# University of Rajshahi

IES
University of Rajshahi

Institute of
Environmental
Science

## Syllabus for Postgraduate Program (2016-2017)


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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 two years) 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 Compulsory 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:

# INSTITUTE OF ENVIRONMENTAL SCIENCE
**RAJSHAHI UNIVERSITY**

## Courses for M.Phil/Ph.D. Study
**(32 Cr. hr.)**
**Period: 12 months**

**Compulsory eight courses (24 Cr. hr.)**

| Course No. | Title of Courses | Cr. hr. | Marks |
|---|---|---|---|
| ENV C701 | Introduction to Environmental Science | 3 | 75 |
| ENV C702 | Ecology and Environment | 3 | 75 |
| ENV C703 | Environmental Chemistry | 3 | 75 |
| ENV C704 | Geo-environment | 3 | 75 |
| ENV C705 | Environmental Pollution and Waste Management | 3 | 75 |
| ENV C706 | Disaster and Environmental Management | 3 | 75 |
| ENV C707 | Environmental Impact Assessment (EIA) | 3 | 75 |
| ENV C708 | Research Methodology | 3 | 75 |
| **Optional four courses (8 Cr. hr.)** | | | |
| ENV O751 | Biodiversity and Conservation | 2 | 50 |
| ENV O752 | Society and Environment | 2 | 50 |
| ENV O753 | Climate Change and Human Adaptability | 2 | 50 |
| ENV O754 | Water Resources: Planning and Management | 2 | 50 |
| ENV O755 | Eco-toxicology and Environmental Microbiology | 2 | 50 |
| ENV O756 | Environmental Laws and Ethics | 2 | 50 |
| ENV O757 | Environmental Health and Sanitation | 2 | 50 |
| ENV O758 | GIS and Remote Sensing | 2 | 50 |
| ENV O759 | Wetland and Land degradation Management | 2 | 50 |
| ENV O760 | Geophysical Modeling | 2 | 50 |
| ENV O761 | Environmental Planning and Sustainable Development | 2 | 50 |
| ENV O762 | Environmental Psychology | 2 | 50 |
| ENV O763 | Energy and Environment | 2 | 50 |
| ENV O764 | Agriculture and Environment | 2 | 50 |
| ENV O765 | Environmental Economics | 2 | 50 |
| ENV O766 | Environment and Governance | 2 | 50 |
| ENV O767 | Environment, Mass Media and Awareness | 2 | 50 |
| ENV O768 | Environmental Accounting and Auditing | 2 | 50 |
| ENV O769 | Coastal Ecology | 2 | 50 |
| ENV O770 | Environmental Biochemistry and Toxicology | 2 | 50 |
| ENV O771 | Silviculture and Sustainable Forest Management | 2 | 50 |
| | **Grand Total:** | **32 Cr. hr.** | **800** |

# Syllabus for Courses of M.Phil./Ph.D. Study, Session: 2016-2017
# Institute of Environmental Science
**Rajshahi University**

## Compulsory Courses

Credit hour: 3 (Total Marks 75: Examination – 50, Assignment –15, Attendance - 10)

**ENV C701: Introduction to Environmental Science**

Definition, history and development of environmental science. Biotic and abiotic factors and their interactions to environment. Human influences on ecosystem. Scope and significance of environmental science study.

Environmental problems and issues: groundwater arsenic contamination, stratospheric ozone layer depletion, El-nino, La-nina, tsunami, acid rain, green house effect, global warming and climate change. Surface water pollution, air pollution in major cities, brick-fields, industrial waste, deforestation and desertification in the Barind region, hill cutting and shifting cultivation, salinity intrusion in southern Bangladesh, top-dying symptom of Sundarban, agro-chemical pollution, wetland and fisheries resources depletion, Bhopal gas leak, Chernobyl disaster, etc.

Renewable and non-renewable energy, environmental health and toxicology. Concepts of sustainable development. Environmental laws and ethics, environmental awareness and global environmental politics. Concepts of EPA, UNEP, CITES, WWF, IUCN, Green Peace, etc.

**Recommended Books**


Environmental Science – Earth as a Living Planet by Botkin, D. B. and Keller, E. A. 2000. Third Edition. John & Wiley Sons, Inc. New York.

