

KUVEMPU  **UNIVERSITY**

NATIONAL EDUCATION POLICY- 2020(NEP-2020)

**PROPOSED CURRICULAR FRAME WORK FOR
FOUR YEARS UNDER-GRADUATE PROGRAMME**

IN

ENVIRONMENTAL SCIENCE

FOR COLLEGES AFFILIATED

TO

KUVEMPU UNIVERSITY

Submitted to

The Registrar

Kuvempu University, Shankaraghatta- 577451

November 2021

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 geo-science, 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, teamwork and collaboration. There is also an additional emphasis in providing opportunities to understand the integration of modern disciplines such as environmental modeling, 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 out comes 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 ademand 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 pages 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 188 credits spread over Forty Six (46) papers to be completed in four years/eight semesters. The credits will be distributed as 20 papers constituting Core Courses, 3 papers of Discipline Specific Elective, 4 papers comprising Open Elective Courses, 2 papers of vocational courses, 1 Internship, 2 papers of Ability Enhancement Courses, comprising of 8 languages, 4 Skill based and 8 Value based as Skill Enhancement Courses, 1 Research Methodology and 1 Research Project. Courses on Environmental Studies and Constitution of India are included as per the earlier UGC directives.

1. To ensure the interdisciplinary spirit of the proposed curriculum, teaching must be carried out by the faculty with M.Sc. in Environmental Science and Ph.D. Degree in the '**Environmental Science**' subject. A candidate who is qualified with UGC-NET/K-SET in the area of Environmental Science will be well-equipped to teach this curriculum.
2. Further, the existing number of UGC NET Fellowships in the field of Environmental Sciences is highly inadequate; it is proposed to increase the number of Fellowships in this area. An Environmental Science programme at the undergraduate level will be successful only when independent Department of Environmental Science is established at under-graduate colleges. It is important to avoid existing problem, soft co-ordination

in teaching carried out through participatory approach. NEP-2020 committee may like to pursue the matter with Universities/Colleges and take necessary steps in this direction.

EXIT OPTION AND CREDIT REQUIRMENTS

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. | 144 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. | 188 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 with Higher order thinking skills following graded approach over year(30%:70%, 40%:60%, 50%:50%, 60%:40% for theory course and 50%:50% for Laboratory, Field Works, Projects, Internship and Education tour over the Years).

MODEL CURRICULUM

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

Discipline Core: **Environmental Science**

Total Credits for the Programme: **188** 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/Teamwork
8. Reflective thinking
9. Multidisciplinary competence catering to environmental sustainability

Assessment:

Weightageforassessments(inpercentage)

| TypeofCourse | Formative Assessment/IA | Summative Assessment |
|--|-------------------------|----------------------|
| Theory | 40 | 60 |
| Practical | 25 | 25 |
| Projects/Experiential Learning (Internship set c.) | Viva-voce=40 | Report=60 |

B.Sc.(Basic/Hons.) Semester1

Title of the Course: **ES1T1-DIVISIONSOFENVIRONMENT**

| Number of Theory Credits | Number of lecture hours/semester | Number of Practical Credits | Numberofpracticalhours/semester |
|--------------------------|----------------------------------|-----------------------------|---------------------------------|
| 4 | 52 | 2 | 52 |

| Programme specific objectives | |
|-------------------------------|---|
| PSO1 | To develop competency in understanding the interrelatedness of the divisions of the Environment. |
| PSO2 | To instill an introductory knowledge of the divisions of Environment and develop necessary analytical skills to characterize their variations. |
| PSO3 | To motivate and inspire to acquire contemporary understanding and skills leading to issue identification. |
| PSO4 | To inculcate creativity and innovative spirit in the domain of human-environment interface leading to vocation / entrepreneurial opportunities. |

| Programme outcomes | |
|--------------------|--|
| PO1 | Demonstrate an entry level competence in understanding the environmental divisions and associated processes. |
| PO2 | Demonstrate the ability to carry out water quality analysis in the laboratory and interpret the results. |
| PO3 | Ability to understand and appreciate the role of environmental parameters in specific day-to-day activities. |
| PO4 | Be able to understand the demands and function in work environment dealing with environmental systems |

