

University of Rajshahi



**Institute of
Environmental
Science**

Syllabus for Postgraduate Program (2009-2010)

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POSTGRADUATE CURRICULA

Postgraduate study in the Institute of Environmental science, University of Rajshahi will lead to M.Phil and PhD degrees. To obtain IES postgraduate degrees, in addition to completion of necessary coursework, students must prepare and successfully defend a thesis, which will investigate a problem that initiates, expands, strengthens or clarifies existing knowledge in the field. Students will be required to define an appropriate problem for investigation, review relevant information, develop a study plan incorporating techniques appropriate for the problem, implement the plan, and relate the results to already existing theory or a body of knowledge in the field. For a Doctor of Philosophy degree, however, students must make original contribution to their field of research.

A recognized Masters degree (i.e., 3-year Bachelor plus 1-year Masters) or equivalent degree in any discipline related to environment is the normal entry requirement for the program. However, **student from social science and business discipline background shall have a science background in higher secondary certificate level.** Performances in the degree and/or relevant experience will also be considered in granting admission.

Students seeking admission to postgraduate degree program are required to file their completed application forms which must include previous academic transcript, records of professional qualifications if any, and a synopsis of their proposed research plan. Application forms for admission to the institute can be obtained directly from the IES Office.

Successful applicants are normally registered for M.Phil in the first instance and those who wish to study for the Ph.D are transferred at a later stage (normally after one year) subject to satisfactory progress.

Each student will be allotted a supervisor who has enough knowledge on the proposed research work to provide frequent personal supervision of the progress of research and if necessary, co-supervisor(s) abiding by the principles of the University may be allotted.

The academic programs at the Institute will be designed for people from a wide range of disciplinary backgrounds, professional experience and environmental knowledge. It is envisaged that as well as environment, such backgrounds and experience may include physical science, life science, social science, economics, law, management and engineering, landscape architecture and the health professions. The Institute aims at providing a flexible program, which can be tailored to individual student's needs.

The IES program will rest on a solid foundation of Core and Optional Courses, which will provide, respectively, both a basis of critical appreciation of frameworks of Environmental Science and basic 'environmental literacy' in key disciplinary areas. Since students will bring very different knowledge bases to the program and may need to fill knowledge gaps, the latter courses will be seen as a key attribute in the environmental field, which necessarily involves collaborative as well as integrated decision-making by specialists from many disciplines. For this to be effective mutual understanding of others' disciplinary perspectives is critical. Compulsory Courses will also provide for appreciation of the inherently inter-and trans-disciplinary nature of environmental science. Beyond this foundation, students, with the assistance of the supervisors, will be free to design a balance program to suit their specific needs. This program will be taken from a wide range of Optional Courses, which will enhance their specialist expertise and will expand their knowledge and skills in the particular field related to their thesis research works.

Students enrolled in the IES Postgraduate Program are required to complete a coursework made up of:

- Eight (8) Compulsory Courses of 24 credits**
- Four (4) Optional Courses of 8 credits**

Course curricula and course description of Compulsory and Optional Courses for the IES Postgraduate Program follows:

Postgraduate Course Curricula (2009-2010)

Compulsory Courses				
Number	Title	Total Marks	Hours of Lecture	Credit
ENV C701	Introduction to Environmental Science	75	42	3
ENV C702	Ecology and Environment	75	42	3
ENV C703	Environmental Pollution and Control	75	42	3
ENV C704	Environmental Impact Assessment (EIA)	75	42	3
ENV C705	Geo-Environment	75	42	3
ENV C706	Research Methodology	75	42	3
ENV C707	Disaster and Environmental Management	75	42	3
ENV C708	Geo-informatics and Resource Mapping	75	42	3
Total	8 (Eight) courses	600	336	24

