExamination | 50% (25Marks) |
| Total | 100% (50Marks) |

Date Course Co-ordinator SubjectCommitteeChairperson

## ES 4OE4: ENVIRONMENT AND SUSTAINABLE AGRICULTURE

| Number of Theory Credits | Numberoflecturehours/semester |
|---|---|
| **3** | **42** |

| Content of OPEN ELECTIVE Theory Course 4 | 42 Hours |
|---|---|
| **Unit - 1** | **14** |
| Environment – Definition, scope and significance.<br>Agriculture – Definition, scope and significance. Environmental basis for agriculture and food. Agricultural patterns in India. Socio-economic pressures on agriculture. Food security and food scarcity.<br>Types of agriculture – rain-fed cultivation and irrigation – water intensive agriculture – Reservoirs and ground water exploitation. Conventional and mechanised agriculture.<br>Natural and Modern agriculture. Subsistence and commercial agriculture. Environmental effects of land use and landscape changes. | |
| **Unit - 2** | **14** |
| Environmental determinants of agriculture – role of rainfall, humidity, wind, topography and edaphic factors in crop selection.<br>Animal husbandry – Dairy and poultry – role of transboundary species of cattle in Indian scenario.<br>Pisiculture – Environmental effects of intensive pisiculture.<br>Agricultural biodiversity: Crop diversity – Definition and significance. 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. Pollination crisis. Integrated pest management. | |
| **Unit - 3** | **14** |
| Environmental impacts of agriculture–Loss of biodiversity–soil salinity – fertiliser and pesticide pollution, Climate change and global warming. Erosion and problems of deposition in irrigation systems. Desertification. Biomagnification – Case studies.<br>Contemporary issues and management – Farmer distress – market mechanisms – natural farming methods/organic farming. Urban agriculture and hydroponics.<br>Ecological principles of farming – Sustainable agriculture – Significance of indigenous crops and cattle varieties. Watershed management. Agricultural policies of | |

| | |
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| India. | |

## References


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Kazim B. Rahim Debash Sarkar Bidhan Chand. (2012). *Sustainable Agriculture and Environment*. New Delhi Publishers.

Satyanarayana, T., Johri, B. N., & Prakash, A. (Eds.). (2012). *Microorganisms in sustainable agriculture and biotechnology*. Springer Science & Business Media.

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| FormativeAssessment–ContinuousInternalAssessment=40%(40Marks) | |
|---|---|
| Assessment Occasion/ type | Weightage inMarks |
| End SemesterExamination | 60% (60Marks) |
| Total | 100% (100Marks) |

Date Course Co-ordinator SubjectCommitteeChairperson

## ES 4OE4: INITIATIVES FOR ENVIRONMENTAL MANAGEMENT

| Number of Theory Credits | Numberoflecturehours/semester |
|---|---|
| **3** | **42** |

| Content of OPEN ELECTIVE Theory Course 4 | 42 Hours |
|---|---|
| **Unit - 1** | **14** |
| Environment: Definition and components of the environment – Atmosphere, hydrosphere, lithosphere and biosphere – Definitions and influences on human beings.<br><br>Environmental issues: Natural resource overuse and depletion, pollution, loss of biodiversity, Degradation of air, water and land.<br><br>Water and wastewater management: Household water demand and uses. Availability of water for household uses. Centralised supply system – Rivers. Water treatment for portable purposes. Decentralised sources – Bore wells. Sustainable use of water – Reuse and recycling, rooftop rainwater harvesting. Grey water management – Septictanks.<br><br>Energy conservation: Sources of energy – Electricity, LPG, Other petroleum fuels and feasible alternative sources (Solar heating and photovoltaic). Measures to conserve energy – LED, energy efficient electrical appliances. Bureau of Energy Efficiency standards and labelling.<br><br>Domestic solid waste management: Biodegradable – Kitchen waste - Issues and management. Compositing – Composters – Bin composter, three tier composters, pipe composting and mechanical composters. Human excreta - Issues and management. Bio-toilets, Dry/waterless toilets.<br><br>Non- Biodegradable – Issues and management. Segregation – Dry, recyclables and sanitary wastes – Incinerators, pyrolysis and sanitary landfills. | |
| **Unit - 2** | **14** |
| Agriculture: Implications on soil water management – Fertiliser pollution<br>– Soil salinity, Eutrophication and Bio-magnification. Pesticide pollution - DDT and Endosulphan - Integrated Pest Management (IPM), Bio- pesticides, Genetic Modified Crops (GMCs). Natural farming methods. Irrigation and drainage systems (Israel Model), Hydroponics and Aeroponics.<br><br>Alternative cultivation methods: Negative impacts of food grown by conventional agriculture methods. Minimizing fertiliser use and preventing chemical pesticide usage. Role of rooftop gardens and kitchen<br>gardens in regulating microclimate. Biofertilisers – *Rhizobium*, | |