| Content of Theory Course 1 | 52Hrs |
|--|--------------|
| Unit - 1 | 08 |
| <p>Environmental Education: Definition, Aim, Objectives and Scope.</p> <p>Environmental Science: Definition, Aim of study and Scope. Differences between Ecology and Environmental Science; Various approaches of studying Environmental Science.</p> <p>Components of the Environment: Definitions of Atmosphere, Hydrosphere, Lithosphere and Biosphere - their complex interactions and significance.</p> | |
| Unit - 2 | 16 |
| <p>Atmosphere: Evolution of the atmosphere – Principal components – Permanent and variable gases. Structure of the atmosphere on the basis of temperature and composition. Ozone chemistry - Depletion and recovery of stratospheric ozone –monitoring, effects and control measures.</p> <p>Climatology: Differences between weather and climate; Insolation - Factors affecting the distribution. Solar (short-wave) and terrestrial (long-wave) radiations. Earth’s Albedo and Heat budget of the earth. Tropical monsoon climate – Tropical cyclones and their impacts. Weatherforecasting and modification. El-Nino and La-Nina effect.</p> <p>Global warming, effects and control measures; Global dimming - Definition, causes and implications; Urban Heat Islands.</p> | |
| Unit - 3 | 14 |
| <p>Hydrosphere: Hydrologic cycle - process of heat energy transfer - Radiation, Conduction and Convection. Types of lifting and precipitation - Bergeron process – Cloud formation and classification. Forms of condensation; Forms of precipitation. Cloud seeding.</p> <p>Limnology: Definition – Lotic and Lentic environment. Differences between Lotic and Lentic systems.</p> <p>Lotic environment: Springs, Stream profile: Potomom and Rhithron.</p> <p>Lentic environment: Ponds, lakes and estuaries – their types. Photic and thermal stratification of Lentic systems.</p> <p>Marine environment: Zonation, Salinity status of marine environment, biotic communities of oceanic zones, acidification of sea water; ocean currents and tides – significance; Polymetallic nodules.</p> <p>Ground water: Definition. Zonation; Types of wells. Salinization of ground water in coastal regions.</p> | |
| Unit - 4 | 14 |
| <p>Lithosphere: Definition. Internal structure of the earth.</p> <p>Endogenic processes: Plate Tectonics – Earthquake and Volcanism – Causes, Effects, and Management.</p> <p>Exogenic processes: River, Wind, and Glacier as geological agents; Avalanches and Landslides.</p> <p>Mineralogy: Definition. Outline classification of minerals</p> <p>Petrology: Definition, Rock Cycle, Classification - Igneous, Sedimentary and Metamorphic rocks – their formation – types – uses.</p> <p>Pedology: Soil – definition – formation – soil profile. Types – Alluvial; Black; Red and Laterite; Arid and Desert; Saline and Alkaline; Peaty and Marshy; Grassland, Forest and Mountain Soils. A brief account of Soil biota. Soil weathering and erosion – Types, effects and management.</p> | |

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- Barry, G. R. and Chorley, J. R. (2003). Atmosphere, Weather and Climate. Routledge, London.
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- Nandini, N. (2019). A text book on Environmental Studies (AECC). Sapna Book House, Bengaluru.
- Wright, R. T. (2007). Environmental science: toward a sustainable future. Jones & Bartlett Publishers.

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

Content of Practical Course1: List of experiments to be conducted

ES1P1: WATER QUALITY ANALYSIS

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

- 1) Sampling technique of water
- 2) Determination of pH – pH metric method
- 3) Determination of Electrical Conductance – Conductivity meter method
- 4) Estimation of Turbidity – Nephelometric method
- 5) TS, TSS & TDS – Gravimetric and Filtration method
- 6) Estimation of Acidity – Alkalimetric method / CO₂ – NaOH titration method
- 7) Estimation of Alkalinity – Acidimetric method
- 8) Estimation of Hardness – EDTA Complexometric method
- 9) Estimation of Chlorides – Argentometric method
- 10) Estimation of Dissolved Oxygen – Modified Winkler's method
- 11) Estimation of Nitrates – Phenoldisulfonic Acid method
- 12) Estimation of Fluorides – Fluoride meter method/SPADNS Reagent method
- 13) Estimation of Sulphates – Barium chloride method
- 14) Determination of Density, Surface Tension and Viscosity of water and other liquid samples