Four Optional Courses (200 marks 112hs. and 8 credits)				
Number	Title	Total Marks	Hours of Lecture	Credit
ENV O751	Environmental Chemistry	50	28	2
ENV O752	Environmental microbiology and Ecotoxicology	50	28	2
ENV O753	Biodiversity	50	28	2
ENV O754	Waste Management	50	28	2
ENV O755	Water Resources: Planning and Management	50	28	2
ENV O756	Climate Change and Global Warming	50	28	2
ENV O757	Energy and Environment	50	28	2
ENV O758	Environmental Health and Sanitation	50	28	2
ENV O759	Wetland and Land degradation Management	50	28	2
ENV O760	Environmental Policy and Modeling Design	50	28	2
ENV O761	Environmental Planning, Population and Sustainable Development	50	28	2
ENV O762	Environmental Law, Regulation and Human Rights	50	28	2
ENV O763	Society and Environment	50	28	2
ENV O764	Environmental Psychology	50	28	2

POSTGRADUATE COURSE DESCRIPTIONS

COMPULSORY COURSES

ENV C701 Introduction to Environmental Science

Definition, history of development of environmental science, field and their scope, significance, components of environment and their interactions; the general environment: radiation, heat, light, gravity, pressure, sound, physicochemical and phases, the atmospheric gases, dissolved salts as limiting factors, ecological relations of soil, abiotic and biotic factors in relation to individual; different kind of environment, evolution of environment, ecological principle and their application, human influences on ecosystem, environmental ethics, religion and environment, interrelated nature of environmental problems, human impacts on natural environment, major environmental problems and issues.

ENV C702 Ecology and Environment

Ecology: autecology of species, population ecology, community ecology and ecosystem ecology; climatic, physiographic, edaphic and biotic factors. Productivity, food chain, food webs, trophic levels and ecological pyramids. Principles and concepts pertaining to biogeochemical cycles

Habitat, ecological niche, ecological equivalents, sympatry and allopatry, natural selection, artificial selection. Fresh water, marine, estuarine, coastal, terrestrial and desert ecology.

Limiting and regulating factors: Concept, Liebig's Law, ecotypes, conditions, biological magnifications of toxic substances, anthropogenic stress.

Environmental monitoring: bio-monitoring, bio-indicator, stress, response, risk, sensitive indicators, cumulative indicators and eco-toxicology.

ENV C703 Environmental Pollution and Control

Water Pollution: classification of water pollutants, sources and consequences of water pollution and wastewater treatment techniques.

Air pollution: sources and types of air pollutants, air quality standard, criteria and air pollution control. Noise sources. Noise pollution and abatement measures.

Major soil contaminants and solid wastes – domestic waste, domestic solid waste, disposal of municipal and industrial waste; sludge treatment and disposal facilities; recovery of resources.

Hazardous waste- Identification and characteristics of hazardous waste; processing and treatment of hazardous waste. Radiation sources in the environment. Biological effects of radiation, dose limits. Technical controls for radioactive sources and radiation apparatus.

Basic concept of chemical analysis: mole concept, analytical methods & techniques.

ENV C704 Environmental Impact Assessment (EIA) and Environmental Management.

Nexus between development and environment. Origin and development of EIA in USA and Bangladesh. Role of USEPA in developing the EIA in developing countries. Relation of EIA to sustainable development. EIA costing. EIA in project planning and implementation.

Screening, Initial Environmental Examination (IEE) and detailed EIA. Categorization of projects and major criteria for project site location. EIA methodology: baseline information collection, scoping, impact assessment methods (checklist and matrix), mitigative measures, environmental management plan (EMP) and environmental monitoring. Application procedure for environmental clearance.

Role of GIS in EIA baseline study. Risk assessment and risk management. Mitigation measures: Green bills. Review of EIA procedures in some developing countries: India, Srilanka, Thailand, Malaysia and Philippines.

ENV 705: Geo-Environment

Geology and Environment, Importance of Geology in environmental science; Solar system; History of Earth and Geological Time scale.

Major Earth components:

Atmosphere: Structure and composition of atmosphere; Significance of physical environment as a life support system; Incoming and outgoing radiation; Green house effect and Global warming.

Lithosphere: Internal structure of the earth, composition of crust, mantle and core; Rock; Soil, soil classification, soil profile and soil composition.