| | |
|---|---|
| *Azotobactor*,*Azospirilium*,Bluegreenalgae,*Azolla*,Mycorrhizae.<br>Livestock management: Dung and urine management – Biogas plants, Farm Yard Manure (FYM) and Vermi-composting.<br>Human dwellings as micro climatic regimes: Variations in temperature and relative humidity in indoor and outdoor environment. Impacts of increased temperatures. Role of vegetation in micro climate regulation and Carbon capture. Green buildings and micro climate regulations. | |
| **Unit - 3** | **14** |
| Environmental Management: Definition, need, significance and applications. Environmental Technology vs. Technology for Environment.<br>Technological solutions for environmental degradation: Concept, advantages and limitations. Remedial actions - Waste recycling; Preventive actions - pollution prevention and Management actions - Environmental Management System (ISO 14000 series).<br>Factors influencing transfer of Environmental technology - developer to technology user: Information, Research and Marketing.<br>Factors influencing technology development: Localisation, Customisation and Contextualisation.<br>External factors influencing technology transfer: Laws and legislation; Administrative/Management systems; Information management; and Codes and Standards (*Eco-labelling and Green ratings*).<br>Role of individuals in Environmental management: Resource measurements and monitoring, Ecological footprint analysis, Carbon footprint analysis, Water footprint analysis, Micro-climate monitoring<br>and Participation in ecofriendly and sustainable endeavours. | |

## References


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| Formative Assessment – Continuous Internal Assessment = 40% (40 Marks) | |
|---|---|
| Assessment Occasion/ type | Weightage in Marks |
| End Semester Examination | 60% (60 Marks) |
| Total | 100% (100 Marks) |

Nandini .N.

Date Course Co-ordinator Subject Committee Chairperson

**Subject Expert Committee Members** actively participated in the preparation of proposed curriculum for four years B.Sc. (Basic/Hons.) degree in Environmental Science.

Several meetings were conducted virtually and physically with Environmental Science subject committee experts; and the proposed curriculum was approved by the Chairpersons - Board of Studies and Board of Examiners of various Universities and Colleges of Karnataka State.

| NEP 2020 - SUBJECT EXPERT COMMITTEE - ENVIRONMENTAL SCIENCE | | | |
|---|---|---|---|
| **Name** | **Designation and address** | **Position** | **Signature** |
| **Members Present** | | | |
| **Dr. N. Nandini** | Professor, Department of Environmental Science, Bangalore University, Bengaluru | Chairperson |  |
| **Dr. N. S. Raju** | Professor, Department of Studies in Environmental Science, University of Mysore, Mysuru | Member |  |
| **Dr. S. Suresha** | Associate Professor and Head, Department of Environmental Science, Yuvaraja's College (Autonomous), University of Mysore, Mysuru | Member |  |
| **Dr. B. S. Prabhakar** | Associate Professor and Head, Department of Environmental Science, St. Joseph's College (Autonomous), Bengaluru | Member |  |
| **Dr. Jayappa, M.** | Special Officer, Karnataka State Higher Education Council, Government of Karnataka | Member Convenor |  |
| **Members Absent** | | | |
| **Dr. S. V. Krishnamurthy** | Professor, Department of PG Studies and Research in Environmental Science, Kuvempu University, Shankaraghatta | Member | Absent |

