Tribhuvan University

Institute of Science and Technology

4 Years B. Sc. Environmental Science Course of Study

Introduction

In recent years, there is an increasing awareness of the consequences of environmental degradation and resource depletion, together with the need to conserve biodiversity and ensure the sustainability of human activities. This has increased the demand for professionals capable of solving environmental problems. In 1997, Tribhuvan University introduced Environmental Science at Bachelor's Level with an objective to produce qualified human resources having understanding of natural environmental processes and environmental management techniques and to prepare for careers in the utilities and conservation. In order to put its graduates in par with other Bachelor's graduates in technical subjects and also to qualify at international market, the B.Sc. in Environmental Science degree has been upgraded to four-year course since 2012. After completion of one syllabus cycle, some revisions have been made this year (2016) to include and focus on more applied subjects. Some redundancies noted in the syllabus have also been corrected, while others updated where applicable.

Environmental science is about understanding how the planet and its ecosystems work in providing resources and absorbing our actions. The governments, development partners and industries are always looking for way outs or better alternative to reduce the impacts of human activities on the environment. As such these organizations need professionals having sound knowledge on:

- interactions between natural systems
- sustainable management of natural resources, waste and energy
- human influences on the environment
- knowledge of environmental changes, natural hazards and disasters

A basic feature of the subject environmental science is its interdisciplinary nature, as it brings understanding of principles from various disciplines of natural science and the social studies. The course emphasizes in imparting skills to diagnose the problems intricately associated with human activities and the natural world, focusing on contemporary issues such as climate change, pollution of land and water and the management of natural resources. Being an interdisciplinary subject, the students will be given exposure to methods, facilities and research agenda that span the environment– from life sciences including biology and biotechnology, through chemistry, hydrology, meteorology, geology, pollution control technology, statistics to socio-economic and policy aspects of managing environment. This provides the learners a firm and rigorous foundation for a career in the environment. The students will attend class lectures, do practical experiments in the laboratory and field, submit assignments given such as report writing, case studies, and attend examinations at the end of courses on annual basis.

The employment opportunities for B.Sc. Environmental Science graduates are various sectors across the country and abroad. They will fit in the civil service as environmental inspectors, environment officers in manufacturing/service industries, and as environmental science teachers for secondary

school levels. They will also work as research officers or extension officers in various environmental institutions and development agencies. They may also be privately engaged in environment related entrepreneurship, such as consultancy in environmental impact assessment, vulnerability assessment, etc. The degree will also qualify the graduates to pursue higher studies leading to master's degree in environmental science or other relevant subjects.

Eligibility and Criteria for Admission

For admission in B.Sc. Environmental Science course, the candidates having 10+2 with second division in science stream or equivalent are eligible to apply. The applicant must appear and pass entrance examination conducted by the Institute of Science and Technology (IoST), Tribhuvan University. The admission will be on merit basis.

Medium of Instruction - English

Duration of the Program- B.Sc. in Environmental Science is completed in four academic years.

Course Structure

The B.Sc. course of Environmental Science at Tribhuvan University is divided into four academic years: introductory in first year, fundamentals in second year, advanced in third year, and applied in fourth year. The course module contains compulsory, interdisciplinary, practical and research project. The total lecture hour of the course is 3,750; however, there is additional 150 hours when the project work is included, which is optional. The total mark of the course is 2,000.

The courses in the first year cover compulsory subjects and Scientific Communication and carries total of 500 marks with total 975 lecture hours. The students in the first year take environmental science as major subject and two allied subjects from among Botany, Chemistry, Mathematics, Physics, Statistics, and Zoology depending on the academic background of the student, whether physical or biological group.

The courses in the second year contain fundamentals of environmental science, applied statistics and two combination papers from physical or biological group. It carries 500 marks with 975 lecture hours.

The courses in third year offer one subject from environmental science and one subject from either biological or physical groups. The major course of third year in environmental science offers environmental pollution and environmental management tools, research methodology and two electives (one from each combination). It carries 500 marks with 900 lecture hours.

