THIRD YEAR

Course Title: Environmental Pollution and Management Tools **Lecture hours: 150**
Course Code: ENV. 301 **Full marks: 100**
Year III (Compulsory) **Pass marks: 35**

Objectives

The broad objective of this subject is to acquaint students on the problems of environmental pollution and assess environmental impacts of development projects and help them learn related management tools. The specific objectives of the course are as follows:

The specific objectives are:

- To make students able to understand of emission and transport of various pollutants in air, water, soil, noise and its effects in environment
- To acquaint students with municipal and hazardous solid wastes
- To introduce students in assessing environmental impacts on various steps of project cycle
- To familiarize with the environmental management system

Unit 1: Environmental Pollution **10 hrs**

Definition, type, source; Major categories of environmental pollution: Pollution of earth surface (land and water), the pollution of atmosphere; Entry of pollutant in the environment; Transfer, transport and dilution of pollutants.

1.1 Air Pollution and Aerosols **20 hrs**

Air pollution: History of air pollution episodes, natural versus polluted atmosphere; Sources; Different types of air pollutants; Criterion and hazardous air pollutants; Effects on human health, plants, animals and materials; Expression units for pollutants concentrations -gaseous and particulates; Concept of air quality index and interpretation; Indoor air pollution: sources, major indoor air pollutants, effects and control; Atmospheric aerosols: Formation, sources, chemical composition, types, vertical variation of aerosol; Radiative effects of atmospheric aerosol; Trans-boundary air pollution; Global issues: Green house effect, atmospheric brown cloud, ozone depletion.

1.2 Water Pollution **20 hrs**

Sources of water pollution: Point source and non-point source; Types of water pollution: Groundwater, surface water and marine; Major types of water pollutants; Water quality parameters: physical, chemical and biological; Water treatment: Scope: Processes – aeration, sedimentation, filtration, disinfection, softening; Wastewater treatment: Principle and practice;

Wastewater characteristic; Types and sources, need of treatment; Characteristics of municipal and industrial wastewater; Working mechanisms of primary, secondary/biological and tertiary: Sludge disposal.

1.3 Noise Pollution **15 hrs**

Sound and Noise; Properties of sound; Sources of noise; Noise descriptors: Equivalent sound pressure, average day night sound pressure level, sound exposure level, noise number index, percentile level; Sound measurement equipment; Health effects and control measures: source control, path control & receiver control.

1.4 Soil Pollution **15 hrs**

Fundamental of soil properties; Field indicators of soil loss; Major sources of soil pollution; Concept about soil quality index and salinity hazard; Effect of soil pollution; Soil pollution control measures.

Unit 2: Environmental Assessment – Introduction and the Process **20 hrs**

Project development: Development, development infrastructures and environmental consideration; Tools for the environment inclusion in Development; Initiation of Environmental Assessment; History of Environmental Assessment; Legal Requirement of Environmental Assessment; Components of project cycle; Environmental inclusion on various steps of project cycle; Environmental Assessment related legal aspects in Nepal.

Environment Assessment(EA) and its types; The EA Process; Environmental screening; Scoping to determine the Terms of Reference (TOR); Terms of Reference; Initial environmental examination/environmental impact assessment (differences); Types of impact; Baseline Information (physical, biological, cultural environment/human development); Methods of collecting baseline information; Issues identification; Mechanism to give the weight age for issues; Prioritization of Issues; Project Alternatives Analysis; Potential Impact Identification; Public Involvement in environmental inclusion in development; Steps of Environmental Assessments in Nepal.

Unit 3: Impacts Assessment Techniques and Mitigation Measures **15 hrs**

Method of impact identification: Checklist, interaction matrix, overlay mapping, networks, GIS, Task specific computer model, expert system; Impact prediction: Introduction, method of impact prediction, uncertainty of impact prediction, impact ranking and comparison of alternatives; Evaluation and determination of significance; Categorization of impacts; Mitigation measures; Public participation and consultations; Environmental Management Plan; Case studies.

Unit 4: Environmental Monitoring, Auditing and Governance 20 hrs

Monitoring: introduction and types of monitoring, monitoring criteria and methodologies, monitoring indicators and monitoring processes; Environmental auditing: introduction, types of audit, timeframe for conducting audit, environment auditing plan.