GOVERNMENT OF KARNATAKA

# NATIONAL EDUCATION POLICY- 2020

# (NEP-2020)

## Report on

## Proposed Curricular Framework for Ability Enhancement Compulsory Course (AECC) under NEP-2020

## in

# ENVIRONMENTAL STUDIES – (AECC)

*Submitted to*

**Karnataka State Higher Education Council**
**Government ofKarnataka**
**Bengaluru**

7th June2022

GOVERNMENT OF KARNATAKA

# NATIONAL EDUCATION POLICY- 2020

# (NEP-2020)

## Report on

## Proposed Curricular Framework for Ability Enhancement Compulsory Course (AECC) under NEP-2020

## in

# ENVIRONMENTAL STUDIES – (AECC)

**Submitted by**


| | |
|---|---|
| **Dr. N. Nandini**<br>**Chairperson, Subject Expert Committee-EnvironmentalScience, NEP-2020**<br><br>Professor, Dept. of Environmental Science, Bangalore University, Bengaluru | **Dr. Jayappa,M.**<br>**MemberConvenor,SubjectExpert Committee-EnvironmentalScience, NEP-2020**<br><br>Special Officer, Karnataka State Higher Education Council Bengaluru and Coordinator, Environmental Science Committee, NEP 2020 |

**and**

**Members of Subject Expert Committee - Environmental Science**

1. **Dr.N.S.Raju**,Professor,DepartmentofStudiesinEnvironmentalScience, UniversityofMysore,Mysuru.
2. **Dr.S.V.KrishnaMurthy**,Professor,DepartmentofPGStudiesand ResearchinEnvironmentalScience,KuvempuUniversity,Shankaraghatta.
3. **Dr. S. Suresha**, Professor and Head, Department of Environmental Science, Yuvaraja'sCollege(Autonomous),UniversityofMysore,Mysuru.
4. **Dr.B.S.Prabhakar**,AssociateProfessorandHead,Departmentof EnvironmentalScience,St.Joseph'sCollege(Autonomous),Bengaluru.


7th June 2022

# PREFACE

Educationempowerslifeandlifesystems.Aholisticeducationparadigm willeffectivelyfocusondevelopingknowledge,employableskillsets,appropriate attitudes and an overall personality. A graduate is the one who acquiresthe followingattributesandemploysthemtobenefitsocieties.

- Skillsofidentifyingaproblemandfactorsresponsiblefortheproblem
- Acquiresandappreciatesproblemsolvingskills
- Logicallyemploysproblemsolvingtools,spatiallyandtemporally
- Identifiestimelyneedsofthecommunityandcontributestothem
- Takesthecommunitytogethercreatinganequitableecosystem
- Works towards creating employment opportunities and work domains fordifferentskillsetsandknowledgedisciplines
- Blendswithvarioussocialandeconomicsituationsmakinglifehappier fortheselfandofthecommunities
- Envisages and employs various attitudes and skill sets for the bettermentoftheNation,blendinglocalandregionalvariations

Environmental Science is a domain which seamlessly connectsthe sciences with day-to-day societal demands. Proposing and developing a curriculumforthesubjectofEnvironmentalScienceisuniqueinmanyways. Mankind is facing serious environmental issues like climate change, desertification,deforestation,pollution,solidwastegeneration,naturalandman- madedisasters.

Improvingthequalityoflifeisaprocessofdevelopmentwhichincludes teaching,trainingandinstruction.Acompetentsubjectexpertcommitteewas constituted by Karnataka State Higher Education Council, Government of Karnatakatoachievetheseobjectives.Theassignedtaskofthiscommitteewasto designcurriculumstructureforboth

- ✓ Under-Graduate and Post-Graduate programmes of Environmental Science
- ✓ EnvironmentalStudies−AECCforallUnder-Graduatecourses

The proposed curricular framework designed by this committee was headedbymewithEminentEducationalistsinthefieldofEnvironmental Science.

| NEP 2020 - SUBJECT EXPERT COMMITTEE - ENVIRONMENTAL SCIENCE | | |
|---|---|---|
| **Name** | **Designation and address** | **Position** |
| **Dr. N. Nandini** | Professor DepartmentofEnvironmentalScience, BangaloreUniversityBengaluru | Chairperson |
| **Dr. N. S. Raju** | Professor Department of Studies in Environmental Science, University of Mysore, Mysuru | Member |
| **Dr. S. V. Krishnamurthy** | Professor DepartmentofPGStudiesand ResearchinEnvironmentalScience, Kuvempu University Shankaraghatta | Member |
| **Dr. S. Suresha** | Professor and Head DepartmentofEnvironmentalScience, Yuvaraja's College (Autonomous) UniversityofMysore, Mysuru | Member |
| **Dr. B. S. Prabhakar** | Associate Professor and Head DepartmentofEnvironmentalScience, St. Joseph's College (Autonomous), Bengaluru | Member |
| **Dr. Jayappa,M.** | Special Officer KarnatakaStateHigherEducation Council,GovernmentofKarnataka | Member Convenor |