The fourth year offers one major specialization course with two compulsory papers. The compulsory papers are: environmental resources and biodiversity conservation, and pollution monitoring and control. The students must complete a project work or applied science (leading to core subject). There

will also be one interdisciplinary subject dealing with climate change. It carries 500 marks with 900 lecture hours or 1050 lecture hours in case a student takes project work.

Evaluation

Students must obtain pass marks in all theory and practical subjects separately. The Office of Examinations Control will conduct final examinations at the end of the academic year. The duration of examinations will be three hours for theory and six hours for practical. For the students taking project work, it is required to work equivalent to 300 working hours while that for Community Work/Internship it is 150 working hours. The grading of students' performance will be as follows:

Grade	**Four-year Average (%)**
Distinction	75 and above
First division	60-74
Second division	45-59
Third division	35-44
Failed	Below 35

Course Distribution

Course Title: Introductory Environmental Science
Course Code: ENV. 101
Year : I (Compulsory)

SN	Unit Title	Lecture hours
1	Introduction to Environmental Science	25
2	Population and Community Analysis	25
3	Ecosystem Dynamics	25
4	Environmental Chemistry	25
5	Atmospheric Environment	25
6	Environmental Earth Science	25
	TOTAL	**150**

FIRST YEAR

Course Title: Introductory Environmental Science **Lecture hours: 150**
Course Code: ENV 101 **Full marks: 100**
Nature of Course: Theory (Compulsory) **Pass marks: 35**

Objectives

The broad objective of the course is to provide basic theoretical knowledge on Environmental Science. The specific objectives of the course are as follows:

- To understand the concept of environmental science
- To acquaint with the society, culture and environment
- To familiarize with population, community and ecosystem dynamics
- To provide knowledge on environmental chemistry
- To provide knowledge on basic geology and atmospheric environment

Unit 1: Introduction to Environmental Science 25 hrs

Environmental Science: Concept of environment and environmental science, historical development, objective, scope and importance, its relation to other disciplines of science; Multidisciplinary nature of environmental sciences; Environmental issues in Nepal and role of environmental science, state of environmental awareness; Historical and philosophical basis: the interconnectedness of lithosphere, hydrosphere, atmosphere and biosphere.

Relationship between society and environment; Concept of culture and human civilization; Historical development of society and culture: Hunting and gathering, pastoral, agrarian, and industrial society and environment; Mode of production, resource utilization and environment; Population growth and

environmental degradation; Use of sociological and anthropological knowledge on environment conservation; Environmental worldviews and ethics, developed countries, developing countries, sustainability.

Unit 2: Population and Community Analysis **25 hrs**

Ecology: Concept, history, scope, types, ecological hierarchy; Biosphere: Evolution, realms; Ecosystem: components and factors, life supporting systems, concept of food chain, food web, trophic structure, ecological pyramids; Concept of limiting factors; Liebig-Blackman law; Shelford's law of tolerance.

Population characteristics: Size and density, pattern of dispersion, age structure, natality, mortality, biotic potential; Population dynamics and theory of population growth; Rate of natural increase; Species interaction: Positive and negative; Regulation of population size.

Community characteristics: Classification and composition; Characters used in community structure: Analytical and synthetics; Concept of ecological dominance; Habitat and niche; Ecological indicators; Keystone species; Ecotone and edge effect; Heterogeneity and equitability; Adaptation: Origin and significance; Ecads; Ecotypes; Ecocline; Speciation and extinction.

Unit 3: Ecosystem Dynamics **25 hrs**

Terrestrial and aquatic ecosystems: Structural and functional aspects of forest, grassland, deserts, lentic and lotic environment; Energy sources for ecosystem dynamics; P/R ratio; Ecological efficiency; Energy flow model- simple and Y-shaped model; Application of thermodynamic laws in ecosystems; Productivity and its types; Methods of measuring primary and secondary productivity; Global primary productivity; Biogeochemical cycles: Hydrological, gaseous (oxygen, nitrogen and carbon) and sedimentary (sulphur and phosphorus); Ecological stability: Carrying capacity, persistence, constancy, resilience; Homeostasis and feedback mechanism; Ecosystem regulation; Ecological succession and climax community; Human impacts on ecosystem.