Environmental Governance: Concept, scope and importance of environmental governance; Sustainable requirement of environmental governance; Environment governance: principle and practices; Environmental governance in Nepal; National legislative framework: Environment Protection Act (EPA), Environment Protection Rule (EPR); Sectoral environmental legislations: National strategy, plans and polices, guidelines, manuals and standards; Legislative framework; International convention and treaties; Major International conventions adopted by Nepal; Environmental justice; Good governance; Capacities of EG (Legal and institutional frame work decision making knowledge, enforcement and incentives, integration mechanism); Concept of EG models (Concept of UNEP, Compliance, Cleaner production).

Unit 5: Environmental Management System 15 hrs

Environmental management tools and their application: green productivity (GP), environmental management system (EMS), cleaner production (CP) and life cycle assessment (LCA); Introduction to International Organization for Standardization (ISO) and ISO 14000 series; Historical development of EMS; Introduction and requirements of EMS; Introduction of Quality Management System (QMS).

Stages of EMS implementation; environmental review, identification of significant environmental aspects, documentation requirements of EMS, environmental policy, objectives, targets and programs, operation control, review.

Certification process of EMA; EMS auditing and mechanism for certification in Nepal; case studies.

References:

1. Agrawal, K.M., Sikdar, P.K., Deb., S.C. (2005). A Text Book of Environment. Macmillan India Limited.
2. Amacher, Michael C.; O'Neil, Katherine P.; Perry, Charles H. (2007). Soil vital signs: A new Soil Quality Index (SQI) for assessing forest soil health. Res. Pap. RMRS-RP-65WWW. Fort Collins, CO: U.S. Department of Agriculture
3. De, A. K. (2010). Environmental Chemistry, 17th edition. New age international publishers.
4. Environment Protection Act 1997 and Environment Protection Rules, 1997. Ministry of Environment, Science and Technology, Nepal
5. ISO. (2004). International Standard ISO 14001, Reference No. 14001:2004 (E), International Organization for Standardization, Geneva.

6. Khadka, R.B. (1997). EIA Training Manual for Professionals and Managers. Asian Regional Environmental Assessment Program. IUCN, Kathmandu, Nepal.
7. Khadka, R.B., Gorzula, S., Joshi A.R., Guragain, S., Mathema, A.B. (2013). Environmental Impact Assessment: Process, Methods and Practices in South Asia (Bangladesh, Bhutan, India and Nepal), 1st edition. SchEMS and IED/RCBI, New Baneshwor.
8. Lohani B.N., Evans J.W., Robert R., Richard A., and Liang, S. (1997). Environmental Impact Assessment for Developing Countries in Asia: Overview and selected case studies, Volume I & Volume II. Asian Development Bank.
9. Masters, G.M. and Ela, WP. (2013). Introduction to Environmental Engineering and Science, 3rd Edition. PHI Learning Pvt. Ltd, Delhi.
10. Miller, Jr. G. T. and Spoolman, S.E. (2009). Living in the Environment: Concepts, Connections, and Solutions, 16th Edition. Brooks/Cole, Cengage Learning.
11. Najam, A., Papa, M., and Taiyab, N. (2006). Global Environmental Governance - A Reform Agenda, iisd, Denmark.
12. NPC and IUCN (1993). National Environmental Impact Assessment Guidelines. National Conservation Strategy Implementation Project, Kathmandu.
13. Rijal, K. and Sapkota, R.P. (2012). Environmental Management Systems: Concept and Approaches, Printwell Offset Press, Kathmandu, Nepal.
14. Santra, S.C. (2005). Environmental Science, 2nd Edition. New Central Book Agency (P) Ltd, Kolkata.
15. Sapkota, B. (2004). Fundamental of Noise Pollution, Department of Physics, Pulchowk Campus, Lalitpur, Nepal
16. The World Bank. (1999). World Bank Safeguards Policies – Environmental Assessment. Washington, DC: World Bank.
17. Uprety, B.K. (2003). Safeguarding the Resources, Environment Impact Assessment, Process and Practices. Shikhar Samundra Offset, Bagbazar, Kathmandu.