Hydrosphere: World wide distribution of water, Surface water and ground Water, Vertical distribution of groundwater, Hydrologic cycle, composition of ground Water, Principal chemical constituents in groundwater-Their sources, concentration and effect on usability; Aquifer and aquifer types; Sea water, composition of sea water, Sources of sea salt and salinity; Sea water intrusion and its Environmental Impact in coastal area of Bangladesh.

Biosphere: Definition; Extent of biosphere etc.

Geo- environment of Bangladesh: Area, population, physiography , hydrology, climate and vegetation; Geological characteristics of Bangladesh; Introduction to the Geo-environment of Indian subcontinent – physiographic division , mountains, glaciers and River basins-Ganges, Brahmaputra, Meghna and Indus.

Biogenic deposits: Origin of petroleum; Natural gas, crude oil and coal,-their composition and classification ; Petroleum formation and reserve in Bangladesh; Impact of mining development on environment.

Natural hazards: Floods, Soil erosion, Earthquakes, Volcanoes, cyclone and tornadoes, tidal surge, Tsunamis, Landslides – hazard characterization, extent of damage, prediction, control and management.

ENV C706 Research Methodology

Introduction to research; major components of research; field surveys; preparation of questionnaire; acquisition of data; sorting and handling primary and secondary data; statistical analysis of data; population; sampling methods; probability distribution: binomial, Poisson's and normal distributions; statistical estimation; hypotheses; type I and type II errors; significance level; analysis of variance and covariance; parametric and non-parametric tests: z, t and F tests; chi-square, correlation test etc. regression analysis; multivariate analysis; ANOVA, ARMA analysis etc.

Basic skills: *basic computing, finding information, safety, ethics and other fundamental matters*; project development: *provides training and guidance in planning and managing research work*; personal skills: *skills in negotiations, team working, assertiveness and other transferable skills*; proposal writing and research thesis writing; scientific article writing; journalistic essay writing etc.

Data processing: Mathematical modeling software and programm based studies on the environmental problems. Microsoft Excel, Graphical representation, Data Entry, Spreadsheet Analysis.

OPTIONAL COURSES (Any Four)

ENV O751 Environmental Chemistry

Chemistry of transition metals- definition, properties and their compounds. Chemistry of non-metals, definition, properties, and their compounds. Concept and scope of environmental chemistry; chemistry of atmosphere, hydrosphere, biosphere and lithosphere; pollutants, contaminants and toxic substances in the environment and their fates; techniques to detect pollution in the environment; identification of sources of pollution;

Analytical techniques, Lambert Law, Beer Law, Optical method of analysis. Atomic absorption spectrophotometer. Electrical method, potentiometer. High Performance Liquid Chromatography (HPLC), Gas Chromatography (GC) Ion Chromatography (IC), etc.; statistical treatment of analytical measurement data; accuracy, reproducibility, significant value, inter-lab measurements, intra-lab measurements etc.

ENV O752 Environmental Microbiology and Ecotoxicology

Microbiology

Introduction – definition, scope, classification of environmental microbes, the rhizosphere. R:S ratios, mycorrhizae, root nodules, microbial plant, animal and human diseases with reference to sanitation: microbes and man – nature at functions of beneficial and pathogenic microbes: Environment and microbes – distribution pattern, types, composition, succession, productivity etc of microbial population in air, water and soil.

Biogeochemical role of microorganisms – biogeochemical transformation of nitrogen, carbon, sulfur, and other nutrients, biodegradation of pollutants: Microbes in food – microorganisms in food, spoilage of food, microbial examination of food, control of microbes: Microbes in domestic and waste water – indicator organisms, coliform bacteria, bacteriological techniques in waste water treatment process.

Microbial decomposition of chemically complex materials; use of bacteria and fungi to detoxify wastes, and conversion into usable substances. Prevention of biodeterioration of valuable materials, biodegradation of minerals, metals, cellulose, aromatics, hydrocarbons, and wastewater treatment.