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

| Formative Assessment–Practical Internal Assessment=50%(25Marks) | |
|---|------------------|
| Assessment Occasion/type | WeightageinMarks |
| EndSemesterExamination | 50%(25Marks) |
| Total | 100%(50Marks) |

ES OE1: ENVIRONMENTAL CONSERVATION MOVEMENTS

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

| Content of OPEN ELECTIVE Theory Course 1 | 42Hrs |
|---|--------------|
| Unit – 1 | 14 |
| <p>Environment: Definition, role of environment in shaping civilizations. Interrelations between civilization and environment – ecological economic and socio-cultural. Industrial revolution and environmental pollution. Globalization and environmental pollution. Modern agriculture and environmental degradation.</p> <p>Development: Definition, Growth and development. Population growth and its impact on natural resources, Modernization and population. Causes for industrialization, changing life styles, regulatory aspects of industrialization, overall impact of industrialization on quality of human life, negative impacts of industrialization and urbanization.</p> | |
| Unit - 2 | 14 |
| <p>Development and Environment: Types of development. Sustainable development – Need, relevance in contemporary society.</p> <p>Principles of Sustainable Development: History and emergence of the concept of Sustainable Development, Definitions, Environmental issues and crisis, Resource degradation, greenhouse gases, desertification, invasive species, wildlife depletion and social insecurity.</p> <p>United Nations Sustainable Development Goals. Strategies for implementing eco-development programmes, Sustainable development through - trade, economic growth, carrying capacity and public participation.</p> | |
| Unit - 3 | 14 |
| <p>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.</p> <p>Environmental Movements: 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.</p> <p>Environmental Movements of India: Bishnoi Movement, The Chipko Movement, Appiko Movement, Silent Valley Movement, Narmada Bachao Andolan, Jungle Bachao Andolan, Beej Bachao Andolan.</p> <p>Urban-based Environmental Movements – Local case studies.</p> | |

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) |

ES OE1: ENVIRONMENT AND SUSTAINABLE AGRICULTURE

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

| Content of OPEN ELECTIVE Theory Course 1 | 42Hrs |
|--|--------------|
| Unit – 1 | 14 |
| <p>Environment – Definition, scope and significance. 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. Types of agriculture – rain-fed cultivation and irrigation – water intensive agriculture – Reservoirs and ground water exploitation. Conventional and mechanised agriculture. Natural and chemical agriculture. Subsistence and commercial agriculture. Environmental effects of land use and landscape changes.</p> | |
| Unit - 2 | 14 |
| <p>Environmental determinants of agriculture – role of rainfall, humidity, wind, topography and edaphic factors in crop selection. 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. 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.</p> | |
| Unit - 3 | 14 |
| <p>Environmental impacts of agriculture – Loss of biodiversity – soil salinity – Fertilizer and pesticide pollution, Climate change and global warming. Erosion and problems of deposition in irrigation systems. Desertification. Biomagnification – Case studies. Contemporary issues and management – Farmer distress – market mechanisms – natural farming methods/organic farming. Urban agriculture and hydroponics. Ecological principles of farming – Sustainable agriculture – Significance of indigenous crops and cattle varieties. Watershed management. Agricultural policies of India.</p> | |

References

- Altieri, M. A. (2018). Agroecology: the science of sustainable agriculture. CRC Press.
- Campanhola, C., & Pandey, S. (Eds.). (2018). Sustainable food and agriculture: An integrated approach. Academic Press.
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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) |