Our Nation's vision for higher education through National Education Policy− 2020istotransformitintoasustainablesystem.TheGovernmentof Karnataka is first State to launch the National Education Policy − 2020. The programme was launched virtually by Union Education Minister **Sri.DharmendraPradhan**.**Sri.BasavarajBommai,**theHonorableChiefMinisterof Karnatakalaunchedthepolicyofdigitization,researchanddevelopmentthat couldhelpimplementthenewNEP-2020,whichaimsatbringingfundamental

changes in the education system. **Dr. C. N. Ashwath Narayan**, Minister for Higher Education and Chairman for Karnataka State Higher Education Council, Government of Karnataka, initiated the implementation of the National EducationPolicy,2020(NEP-2020)inKarnatakaeffectively,asafirstStateinthe countrybyconstitutingvariouscommitteescomprisingofEducationExperts. **Prof.B.ThimmeGowda**,Vice-Chairman,KarnatakaStateHigherEducation Council, Government of Karnataka conducted several meetings withthe committeesconstitutedbyGovernment.

TheChairpersonsofBoardofStudies,BoardofExaminers(Environmental Science)andSubjectExpertsteachingunder-graduateandpost-graduatecourses ofvariousUniversitiesintheStateofKarnataka,whoparticipatedactivelyinthis processare-**Dr.N.S.Raju**,Professor,DepartmentofStudiesinEnvironmental Science,UniversityofMysore,Mysuru;**Dr.B.S.Prabhakar**,AssociateProfessor andHead,St.Joseph'sCollege(Autonomous),Bengaluru;**Dr.J.Narayana**, Professor, Department of Environmental Science, Kuvempu University, Shankaraghatta; **Dr. K. L. Prakash**, Professor, Department of Environmental Science,BengaluruUniversity,Bengaluru;**Dr.G.V.Venkataramana**,Professor and Chairman, Department of Studies in Environmental Sciences, University of Mysore, Mysuru; **Dr. S. SrikantaSwamy**, Professor, Department of Environmental Science, University of Mysore, Mysuru; **Dr. Yogendra, K.,** AssociateProfessor,DepartmentofEnvironmentalScience,KuvempuUniversity, Shankaraghatta;**Dr.PrakashKariajjanavar**,AssistantProfessor,Departmentof Environmental Science, Gulbarga University, Kalaburagi; **Dr. B. C. Nagaraja**, Professor and Chairman, Department of Environmental Science, Bengaluru University, Bengaluru; **Dr. J. S. Chandrashekar**, Assistant Professor and Chairman, Department of Environmental Science, Karnataka State Open University, Mysuru; **Dr. T. S. Harsha**, Assistant Professor, Department of Environmental Science, Karnataka State Open University, Mysuru; **Dr.Basavarajappa,S.H.,**AssistantProfessor,DepartmentofEnvironmental Science,KuvempuUniversity,Shankaraghatta;**Dr.M.R.EbenezerWilson**,

AssociateProfessor,St.Joseph'sCollege(Autonomous),Bengaluru;**Dr.Helen Roselene**, Associate Professor and Head, Department of Environmental Science, MountCarmelCollege(Autonomous),Bengaluru;and**Dr.K.HarishKumar**, AssistantProfessor,DepartmentofEnvironmentalScience,GovernmentFirst GradeCollege,Hosakote;**Dr.Kumar,M**.,Faculty,DepartmentofEnvironmental Science, Bangalore University, Bengaluru; **Dr. Alaknanda J. Adur**, Associate ProfessorandHead,DepartmentofEnvironmentalScience,SuranaCollege, Peenya,Bengaluru;**Sri.SachinA.Rosario**,AssistantProfessor,St.Joseph's College (Autonomous), Bengaluru. This work progressed under the guidance of **Sri.L.S.Ramesh**,SpecialOfficer,KarnatakaStateHigherEducationCouncil, GovernmentofKarnataka,initiallyandlatersteeredby**Dr.Jayappa,M**.,Special Officer,KarnatakaStateHigherEducationCouncil,GovernmentofKarnataka.

Thevaluablesupportfromsubjectexperts**Dr.B.S.Prabhakar**,Associate Professor and Head, St. Joseph's College (Autonomous), Bengaluru and **Dr.Kumar,M**.,Faculty,DepartmentofEnvironmentalScience,Bangalore University,Bengaluru,incompilingthereportandoveralleditingisappreciated.