Environmental Science – A Global Concern by Cunningham, W.P., Cunningham, M.A. and Saigo, B.W. 2003. Seventh Edition. The McGrew-Hill Companies, Inc. New York, USA.

Environmental Science by Arms, K. 1990. London Sundars College Pub.

A Text book of Environmental Science by Trivedi, R.N. 1997. Anmol Pub.

Fundamentals of Environmental Science by Dhaliwal, G.S. 2000. Kalyani Pub.,

Environmental Science – A Framework for Decision Making by Chiras, D. D. 1985. The Benjamin/Cummings Publishing Company, Inc.

Human Environments and Natural Systems by Greenwood, N. J. and Edwards, J. M. B. 1979. Duxbury Press (Wadsworth Publishing Company, Inc.).

Plants, People & Environment by Kaufman, P. B. and LaCroix, J. D.1979. Macmillan Publishing Company, Inc.

Living in the Environment – An Introduction to Environmental Science by Miller, Jr., G. T. 2001. Eighth Edition. Wadsworth Publishing Company.

Bangladesh Environment-Facing the 21st Century by Gain, P. 2002. SEHD, Bangladesh.


**ENV C702 Ecology and Environment**

History and Scope of Ecology, Environment and Environmental Factors such as Climatic, Physiographic, Edaphic and Biotic Factors. Autecology, Synecology, Population Ecology, Community Ecology.

Ecosystem Ecology: Concept of Ecosystem, Development and Evolution(Ecological Succession) of Ecosystem and Homeostasis of the Ecosystem.

Ecological Energetics: The Energy Environment and Concepts of Productivity, Food Chains, Food webs, Trophic Levels and Ecological Pyramids. Principles and Concepts pertaining to Biogeochemical cycles.

Limiting and Regulating Factors: Concepts of Limiting Factors, Liebig's "Law" of Minimum, Shelford's "Law" of Tolerance, Ecotypes, Anthropogenic stress. Natural Selection and Artificial Selection. Ecological Niche, Ecological Equivalents, Sympatry and Allopatry.

Concepts of Habitat Ecology: Fresh water Ecology, Marine Ecology, Estuarine and Coastal Ecology, and Terrestrial ecology.

Environmental Monitoring: Bio-monitoring, Bio-indicator, Stress, Response, Risk, sensitive Indicators, Cumulative indicators and Eco-toxicology and Biological Magnifications of toxic substances.

Radiation Ecology: Concepts of Ecologically Important Radionuclides and Environment.

Human Ecology: Historical Review, the Population Ecology of Man and Components for Applied Human Ecolgy.

**Recommended Books:**

Principles of Animal Ecology by Allee, W.C., Orlando, P., Alfred, E. E., Thomas, P. and Karl, P.S. 1949. W.B. Saunders Company, Philadelphia and London

Silent Spring by Carson, R. 1962 (Reprinted,2002).Mariner Books, New York

The Global Ecology Handbook by Carson, W.H. 2000. Becon Press, Boston

Ecology Principles and Application by Chapman,J. L. and Reiss,T.I. 1999. Cambrigdge University Press Excellence in Ecology by Kinne,O. 2003. International Ecology Institute, Germany

Concepts of Ecology by Kormondy, E.J. 1976. Prentice and Hall, London

Ecology by Krebs, C. J. 1994. Herpercollins College Publication, New York

Advances in Ecology and Environmental Science by Mishra, P.C., Bhera, N. and Guru, B.C. 1995. A.P.H. Publication Corporation, New Delhi

Fundamentals of Ecology by Odum,E.P.1971. W.B. Saunders Company, Philadelphia and London

Fundamentals of Ecology by Eugene Odum, Gary W. Barrett

**ENV C703 Environmental Chemistry**

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; Chemistry of transition metals-definition, properties and their compounds; Chemistry of non-metals, definition, properties, and their compounds.

Analytical techniques: Optical method of analysis, Lambert Law, Beer Law, 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.

**Recommended Books:**

A Text book of Environemtal Chemistry by O.D. Tyagi, M.M. Mehra and M., Mehta, 1996 Anmol Publications Pvt Ltd, New Delhi, India.

Environmetal Chemistry by Kudesia, V.P. 2003, Pragati Prakashan, New Delhi, India.

Environemtal Chemistry by John Wright, 2003, Routledge, London, UK.

Environemtal Chemistry by S.K. Benerji, 1999. PHI Learning Pvt. Ltd., India.