Ecotoxicology

Classification and sources of toxic substances. Pathways of toxic substances into ecosystem – principles and methods of studying toxins in an ecosystem. Effect of toxic substances – pesticides and therapeutic agents. Mutagenesis – distribution, biochemistry and abuse: Bioaccumulation, biomagnification and biomonitoring of toxic substances. Toxicological case studies in developed and under developed countries.

Biochemical degradation of pollutants inside the cell: Cellular interaction with the pollutants: Pollutant interaction with biological system at different levels e.g., organisms, organs and tissues, cells. Active vs inactive processes: Enzymatic degradation by monooxygenase: Role of cytochrome P450 and its multiple form: Metal toxicity; chemical form, metal biomacromolecule interaction, teratogenicity and carcinogenicity: Cellular/Tissue injury; altered membrane permeability, free radical formation, lipid peroxidation, lysosomal degradation, superoxide dismutase.

ENV O753 Biodiversity

Biodiversity: Concept, definition and different levels of biodiversity. biological, economical and social need for biodiversity, Species diversity and ecosystem stability. Biodiversity with respect to niche structure and tropic level. Assessment of biodiversity status and determination of IUCN threat categories. Sources of genetic variation and biodiversity functions. Economical and social importance of biodiversity.

Economical and social importance of biodiversity. Extinct, endangered, rare and vulnerable species. Biodiversity conservation methods: in-situ and ex-situ, gene bank, biotechnology, national park, zoo and herbarium. Eco-tourism and its benefit.

Different approaches of biodiversity conservation and management, registering biodiversity. Valuing biodiversity resources and their contribution to agriculture, community health and environment. Causes of biodiversity loss. Techniques of species reintroduction and restoration of the degraded habitat.

Biodiversity policy and legislation. Biodiversity and intellectual property right: Wildlife conservation and management: Status of biodiversity conservation in Bangladesh: Agenda 21 (Convention on biodiversity).

ENV O754 Waste Management

Solid waste - Sources and types of solid waste; physical and chemical properties of solid waste – domestic waste, domestic solid waste, disposal of municipal and industrial waste – different methods; sludge treatment and disposal facilities; recovery of resources.

Hazardous waste- Identification and characteristics of hazardous waste; processing and treatment of hazardous waste – physical processes, chemical processes, thermal processes biological processes; natural systems for hazardous waste treatment – waste stabilization pond, aquatic weeds and constructed wetland system; hazardous waste disposal, biological detoxification and application of biotechnology, institutional and legal framework.

ENV O755 Water Resources: Planning and Management

Environmental problems associated with groundwater in aquifer systems of importance to Bangladesh. Environments will include natural saline groundwater, deep sedimentary basins, groundwater-surface water interaction, fractured rock, alluvial plain, and unconsolidated sediments.

Principles of water quality control. Monitoring and sampling methods. Groundwater contamination evaluation. Site management and investigation. Risk assessment and risk management. Aquifer protection and rehabilitation. Remediation. Case studies.

Basic concepts in the water resource planning and management: Precipitation, evaporation, transpiration, infiltration: Water resource development, and conservation in dry periods and in arid regions. Wetlands and water resources: soil-water relationship: Human impacts on water resources: Irrigation and flood control system. Participation of beneficiaries, formation of user's group. Case studies of Farakka Barrage, the Flood Action Plan and the National Water Management Plan of Bangladesh.

ENV O756 Climate Change and Global Warming

Overview of climate system. Climate variation during the postglacial period and to assess prospects for future decades and, second, of current understanding of key climate issues such as the working of the climate system, impacts on humanity, the natural causes of climate change and anthropogenic effects on climate.

Basic Science - Covers the fundamental science underlying the problem of global climate change induced by greenhouse and gas emissions, including greenhouse gas sources, gas cycles, modeling effects on global temperature, sea level and regional climate, detection of the global warming signal and climate impacts.

Policy Responses - Adaptation and emission control, the two possible societal responses to the threat of global climate change, and it involves the study of the practical application of policy-orientated models dealing with, for example, the imposition of emission targets, energy taxes and land management options as well as study of the Framework Convention on Climate Change.