Itakethisopportunitytoexpressmygratitudetotheauthoritiesof Karnataka State Higher Education Council, Government of Karnataka for giving us an opportunity to be a part of curriculum framework design and implementation ofNEP-2020.

- **Prof.N.Nandini**
Chairperson
SubjectExpertCommittee–
EnvironmentalScienceKarnatakaStateHigherEducationCouncil
Government ofKarnataka

# ENVIRONMENTAL STUDIES

## ABILITY ENHANCEMENT COMPULSORY COURSE (AECC)

Thismoduleconsistsof3units,covering40lecturehourswhichare classroombasedand5hoursoffieldworkintendedtocreateawareness,enhance knowledge,developskillsandattitudesnecessarytounderstandtheEnvironment initstotalityandenablesstudentstoparticipateproactivelyforthecauseofthe environment.

1. Environmental Studies (AECC) is made compulsory core module syllabus framed by UGC for all the Indian Universities/Colleges as per the directionsgivenbytheHonorableSupremeCourt,whichbelievedthat, conservationofenvironmentshouldbeanationalwayoflifeandtobe included into the education process. As suggested by NEP-2020State Level Environmental Science Subject Expert Committee, Chairpersons of BoardofStudies,BoardofExaminersandsubjectexpertsitisproposedto implementthedetailslistedinthetabularcolumnbelow,**mandatorily**.

| Environmental Studies (AECC) - Ability Enhancement Compulsory Course | | Semester in which the course is to be taught |
|---|---|---|
| Streams | B.Sc/BA/BCA/BSW/BFAandother streamsofHumanitiesandScience | I |
| | B.Com, /B.B.A/BBA (T&T)/BFT and other streams of Commerce and Management | II |

2. This pattern helps in distributing the workload of teachers of Environmental Studies to both **I and II semesters** enabling the distribution of the **teaching workload of an institution for full academicyear**;ensuresdistributionofexaminationsintotwosemesters; alsoprovidescopeforafull-timeteacherofthesubject.
3. **Qualifications to teach Environmental Studies (AECC):** A candidate withminimumqualificationsofM.Sc.inEnvironmentalSciencesubject

onlyiseligibletoteachEnvironmentalStudies(AECC)attheunder graduate level in all types of Universities, Deemed Universities, Autonomous Institutions, Government, Aided and Private Colleges in the StateofKarnataka.PreferencemaybegiventocandidateswithUGC-NET/K-SET/Ph.D.inEnvironmentalScience.

However, when such candidate is not available, teachers of the subjects listed below are to be preferred to teach **ONLY ENVIRONMENTAL STUDIES - AECC** paper in the following order:

i. **BiologicalSciences**:
   Botany/Zoology/Microbiology/Biotechnology/Life Sciences

ii. **ChemicalSciencesandEarthSciences**:
   Chemistry/Geology/EarthSciences

TheteachersNOTELIGIBLEtoteachEnvironmentalStudies(AECC) paper are - Humanities (Economics, Geography, History, Sociology, Political Science, Rural Development, Philosophy and others) Commerce, Management, English & others languages, Communication, Performing Arts, Fine Arts, Social work, Women Studies, Psychology, Home Science, FashionTechnology,Travel&Tourismandothersimilarsubjects.

4. **PatternofExamination**:Totalmarks–50(InternalAssessment-20 marksandFinalExamination-30marks).
5. **FinalExaminationQuestionPaperPattern(Shortanswerandessaytype)**
   a. Section-A(5questionsx2marks=10marks)–5questionsoutof7
   b. Section-B(4questionsx5marks=20marks)–4questionsoutof6
6. **Durationoftheexamination**:1hour30minutes(1½hours)
7. **Teachinghoursandcredits**:3hoursofteachingperweekand2credits.