ES OE1: ENVIRONMENTAL POLLUTION

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

| Content of OPEN ELECTIVE Theory Course 1 | 42Hrs |
|--|--------------|
| Unit – 1 | 14 |
| <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, degradable and non-degradable, 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.</p> <p>Air pollution: Definition, sources of air pollution and their effects on flora, fauna, human-beings and materials. Indoor pollution, automobile pollution, ozone depletion and recovery, global warming and climate change. London smog, Bhopal gas tragedy, Visakhapatnam gas leak and endosulphan tragedy in Karnataka. Air quality standards – NAAQS, AQI, Bharat Stage - VI Emission standards. Air pollution control measures.</p> | |
| Unit - 2 | 14 |
| <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 pollution – fluoride, nitrate, Arsenic pollution and their control. Water quality criteria – specifications for drinking and inland surface waters. Water Quality Indices.</p> <p>Soil pollution: Definition, sources and types. Soil pollutants – metals, inorganic ions and salts; and organic substance. Effects of pollution on soil health and productivity. Effects of pesticides on soil. Soil erosion, types and control.</p> | |
| Unit - 3 | 14 |
| <p>Noise pollution: Definition, sources and effects. Noise induced hearingloss. Decibel scale. Noise control measures.</p> <p>Solid waste pollution: 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.</p> <p>E-waste: Definition, sources, composition, recycling and disposal methods.</p> <p>Hazardous waste: Definition, sources, classification, effects and disposal methods.</p> | |

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) |

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

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

| 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 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. |

| Programme outcomes | |
|--------------------|--|
| 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. |

| Content of Theory Course 2 | 52Hrs |
|---|--------------|
| Unit – 1 | 14 |
| Levels of organization, Ecology: Divisions of Ecology - approaches in studying Ecology. Ecosystems – Definitions. Classification of ecosystem – Terrestrial and Aquatic with their divisions. Structure of the ecosystem - Function of ecosystem - food chain – food web – bio-magnification. Ecological pyramids – Types. Biogeochemical cycles: Classification. Carbon and Phosphorus 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. | |
| Unit – 2 | 14 |
| 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. | |
| Unit - 3 | 14 |
| 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. | |
| Unit - 4 | 14 |
| Biotic and Abiotic factors: Influence Temperature, Wind and Water, Edaphic, Topographic on flora and fauna. 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. | |

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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) |

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 of phytoplankton
2. Sampling technique of zooplankton
3. Quantitative estimation of phytoplankton – Sedgwick-Rafter method
4. Quantitative estimation of zooplankton – Sedgwick-Rafter method
5. Determination of organic pollution – Palmer's Algal Pollution index
6. Estimation of primary productivity of a pond – Light and Dark bottle method
7. Estimation of primary productivity of terrestrial vegetation – Chlorophyll method
8. Estimation of primary productivity of grasses – Harvest method
9. Study of plant community – Individual count method/Quadrat method
10. Study of animal community – Line transect method
11. Determination of species diversity indices – Simpson and Shannon's Wiener Index
12. Estimation of carbon capture and storage of trees
13. Identification of ecological indicators

References

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- Rolan, R. G. (1973). Laboratory and Field Investigations in General Ecology. Macmillan Co.
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- Trivedi, P. K. and Goel, P. K. (1984). Chemical and Biological Methods of Water Pollution Studies. Environmental Publications.

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

ES OE2: CLIMATE CHANGE AND ITS IMPLICATIONS

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

| Content of OPEN ELECTIVE Theory Course 2 | 42Hrs |
|--|--------------|
| Unit – 1 | 14 |
| Climate Change: Definition, scope and facts of climate change. 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 & direction. Introduction to the effects of various anthropogenic activities on earth’s atmosphere. Monsoons – Definition, Indian monsoons – seasons: Cold weather season (Winter), the hot weather season (Summer), season of advancing monsoon (The rainy season) and season of retreating monsoon (The transition season). Cyclones of the Indian region; El-Nino, La Nina and their impacts. | |
| Unit - 2 | 14 |
| Greenhouse effect 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 global 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. | |
| Unit - 3 | 14 |
| Climate change and policy frameworks – 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), Ministry of Environment, Forests & Climate Change (MoEF&CC), National Action Plan on Climate Change (NAPCC), Agenda 21, The Kyoto protocol, Paris agreement. Overview of Conference of Parties (CoP). Evolution of climate change negotiations. Climate change adaptation and mitigation: Definition, scope and objectives. Linkages between development, 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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- Agarwal K.M, Sikdar P.K. and Deb S.C. (2002). A text book of Environment – MacMiller India Ltd., Calcutta
- Climate Change: Science and Politics. (2021). Centre Science and Environment, New

