Environmental Science

SECOND YEAR

Course Title: Fundamentals of Environmental Science **Lecture hours: 150**
Course No: ENV 201 **Full marks: 100**
Nature of Course: Theory (Compulsory) **Pass marks: 35**

Objectives

The broad objective of the course is to familiarize the students with fundamentals of environmental science. The specific objectives of the course are as follows:

- To enrich students understanding on basic concept of fundamental environmental science
- To make students familiar with concept and scope of limnology and ecological values of freshwater environment
- To give the students knowledge of hydrological phenomenon, its processes and climate of Nepal
- To acquaint with the role of microorganisms in environment
- To enhance students' understanding on broader aspect of environmental science linking it with geology and biotechnology, and
- To make students familiar about environmental survey and analytical techniques

Unit 1: Limnology 25 hrs

Concept, importance, scope, its relationship with other disciplines and history of limnological study with focus to Nepal; Wetlands: Concept, types, roles, threats and conservation; Freshwater environment: Definition, types and limiting factors, morphometry of freshwater bodies, physico-chemical properties of freshwater, ecological classification of freshwater organisms; Freshwater biodiversity: Microbes, macrophytes, macro-invertebrates, fishes, amphibians, reptiles, birds and mammals; Physico-chemical and biological water quality index; Comparative study of lentic and lotic environment; Ecological, economic and cultural importance of freshwater environment; Land-water interactions; Impacts of dam on lacustrine and riverine ecosystems; Freshwater habitat degradation, fragmentation and loss; Protecting, sustaining and restoring of freshwater environment.

Unit 2: Hydrology 25 hrs

Hydrological cycle: Phases, interaction with ground water and surface water, stocks and fluxes in the global cycle; Precipitation: Forms of precipitation, effective precipitation; Analysis and interpretation of rainfall data; Snow hydrology: Snowfall and measurement, properties; Metamorphism, sublimation and deposition; Movement of water through snow, water quality aspects of snow; Introduction to glaciers, remote sensing in snow hydrology study; Infiltration: Infiltration process, factors affecting

infiltration capacity; Estimation by hydrologic budget, Horton's, Kostiakov's, Darcy's and Philip equation methods; Evaporation and evapotranspiration: Factors affecting evaporation and evapotranspiration, control of evaporation and evapotranspiration; Estimation of evapotranspiration by Blaney-Criddle, Thornthwaite and Penman's methods; Stream flow: Components of runoff, factors affecting runoff, environmental effects of surface runoff and their mitigation; Introduction to stream simulation model; Hydrological prediction: probability of hydrologic event, distribution functions; Frequency analysis, analysis of hydrologic time series, reconstruction of hydrologic data; Flood forecast technique, extreme flood event estimation method; Ground water: zonation and occurrence of ground water; Aquifer parameters, Darcy's law; Ground water level and environmental influences; Hydro-geological investigation; Ground water quality.

Unit 3: Climatology **25 hrs**

Climatology: Definition, scope and types; Concepts of weather and climate, insolation and heat budget; Characteristics of atmosphere; Features of monsoon; Jet stream: temperature, pressure and wind field, types and location, importance in Nepalese ecology, agro climatology, urban climatology, aviation climatology, environmental and economic importance of the monsoon; Classification of climate: objectives of the classification, basis of the classification, Koppen's classification, Thornthwaite classification, climates of Nepal, climatic pattern, spatial and temporal patterns of climatic parameters in Nepal, rainfall and temperature variation with east-west, north-south, intraregional variations in Nepal, Climate types: tropical climate, temperate climate, highland climate, tundra climate, ice caps climate; Forecast: Long and short range weather forecast; Dendro-climatology and its techniques to reconstruction of past climatic environment, case study examples of Nepal.

Unit 4: Environmental Geology and Environmental Survey **25 hrs**

Introduction to environmental geology and its concepts; Human modification of nature; Geological criteria of land use planning and decision making for waste disposal and infrastructural developments: roads, tunnels, bridges and foundation; Dams and reservoirs: Geotechnical consideration and environmental impacts; Land capability mapping; Instability of hill slopes and landslides; Geological aspects of environmental health: Trace elements and human health, chronic diseases and geologic environment; Physiographic, geomorphic and tectonic division of Nepal Himalaya and major hazards associated with these zones, mitigation measures.

Environmental survey: Definition and concept, objective, importance and scope; Introduction and types of map, topographical and geological maps; Topographic surveying: Concepts, inventory and mapping, methods of topographic surveying, methods of representing relief; Contours: concepts and characteristics, methods of locating and interpolation; Concept and application of Remote Sensing (RS), RS and uses of aerial photographs; Geographic Information System (GIS), Global Positioning System (GPS) in relation to environmental monitoring; Methods of resources surveying: land, water, forest, mines.