Chemistry for Environemtal Engineering and Science by Clair N. Sawyer; Perry L. McCarty; Gene F. Parkin, 2002. McGraw-Hill Science Engineering, New York, USA.

A text book of Quantitative Inorganic Analysis by A.I. Vogel, 1966. 3rd edition, Longmans Green and Co Ltd., UK.

Environmental water and soil analysis by P.R. Trivedi, 2007. Akashdeep Publishing House, India.

**ENV C704 Geo-environment**

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

Major Earth components:

Atmosphere: Birth and history of the atmosphere; structure and significance of the atmosphere; atmospheric compositions and their sources; principal uses of the atmosphere; solar radiation; Green house effect and Global warming.

Lithosphere: Description of the lithosphere, Continental drift and Plate tectonic theory, structure of the earth interior; composition of crust, mantle and core; Rock- classification, composition, Rock cycle; Soil-soil formation, classification, soil profile, composition and management.

Hydrosphere: Water classification and its distribution; hydrologic cycle; Surface water ; Ground Water-Vertical distribution, Groundwater compositions and their sources, concentration and effect on usability; Aquifer and its types; Sea water- composition of sea water, sources of sea salt, salinity, sea water intrusion and its environmental impact in coastal area of Bangladesh.

Biosphere: Definition; Extent of the Biosphere etc.

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

Geo-environment of Bangladesh: Geological characteristics of Bangladesh, Tectonic frame work of Bangladesh, Hydrogeology, climate and vegetation, Indian subcontinent-physiographic division, mountains, glaciers and River basins- Ganges, Brahmaputra, Meghna and Indus.

**Recommended Books:**


Planet Earth by Cesare Emiliani 1992. Cambridge University press, UK.

Earth in crisis by Burrus, T. L. and Spiegel, H. J. 1980. The C.V. Mosby Company, USA.

Environmental Science, 2nd edition by Byrne, K. 1997. Thomas Nelson and Sons Ltd., UK.

Earth science by Pasachoff, J. M., Pasachoff, N. and Cooney, T. M. 1983. Scott and Foresman and Company, USA.

Focus on environmental geology, 2nd edition by Ronald Tank, 1976. Oxford University Press, London.

Geology in Environmental Planning by Howard, A.D. and Remson, I. 1978. McGraw-Hill Book Company, New York, USA.

Introduction to Geochemistry by Krauskopf, K. B. and Bird, D.K. 1995. McGraw-Hill Inc,, New York, USA.

Principles of Geomorphology, 2nd edition by Thornbury, W. D. 1969. John Wiley and Sons, Inc., USA.

Physical Geology, 4th edition by Robert J. Foster, 1983. Charles E. Merrill Publishing Company.

Physical Geology by Edgar W. Spencer, 1983. Addision-Wesley Publishing Company, Inc., Canada.

Essentials of Earth History by W. Lee Stokes, 1982. 4th edition, Prentice-Hall, Inc, Engle wood Cliff, New Jersey 07632.

Historical Geology, 3rd edition by Dunbar, C. O., Waage, K. M. 1969. John Wiley and Sons, Inc., USA.

Basic Concept of Historical Geology by Edgar Winston Spencer, 1962. Oxford and IBH Publishing Co. India.

Geology of India and Burma by Krishnan, M. S. 1982. CBS pub. and Distributors, Delhi, India.

Geology of Bangladesh by Khan, F.H. 1991. Wiley Eastern Limited, New Delhi, India.

Hydrogeology by Davis, S.N. and Dewiest R.J.M. 1966. John Wiley and Sons Inc., USA.

Groundwater development and Management by PBS Sarma, 2008. applied publishers Private Limited, India.

Groundwater Hydrology by Herman bouwer, 1978. MC Graw-Hill Inc.

Applied Hydrogeology, 2nd edition by Fetter, C. W. 1988. Merrill Publishing Company, USA.

An Introduction to the World's Oceans by Duxbury, A. C. and Duxbury, A. 1984. Addison-Wesly Publishing company, Inc., Canada.

Applied Principles of Hydrology by Manning, J.C. 1987. Merrill Publishing Company, USA.

Groundwater Hydrology by Todd, D.K. 1989. John Wiley and Sons Inc., USA.