Course Title: Environmental Pollution and Management Tools **Working hours: 150**
Course No: ENV. 302 **Full marks: 50**
Nature of Course: Practical (Compulsory) **Pass marks: 20**

1. Study the instrumentation techniques of air pollutants (gravity settling chamber, spectrophotometer, cyclone collector, dynamic precipitator, spray tower, dry venturi scrubber, charcoal absorption tube, electrostatic precipitator, fabric filter etc.).
2. Examine air pollution using:
    a. Natural indicators (e.g. vegetation)
    b. Standard methods or sampling for parameters such as SOx, NOx, etc. as indicator in indoor and ambient air.
3. Study of water pollution using following parameters:
    a. Free Carbondioxide; Dissolved Oxygen (DO); BOD and COD and Heavy metals.
4. Determination of iron by spectrophotometric technique or AAS in groundwater samples.
5. Measure and compare the noise levels in public, residential and business area.

6. Study of physical and chemical characteristics of soil (temperature, pH, moisture, nitrate, phosphate, potassium, organic matter, C: N ratio).
7. Determination of soil pH and conductivity from different agricultural setting.
8. Determination of texture in soil by hygrometric method.
9. Conduct an Environmental Assessment and prepare a report of an ongoing or possible development works (e.g. construction of road, residential complex, hospital, establishment of cottage industries, hydropower plant, landfill site etc.).
   (Field work of at least five days is required for stakeholder/public consultations and data collection - primary and secondary).
10. Develop an ISO 14001 Environmental Management System for an industry (manufacturing/service).

Course Title: Ecological Restoration and Management **Lecture hours: 75**
Course Code: ENV. 303 **Full marks: 50**
Year IV (Elective - I) **Pass marks: 17.5**

Objectives

The broad objective of this course is to acquaint students on the fundamentals of ecological restoration and management. The specific objectives of the course are:

- To make the students understand the concepts and knowledge of ecological processes and their implications on restoration.
- To provide the students with basic understanding on the applications pertaining to land and wildlife habitats restoration.

Unit 1: Ecological Processes **15 hrs**

Ecosystem as an ecological unit; Terrestrial and aquatic ecosystems; Structural components; Functional components: Energy flow, nutrient cycling; Physico-chemical components as limiting factors in ecosystems; Life history pattern of species; Population growth and regulation; Ecosystem productivity; Species interactions; Ecological niches; Plants and animals adaptation to environment; Ecosystem development and succession; Disturbance ecology; Fire as an ecological tool: disturbances, prescribed burning, fire-adapted ecosystems, fire suppression; Biogeography of ecosystems; Human impacts on ecosystem health.

Unit 2: Conceptual Framework on Ecological Restoration **15 hrs**

Ecological Restoration: Terminologies, history and importance; Ecological theory and restoration ecology; Hierarchical levels of consideration in Restoration Ecology; Restoration of populations and communities; Disturbance and impairment of ecosystems; Ecological attributes of restored ecosystems; Guidelines for restoration practices and steps; Reference sites; State and transition model; Functional group and ecosystem engineers; Thresholds in ecosystem degradation**.**

Unit 3: Land Degradation and Restoration **25 hrs**

Causes and processes of land degradation: Natural hazards (flood, wind, unmanaged fire, landslides, erosion), anthropogenic causes (land encroachment, poor farming practices, overgrazing and overdrafting, land use change and developmental structures, unmanaged transportation, quarrying, dumping wastes, soil contamination and acidification) and socio-economic and policy factors; Ecosystem stability, sensitivity and resilience in relation to land degradation processes; Quantitative evaluation of land degradation problems: (a) evaluation of degradational problems at national, regional and global scale (b) ecological, and economic indicators of ecosystem degradation - soil erosion, nutrient cycling, hydrological cycling, nutrient and water use efficiency, biodiversity, productivity, profitability (c) rapid appraisal techniques; Ecological basis of ecosystem restoration: Reproductive and growth strategies of plants, nutrient/water uptake and use strategies, environmental controls on soil formation and ecosystem productivity: vertical mulch, compost, tillage, topsoil salvage, soil biology and fertility processes, plants-animals-microbes linkages; Socio-economic considerations in ecosystem restoration: (a) Relationships between environmental, economic and social opportunities and constraints in restoration, (b) Ecosystem restoration imperatives in developing and developed countries, (c) Institutional requirements for ecosystem restoration, (d) Consideration of socio-cultural values in developing restoration strategies; Case studies on successful ecosystem projects.