ENV O757 Energy and Environment

Introduction – history and scope; importance: Energy use; world energy use, reserves. Energy demand and energy supply – approaches to energy balance, production and consumption of energy, transformation of primary energy to secondary energy, final energy: Energy scenario in Bangladesh.

Measurement of energy conservation – industrial, commercial, residential and transport sector; Thermal power plants energy conservation measures and pollution control hydroelectric power plants, potential impact on biodiversity and habitat loss: Nuclear power plant – disposal of radioactive waste.

Renewable energy technologies: Solar energy, introduction to semiconductor p-n junction diodes, photoelectric effect, solar cell modules, application of solar cells, solar cells in rural electrification and other areas. Geothermal, wave, tidal and ocean energy importance of renewable energy in Bangladesh.

Biomass: introduction, biomass conservation, generation, biogas digester and design, operational problems and kinetic consideration of biogas digesters, introduction to pyrolysis and gasification. Wind energy; basic theory, types of turbines and their application. Clean Development Mechanism (CDM).

ENV O758 Environmental Health and Sanitation

Environment and diseases. Transmission of disease. Classification of transmission mechanisms (water-borne, water-washed, water based and insect vector). Classification of infections (excreta-related: faecal-oral by bacteria and non-bacteria, soil transmitted helminthes, beef and pork tapeworms, water-based helminthes, excreta related insect vectors). Vectors, parasites and their control. Principles of toxicology. Epidemiological studies. Development of health criteria. Application to home, work and community environment. Comprehensive planning. Health administration.

Environmental factors and quality of human health. Types of toxic substances affecting human health. Adverse effects of air pollution, water pollution and land degradation. Village, urban, industrial and institutional sanitation.

Introduction to hygienic sanitation system. Water pollutants removal and purification techniques, water supply and different types sanitary toilets and waste management. Environmentally sound settlement planning.

ENV O759 Wetland and Land Degradation Management

Different types wetlands of Bangladesh and its area. Social, economical and biological importance of wetlands. Causes for loss of wetlands. Conservation activities of wetlands through govt-NGO and local people's participation.

Physiographic and limnological characters of all types of wetlands. River, canal, ditch and lake water, nutrient cycles, eutrophication and its control, plankton and benthos of limnologic significance, distribution and role of aquatic plants in inland water. Wetland pollution and remedies in Bangladesh perspective.

Major causes of land degradation in Bangladesh and in the world. Increased salinity and desertification problems.

Inter-relationships of scientific, technical, cultural and social issues facing agriculture. Maintenance of soil fertility and techniques to control soil erosion. Principles of land use and environmental considerations. Agriculture and land use policy analysis. Case studies of the green revolution in developing nations together with their merits and demerits.

ENV O760 Geographic Information System (GIS) and Remote Sensing

Introduction - elements and principles. Data acquisition, storage, manipulation and interpretation. Importance of GIS in planning, management, monitoring and evaluation. Applications of GIS in resource management, monitoring, forecasting changes, service planning, transport network management, public protection and security services, mineral resource exploration and evaluation, watershed management, conservation and river basin planning. Hardware requirements. Use and application of GIS software: ArcInfo, ArcView, ERDAS, IDRISI and ILWIS.

Introduction - systems, techniques and commercial services. Primary data acquisition. Photogrammetry and remote sensing – advances in airborne and spaceborne sensor systems, digital photogrammetry, image understanding and computer-vision leading to integrated acquisition techniques. Concepts, systems and methods of image transformation and information extraction from primary data. Quality and performance of both topographic and thematic data processing. Interpretation and analysis of images. Optimization of geoinformatics processes – planning and management of integrated geoinformation production systems.

ENV O761 Environmental Planning, Population and Sustainable Development

Significance of environmental planning and design in sustainable development. Planning processes and methodologies – content and function, the plan as a process, social and historical considerations, elements of planning and team work. Concept of planning in the developed and developing countries. Protection and restoration of natural system. Design plan – implementation process, comprehensive plan, zoning plan, industrial performance, history preservation, flexible zoning, specific plan.