Contaminant Hydrogeology by Fetter, C.W. 1993. Macmillan Publishing Company, New York, USA.

Geology of Petroleum by Levorsen, A. I. 1970. Vaskils, Feffer and Simons Private Ltd.

Petroleum Formation and Occurrence by Tissot, B.P. and Welte, D.H. 1984. Springer-Verlag,berlin Heidelberg, New York.

Energy Resources of Bangladesh by Badrul Imam, 2005. University Grants Commission of Bangladesh, Dhaka.

**ENV C705 Environmental Pollution and Waste Management**

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

Air Pollution : Definition, sources and types of air pollutants, effects and control of air pollution.

Noise Pollution: Definition, sources, effects and control of noise pollution.

Radiation Pollution: Definition, radiation sources in the environment, biological effects of radiation, dose limits, control for radioactive sources and radiation apparatus.

Soil Pollution: Definition, causes of soil pollution, effects and control of soil pollution.

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 frame work. Basic concept of chemical analysis: Mole concept, analytical methods & techniques.

**Recommended Books**

Environmental Science-Earth as a living planet. Third Edition by Botkin, D.B. and Keller, E.A. 2000. John & Wiley sons. Inc. New York.

A Text Book of Environmental Science by Trivedi, R.N. 1997. Anmol pub.

A Text Book of Environmental Science by Sattar, M.A. 1996.

Fundamentals of Environmental Science by Dhaliwal, G.S.2000. Kalyani Pub.

Environmental Science by Jackson, A.K.W. and Jackson, J.M. 1996. Longman.

Water Pollution by Kudesia, V.P. Meeraut, Pragati, Prokashon.

Water Pollution by Tripathi, A.K. 1990. Ashish pub. New Delhi.

Air Pollution by Rao, M.N. 1989. Tata McGraw Hill pub., Co., LTD.

Environmental Soil Chemistry by Sparks, D.L. 1995. Academic Press.

Soils and the Environment by Wild, L. 1996. Cambridge Univ. Press.

Hazardous Waste Management by Wentz, C.A. 1989. McGraw-Hill Book Co.

**ENV C706 Disaster and Environmental Management**

Disasters, Environmental Emergency Vulnerability, Hazards, Risks, Natural disasters and man-made disasters

Land movement disasters- landslides, slope stability, causes of landslides, human use and landslides, river erosion, Avalanches, Lahars and volcanic eruptions

Earthquake, intensity and frequency of earthquakes, earthquake hazard reduction, prediction and control.

Floods-types, magnitude and frequency of floods, nature and extends of flood hazards, urbanization and flooding; Limnic eruptions and Tsunamis etc.

Blizzards, Storms, Hailstorms, Cyclones, Tornadoes, Drought, Heat waves

Fire disasters; Health and Diseases- Epidemic and Famine

Disaster Management: Risk assessment, Extreme event analysis, Risk perception, Adjustment to hazards and loss sharing, Hazard resistance, Preparedness, Forecasting, and Warning; Environmental hazards and disasters management system in Bangladesh.

**Recommended Books:**

Tolley's Handbook of Disaster and Emergency Management, Edited by Tony Moore and Raj

Lakha, 2006. Taylor & Francis; 3 edition , UK.

Principles of Emergency Planning and Management by David Alexander, 2002. Oxford University Press, USA.

Disaster and Emergency Management Systems by Tony Moore, 2008. BSI Standards, UK.

Natural Disasters by Patrick L. Abbott, 2008. McGraw-Hill Science Engineering, New York, USA.

Natural Disasters by Alexander David , 1993, Routledge, London, UK.

Learning from Disasters: A Management Approach by Toft, B. and S. Reynolds, 1994. Butterworth Heinemann, Oxford, UK.

At Risk: Natural Hazards, People's Vulnerability and Disasters by Blaikie, Piers, Terry Cannon, Ian Davis and Ben Wisner, 2004. Routledge, London, UK.

Disaster Plan and recovery – A guide for facility process by Levitt, Alan M., 1997. John Wiley and Sons, Inc., USA.

Disaster Risk anagement Systems Analysis by Stephan Baas, Selvaraju Ramasamy, Jenny Dey de Pryck, Federica Battista, 2008. Food & Agriculture Org. Rome Italy.

**ENV C707 Environmental Impact Assessment (EIA)**

Introductory background: 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.