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- Donald Ahrens.C. (2008). Essentials of Meteorology: An Invitation to the Atmosphere. Cengage Learning publication.
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- Mann, M. E. (2021). The New Climate War: the fight to take back our planet. Hachette UK.
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- Rajit Sengupta and Kiran Pandey. (2021). State of India's Environment 2021: InFigures. Centre Science and Environment, New Delhi.
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- Romm, J. (2018). Climate Change: What Everyone Needs to Know®. Oxford University 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) |

ES OE2: ENVIRONMENT AND PUBLIC HEALTH IN CONTEMPORARY SOCIETY

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

| Content of OPEN ELECTIVE Theory Course 2 | 42Hrs |
|--|-----------|
| Unit – 1 | 14 |
| 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. Types of diseases - deficiency, infection, pollution diseases - allergies, respiratory, cardiovascular and cancer. Personal hygiene- food- balanced diet. Health effects of smoking, drugs and alcohol consumption. | |
| Unit - 2 | 14 |
| 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. Non-communicable diseases and Lifestyle diseases - Diabetes and Hypertension. 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. | |
| Unit - 3 | 14 |
| Occupational health: Sick Building Syndrome; Noise and Radiation; Ergonomics - Stress and Fatigue; Carpal tunnel syndrome (CTS); Methyl mercury and cerebral palsy; 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; New Delhi Antibiotic-Resistant superbug. | |

References

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- Bedi and Yashpal. (1971). Handbook of Hygiene and Public Health. Atma Ram & Sons, Delhi.
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- Walton, M. (2017). One Planet, One Health. Sydney University Press.

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| Formative Assessment – Continuous Internal Assessment = 30% (30 Marks) | |
| Assessment Occasion/ type | Weightage in Marks |
| End Semester Examination | 60% (60 Marks) |
| Total | 100% (100 Marks) |

ES OE2: WILDLIFE AND CONSERVATION

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

| Content of OPEN ELECTIVE Theory Course 2 | 42Hrs |
|--|--------------|
| Unit – 1 | 14 |
| Wildlife: Definition, significance – Values of wildlife: Ecological, Economic, Cultural, Aesthetic, Scientific, Recreational and Medicinal. Biogeographical zones of India. Significant wildlife of India. Causes for wildlife depletion – HIPPO (Habitat destruction, Invasive species, Pollution, Population (human overpopulation), Overharvesting by hunting and fishing. Forest fires and wildlife depletion. Effects of depletion of wildlife – Ecological, Economic Socio-cultural. Urban wildlife. Human-wildlife conflict and management. Categories of Wildlife: IUCN Red data 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, Indicatorspecies. | |
| Unit - 2 | 14 |
| Wildlife conservation: Need for conservation of wildlife. History of wildlife conservation in India. Biosphere reserves, National parks, Wildlife sanctuaries, wildlife reserves, protected areas, privately owned wildlife reserves &, 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. Captive breeding - Role of Zoos in conservation. Community conserved areas – <i>Devarakadu</i> and <i>Pavitra Vana</i> . Case studies: Project tiger, Project elephant. Role of BSI and ZSI in conservation. People and conservation: Traditional knowledge, Traditions and cultures, Women and people’s participation in managing protected areas. Role of NGOs in conservation. Conservation Institutions – Bird Life International, GEF, IUCN, UNEP, WCS, WWF; BNHS, WTI. | |
| Unit - 3 | 14 |
| Wildlife tourism: Definition, scope and relevance. Role of Zoos and Botanical parks in tourism and awareness creation. Bird and butterfly watching. 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 (CITIES). Wildlife Trade Monitoring Network (TRAFFIC). Salient features of Indian wildlife act 1972. | |

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) |