# ENVIRONMENTAL STUDIES

## ABILITY ENHANCEMENT COMPULSORY COURSE (AECC)

| Number of Theory Credits | Numberoflecturehours+ fieldwork |
|---|---|
| **2** | **45** |

| **Content of ENVIRONMENTAL STUDIES – AECC** | | **45 Hours** |
|---|---|---|
| **Unit 1** | **Introduction to Environmental Studies:** Multidisciplinary nature of environmental studies. Scope and importance; Concept of sustainability and sustainable development.<br><br>**Ecosystems:**Whatisanecosystem?Structureandfunction ofecosystem;Energyflowinanecosystem:foodchains,food websandecologicalsuccession.Casestudiesofthefollowing ecosystems:<br><br>a) Forestecosystem<br>b) Grasslandecosystem<br>c) Desertecosystem<br><br>Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)<br><br>**Natural Resources: Renewable and Non-Renewable Resources**<br><br>Land resources and land-use change; Land degradation,soil erosion anddesertification.<br><br>Deforestation:Causesandimpactsduetomining,dam building on environment, forests, biodiversity and tribal populations.<br><br>Water: Use and over-exploitation of surface and ground water,floods,droughts,conflictsoverwater(International&Inter-state).<br><br>Energy resources: Renewable and non-renewableenergy sources,useofalternateenergysources,growingenergy needs, casestudies. | **15** |
| **Unit 2** | **Biodiversity and Conservation:** Levels of biological diversity: Genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns and | **12** |

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| | global biodiversityhotspots.<br><br>India as a mega-biodiversity nation; Endangered and endemic species of India.<br><br>Threatstobiodiversity:Habitatloss,poachingofwildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity:In-situandEx-situconservationofbiodiversity.<br><br>Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.<br><br>**Environmental Pollution:** Types, causes, effects and controls; Air, water, soil and noise pollution.<br><br>Nuclear hazards and human health risks.<br><br>Solidwastemanagement,Controlmeasuresofurbanand industrialwaste.<br><br>Pollution case studies. | |
| **Unit 3** | **Environmental Policies and Practices:** Climatechange, globalwarming,ozonelayerdepletion,acidrainandimpacts onhumancommunitiesandagriculture.<br><br>Environment Laws: Environment Protection Act; Air (Prevention&ControlofPollution)Act;Water(Prevention andControlofPollution)Act;Wildlife(Protection)Act; ForestConservationAct.Internationalagreements:Montreal andKyotoprotocolsandConventiononBiologicalDiversity (CBD).<br><br>Naturereserves,tribalpopulationsandrights,andhuman wildlifeconflictsinIndiancontext.<br><br>**Human Communities and the Environment**<br><br>Human population growth: Impacts on environment, human health and welfare.<br><br>Resettlement and rehabilitation of project affected persons; case studies.<br><br>Disaster management: Floods, Earthquake, Cyclones and Landslides.<br><br>Environmental movements: Chipko, Silent valley, Bishnois of Rajasthan.<br><br>Environmentalethics:RoleofIndianandotherreligionsand | **18** |

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| | cultures in environmental conservation.<br><br>Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).<br><br>Field work (5 hours) | |

## Reference


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**Subject Expert Committee Members** actively participated in the preparation of proposed curriculum of Environmental Studies (AECC) for all the under-graduatecoursesintheUniversities/CollegesinthestateofKarnataka.

Several meetings were conducted virtually and physically with EnvironmentalScienceSubjectCommitteeExperts;andtheproposedcurriculum wasapprovedbytheChairpersonsofBoardofStudiesandBoardofExaminersof variousUniversitiesandCollegesofKarnatakaState.

| NEP 2020 – SUBJECT EXPERT COMMITTEE – ENVIRONMENTAL SCIENCE | | | |
|---|---|---|---|
| **Name** | **Designation and address** | **Position** | **Signature** |
| **Members Present** | | | |
| **Dr. N. Nandini** | Professor, Department of Environmental Science, Bangalore University, Bengaluru | Chairperson |  |
| **Dr. N. S. Raju** | Professor, Department of Studies inEnvironmental Science,UniversityofMysore, Mysuru | Member |  |
| **Dr. S. Suresha** | AssociateProfessorandHead Department ofEnvironmental Science,Yuvaraja'sCollege (Autonomous), University of Mysore, Mysuru | Member |  |
| **Dr. B. S. Prabhakar** | AssociateProfessorandHead Department ofEnvironmental Science,St.Joseph'sCollege (Autonomous), Bengaluru | Member |  |
| **Dr. Jayappa,M.** | Special Officer, Karnataka State HigherEducationCouncil, GovernmentofKarnataka | Member Convenor |  |
| **Members Absent** | | | |
| **Dr. S. V. Krishnamurthy** | Professor, Department of PG Studies and Research in Environmental Science, Kuvempu University, Shankaraghatta | Member | Absent |