Unit 4: Habitat Restoration **20 hrs**

Habitats and quantification; Wildlife habitat restoration: Introduction, desired conditions; Habitat disturbances: Natural and human accelerated; Passive and active restoration; Ecosystem-scale restoration of forests and wetlands; Methods to restore and monitor wildlife habitats (aquatic and terrestrial); Formulation and implementation of restoration plans; Introduced/Exotic species; Habitat restoration design concepts; Landscape restoration: Pattern and process; Connectivity: matrix restoration, corridors, stepping stones; Metapopulation: Metapopulation networks, metapopulation dynamics; Case studies on metapopulation approach to restoration.

References

1. Clewell, A. and Aronson, J. (2013). Ecological Restoration: Principles, Values, and Structure of an Emerging Profession, Society for Restoration Ecology International, Island Press: Washington D.C., 2nd ed. ISBN 13: 978-1-61091-168-9.
2. Falk, D. A., Palmer, M. A., and Zedler, J. B. editors. (2006). Foundations of restoration ecology, Society for Ecological Restoration International. Island Press, Washington, D.C., USA.
3. Ferris, et al., (1996). Handbook of Western Reclamation Techniques, Office of Surface Mining Reclamation and Enforcement, Denver, CO.
4. Morrison, M.L. (2009). Restoring wildlife: Ecological concepts and practical applications. Island Press, Washington, D.C., USA.
5. SER International. (2002). Wildlife Restoration, Island Press.

6. SER International. (2004). Primer on Ecological Restoration, Society of Ecological Restoration.

Course Title: Solid Waste Management **Lecture hours: 75**
Course No: ENV. 304 **Full marks: 50**
Nature of Course: Theory (Elective) **Pass marks: 17.5**

Unit 1: Introduction and Characteristics of Solid Waste 15 hrs

Definition of waste, types of waste; Global scenario of waste, global and local issues on solid waste management; Waste management hierarchy; Integrated solid waste management; Holistic solid waste management; Waste management scenario in the context of Nepal.

Definition of municipal solid waste (MSW); Physical, Chemical and Biological properties of municipal solid waste; Sources of municipal waste; Types of municipal waste; Composition of municipal solid waste and its determination; Process of municipal solid waste management; Social , environmental and economic aspects of MSW management; Types of materials recovered from MSW.

Unit 2: Generation, Collection and Processing of Solid Waste 20 hrs

Assessment of solid waste generation and characteristics; Factors affecting solid waste generation rate; Source reduction: quantity and toxicity, effects of source reduction, strategies for source reduction.

The logistics of solid waste collection; Types of waste collection systems, equipment and personnel requirements; Collection routes; Management of collection systems; Collection system economics.

3R principle; Transfer station; Recycling and recovery of recyclable materials; Processing of municipal solid waste e.g. storage, conveying, compacting, shredding, pulping, granulating etc; Material recovery facilities (MRF); Recycling economics; Energy recovery from solid waste; Effects of combustion; Composting of municipal solid wastes - principles, technology and economics; case study.

Unit 3: Disposal and Landfill Management 15 hrs

Transfer station; Landfill: classification, planning and landfill processes; Landfill design considerations; Generation and composition of landfill gases; Formation, composition and management of leachate; Landfill operation; Environmental quality monitoring at landfills;

Landfill closure, post-closure care and remediation; case study.

Unit 4: Hazardous and Special Wastes **10 hrs**

Definition, identification and classification of hazardous solid waste; sources, impacts and characteristics of hazardous solid waste; Bio-medical waste, its sources, generation, storage, transportation, treatment and disposal; Hazardous waste management techniques; Special wastes and e-wastes and their management; Disaster waste and its management; case study.

Unit 5: Institutions and Regulatory Framework **10 hrs**

National level organization structure, human resource management, community mobilization, financial management on SWM; Types of private sector participation and its benefits.

Policy, law and regulations, strategy related to SWM in Nepal; International laws and treaties related to SWM; IEE/EIA related SWM projects; Solid Waste Management Act 2011 and Regulations 2013 in Nepal; UNEP guidelines and legal framework for solid waste management.

References

1. Tchobanoglous, G. and Kreith, F. (2002). Handbook of Solid Waste Management Second Edition; McGraw-Hill Publication, New York Chicago San Francisco.
2. ADB. (2013). Solid Waste Management in Nepal: Current Status and Policy Recommendations. Asian Development Bank, Philippines.
3. PAN and EU. (2008). Best Practices on Solid Waste Management in Nepalese Cities. Practical Action Nepal, Kathmandu.
4. UN-HABITAT. (2010). Solid Waste Management in the World's Cities. United Nations Human Settlements Programme. Earthscan Publications, London.