Unit 4: Environmental Chemistry **25 hrs**

Environmental Analytical techniques; Volumetric and gravimetric analysis; Potentiometric titration; Conductometric titration; Colorimetric/spectrophotometric analysis; Errors and statistical methods in chemical analysis; Atmospheric Chemistry: Characteristics of the atmosphere; Atmospheric processes and reaction of gases and particulates; Chemistry in ozone depletion; Chemical reactions of global warming; Chemistry of aquatic media: Water in the Environment; Characteristics of water bodies; Major aquatic chemical processes, structure and property of water, solubility; Acid base reactions: general behavior, carbonic acid, pH and solubility; Oxidation-reduction processes; Soil chemistry: Basic concept of colloidal chemistry; Ion exchange reaction in soil; Pesticides: classification, environmental contamination and fate of pesticides in soil.

Unit 5: Atmospheric Environment **25 hrs**

Origin, composition and structure of the atmosphere; Meteorological fundamentals: Radiation and heat budget, temperature, pressure, wind, humidity, water vapour, clouds, fog, precipitation; Atmospheric stability; Adiabatic diagrams-slide and parcel method; Turbulence and diffusion; Scales of meteorology; Application of micro-meteorology to vegetated surfaces, urban areas, human beings, animals and airport; Application of meteorological principal to transport and diffusion of pollutants; Scavenging process; Effects of meteorological parameters on pollutants and vice versa; Wind roses; Temperature inversion; Lapse rate; Concept of weather and climate, Weather forecasting; Climate change: Introduction and impacts; Greenhouse effect; Atmospheric circulation; Weather and seasons; Monsoon; Extreme weather events: Thunderstorms, tornadoes, hurricanes and El Nino/ ENSO.

Unit 6: Environmental Earth Science **25 hrs**

Relationship between geology and environmental science; Conceptual framework of earth as a closed system; Introduction to geological time scale; Mountain building process; Internal structure of earth; Earth materials (rocks and minerals): Classification, types, composition, formation and abundance; Earth processes: Endogenic and exogenic; Tectonism; Volcanism; Earthquake; Geological agents of change: Wind, water and ice; Landslide and mass wasting.

Soil Science: Concept and relation with environment; Chemical and mineralogical composition of soil; Process and factors affecting soil genesis; Properties of soil: Physical, chemical and biological; Humus: Nature, properties and formation; Soil profile and types; Soil types of Nepal.

References:

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Course Title: Introductory Environmental Science **Working hours: 180**
Course No: ENV 102 **Full marks: 50**
Nature of Course: Practical (Compulsory) **Pass marks: 20**

1. Sampling techniques for biological analysis:
   - Vegetation sampling
   - Animals
2. Measurement of population and community parameters: density, frequency, abundance, dominance, community composition, similarity index, species-area-curve, minimum number of sampling units, species diversity and IVI of vegetation and animals by different methods.
3. Determination of total biomass of plants (tree by non-harvest method and herbs by harvest method).
4. Determination of total biomass of animals.
5. Biological analysis of soil from grassland/cropland/forest ecosystems.
6. Determination of Temperature, Transparency, pH, Conductivity, Dissolved Oxygen (DO), Hardness, Alkalinity, Chloride.
7. Study of topographic map and interpretation for geo-environmental study.
8. Identification of rocks and common minerals in hand specimen.
9. Analysis of weather parameters (temperature, precipitation, humidity).
10. Estimation of missing weather data (temperature, precipitation, humidity).
11. Estimation of optimum number of rain gauge station.
12. Measurement of dust fall/total suspended particulates by using trap method.
13. Construction of wind rose.

Field Visit

1. Visit nearby forest /grassland ecosystem to enumerate floral and faunal diversity.
2. Visit human settlement area for socio-cultural study.
3. Study of rock/minerals and soil profile.
4. Visit nearby meteorological station to acquaint with the weather recording instruments.