Concepts of sustainable development, dynamic relationship of population, environment and sustainable development; methods of integrating population variables into development planning and institutional framework for formulating population and development planning.

Ecological and other perspectives on the interrelationship of population and environment; consequences of environment degradation; carrying capacity; utilization of resources; population-resource ratio; population and land utilization; population growth and increasing pressure on food and other resources; factors affecting supply and demand of natural resources, and environmental impact of development programs.

ENV O762 Environmental Law, Regulation and Policy

Basic concepts of policy, regulation and law; how a law is made, judicial systems; different types of law; history and relevance of environmental law; legal aspects of environmental resource management; origin of environmental law in Bangladesh and other countries: major environmental laws, policies and regulations such as Environment Conservation Act (ECA, 1995), Environment Conservation Rules (ECR, 1997), Green Court (2000), Forest Act (2000), Wildlife Preservation Act, Fish Act etc. and some case studies;

Roles of law enforcing authorities; contradictions in existing laws/policies of Bangladesh; strengths and weakness of different laws; ethics of resource management: *obligation to future generation*; the Lane Ethics: *responsibilities of developed and developing nations*;

Environmental dispute and resolution over common resource sharing: *river water sharing (Ganga, Nile, Indus, etc)*, *trans-boundary air pollution, biological diversity & intellectual etc.*; international environmental conventions, protocols and treaties and their implementation in Bangladesh; international organizations involved in environmental law, protocols, conventions and treaties (UNEP, UNDP, Green Peace, CBD, WWF, CITES, IUCN, etc

Bangladesh Environment Policy, 1992. The Environmental Action Plan 1992. National agriculture policy, 1999. Outline of the environmental issues of the agriculture sector. Bangladesh Fifth Year Plan (FFYP) in order to promote, nature, protect and expand nature and natural resources.

ENV O763 Society and Environment

Concept, nature and functions of society; social structure and social processes; social Institutions; approach to study social phenomena: Positivism and Humanism Different schools of thoughts and perspectives used in analysis and understanding social phenomena in social science; culture and social life; community life in rural and urban settings; influence of geographical heredity, Social and techniques factors and development on social life; interactions in human life: the Ecological Systems theory: The micro system, the more systems, the Exo system and the Macrosystem; the ecosystems model: Environmental –structural –culture – Family-etc.; intervention strategies with the people : Intervention with individuals, groups and communities- practicing social work for motivating and ensuing peoples participation in environmental issues and programs.

Revisiting the concepts of Communication, Media, Environment and Awareness. Functions of communication, and communication media. Importance of communication media in meeting environmental problems. Media theories and its critiques. Environmental psychology and the role of mass media in raising human awareness about environment. Researches on the role of communication media in raising people's awareness and relevant learning.

Environmental politics and International media. The role of the print, electronic, and folk media in Bangladesh to overcome environmental enigma and evaluation of the concerned media policies and related studies. Investigating the body of environment related indigenous knowledge in Bangladesh and the harms caused by mass media particularly in the sector of agriculture. Planning for communication campaign and advocacy for creating mass awareness for environment.

Fundamentals of interrelation between environment policy-management issues and politico-administrative settings, socio-politico dynamics in the developing nations with special reference to Bangladesh. Environmental issues in the perception and papers of different stakeholders of the governance. Peoples participation in governance of environmental issues-experience of northern and southern countries. Go-NGO partnership in environmental management. Gender environment and governance.

ENV O764 Environmental Psychology

The Environment: Current Events influencing environment, Methods used in environment psychology, environmental perception, cognition, attitudes.

Effects of Environmental stressors: Environmental stress, temperature, humidity, sunshine, wind, Ion concentration, chemical pollution, noise, pollution density, urbanization, crowding, territoriality, privacy, personal space.

Application of Environmental Psychology: Institutional design, residential design, environmental disaster, and technological catastrophe.

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