Unit 5: Environmental Microbiology **25 hrs**

Concept and historical development of environmental microbiology; Major microbes: Viruses, bacteria, cynobacteria, actinomycetes, protozoans, fungi, and algae; Factors affecting the growth of microorganisms; Distribution of microorganisms: Air, water, soil and food; Microbial interaction in environment; Techniques used for the estimation of microbial population; Application of microbes in environment.

Unit 6: Agriculture and Biotechnology **25 hrs**

Introduction and types of agriculture; Agricultural practices in Nepal: conventional and modern agriculture, environmental consequences; Participatory approach of modern agriculture; Sustainable agriculture: agro-ecological practices; Pesticides: first and second generation; Agrochemical pollution; Integrated Pest Management (IPM); Alternative method of pesticides uses; Sustainable Soil Management (SSM); Land reform; Agricultural policy in Nepal; Impact of globalization in agriculture.

Sustainable soil management techniques; SSMP in mid-hills of Nepal; Farmer to farmer diffusion model, strength, challenges & opportunities of F-F; Soil conservation and watershed management modules: low cost soil and water conservation, integrated soil conservation, watershed management activities, strategies and promotion scale up;

Biotechnology: Introduction, principles and concepts; Detoxification of environmental pollutants; Degradation of high concentrated toxic pollutants: Halogenated, non-halogenated, petroleum, hydrocarbons, metals; Biotransformation of metals, biodegradation of solid wastes; Microbial technology for waste treatment: biotechnological remedies for environmental pollution; Decontamination of groundwater systems, subsurface environment, reclamation and bioremediation concepts; Production of proteins; Biofertilizers; Composting and vermi-composting; Biogas technology; Genetic application: concept of DNA technology, construction of microbial strains, protoplast fusion technology, applications; Ex-situ conservation: Seed bank, gene bank, tissue culture; Environmental effects, safety and ethics.

References:

1. Adoni, A.D. (1985). Workbook on Limnology, Pratibha Publishers, Sagar, India.
2. Agarwal, K.M., Sikdar, P.K., Deb, S.C. (2005). A Text Book of Environment, Macmillan India Limited.
3. Chhetry, D.K. (2012). Environmental Toxicology. Uma Silwal Karki, Kathmandu.
4. Critchfield, H.J. (2013). General Climatology. PHI Learning Pvt. Ltd., New Delhi.
5. Dahal, R.K. (2006). Geology for Technical Students, 1st Edition. Bhrikuti Academic Publications, Kathmandu.
6. Dubey, R.C. (2013). A Textbook of Biotechnology, S. Chand and Company P. Ltd., New Delhi

7. Frey, D.G. and Fry, F.E.J. (1963). Fundamentals of Limnology. Toronto University Press, Canada.
8. Lal, D.S. (2013). Climatology, Revised Edition. Sharda Pustak Bhawan, Allahabad.
9. Punmia, B.C., Jain, A.K, and Jain A.K. (2005). Surveying Vol. Surveying Vol. II, 16th publication. Laxmi publications (P) Ltd, New Delhi.
10. Rami J. P. and Reddy (2008). A Text Book of Hydrology, University Science Press.
11. Shiva, V. and Bedi, G. (2002). Sustainable Agriculture and Food Security, Sage Publication, New Delhi.
12. Valdiya, K.S. (1987). Environmental Geology, 1st edition, Tata McGraw-Hill Limited, New Delhi.

Tribhuvan University

Institute of Science and Technology

Course Title: Fundamentals of Environmental Science **Working hours: 180**
Course No: ENV 202 **Full marks: 50**
Nature of Course: Practical (Compulsory) **Pass marks: 20**

1. Study of macrophytes and macroinvertebrates communities from lentic and lotic environment (sampling methods, sampling sites, density, distribution pattern, composition, biomass and species diversity).
2. Qualitative and quantitative estimation of various types of phyto and zooplankton from lentic and lotic environment (sampling methods, selection of sampling sites, density and composition).
3. Instrumentation and working principle: compound microscope, hot air oven, autoclave, incubator, biological safety cabinet, water bath and related instruments.
4. Analysis of bacterial population (staining, enumeration).
5. Study on grain size of sediments.
6. Application of Geological Compass.
7. Rock Mass Classification.
8. Study on map reading technique and GPS tracking method.
9. Estimation of Potential evapo-transpiration by Penman, Blaney-Criddle and Thornthwaite method.
10. Study on classification of temperature and precipitation zone of Nepal.
11. Study of infiltration of water through soil curve.
12. Estimation of soil loss using universal soil loss equation.
13. Drawing and analysis of hydrograph, unit hydrograph, base flow and rating curve.
14. Measurement of river discharge (surface float, current meter, weir, and bucket method).

Analyze flood frequency and estimate extreme flood events.