Introduction of EIA, Environment and Sustainable Development, What is the objective of an EIA? Impact Identification, Prediction and Evaluation, Environmental Issues related to Infrastructural Development, Screening, Initial Environmental Examination (IEE) and detailed EIA. Structure and format of an IEE report ? Categorization of projects and major criteria for project site location. EIA methodology: baseline information collection, scooping, impact assessment methods (checklist and matrix), mitigation measures, environmental management plan (EMP) and environmental monitoring. Application procedure for environmental clearance. Case Study.

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

**Recommended Books:**

EIA and Risk Assessment by Andrews, R.N.L. 1988. In: P. Wathern (ed.) EIA: Theory and Practice, Routledge, London.

Environmental Impact Assessment for Developing Countries by Biswas, A.K. and Gepiring Qu (eds.) 1987. Tylooly International, London.

Environmental Management and Training, Book-2 by Boland, R.G.A. (eds.). 1986. Project Management and Environment, ILO, Geneva.

Environmental Impact Assessment by Canter, L.L.W. 1977. McGraw Hill, New York.

Environmental Impact Assessment by ESCAP, 1985. Guide line for Planners and Decision-Makers, Bangkok, Thailand.

Environmental Impact Assessment by ESCAP, 1988. Management Tool for Development Project, Bangkok, Thailand.

Introduction to Environmental Impact Assessment by Glasson J., Therivel, R. and Chadwick, A. 1998. UCL press

Hand Books of Environmental Impact Assessment in Developing Countries by Lohani, B.N., Evans, J.W., Ludwig, H.F. and Rees, C. 1987.

Environmental Technology for Developing Countries by Ludwing, H.F., Lohani, B.N., Brockelman, W.Y. and Evans, E.W. 1988. SEATEC International Inc.

Environmental Management of Developing Countries by Tharun, G., Thanh, N.G. and Bidwell, R. Vol. 1, 2, & 3. Asian Institute of Technology, Bangkok, Thailand.

Environmental Impact Assessment by Wathern, P. 1996. McGraw-Hill Co.

**ENV C708 Research Methodology**

Introduction to research; major components of research; social responsibility of a researcher, facilitation, hypothesis, how to write a research proposal, how to write a quality thesis, how to write a review of literature, how to write an introduction, how to write your methodology chapter, how to write result and discussion, how to write your reference chapter, how to do research, the form a PhD thesis, the PhD thesis process, 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; analysis of variance (ANOVA) and covariance; parametric and non-parametric tests: z, and chi-square, correlation test (t), regression analysis; multivariate 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.

**Recommended Books:**

How to get a PhD: A hand book for students and their supervisors by Estelle, M.P. and Derek, S.P. 2005. 4th Edition, Mc Hill Education, England.

Successful Research Careers by Delamont, S. and Atkinson P. (2004) Maidenhead: Open University Press.

Supervising the Doctorate by Delamont, S., Atkinson, P. and Parry, O. (2004). 2nd edn. Maidenhead: SRHE and Open University Press.

Supervision and examination of higher degree students by Francis, J. R. D. (1976), Bulletin of the University of London, 31: 3–6.

Supervising Postgraduates from Non-English Speaking Backgrounds by Zuber-Skeritt (eds). Buckingham: Open University Press.

Intercultural issues and doctoral studies by Gundara, J. (1997), in N. Graves and V. Varma (eds) Working for a Doctorate. London: Routledge.

Science Foundation in China by Hartley J. (2004). On writing scientific articles in English, 11 (2): 53–6.

How to Write a Thesis by Murray, R. (2002). Buckingham, Open University Press.

How to Survive your Viva by Murray, R. (2003). Maidenhead: Open University Press.

The PhD as a learning process by Phillips, E. M. (1983). Unpublished PhD thesis, University of London.

Starting Research: Supervision and Training by Phillips, E. M. (1992) The PhD: assessing quality at different stages of its development, in O. Zuber-Skerritt (ed.). Brisbane, Queensland: Tertiary Education Institute, University of Queensland.

The concept of quality in the PhD by Phillips, E.M. (1993). in D.J. Cullen (ed.) Quality in PhD Education. Canberra: Centre for Educational Development and Academic Methods (CEDAM).

Avoiding communication breakdown by Phillips, E.M. (1994a), in O. Zuber-Skerritt and Y. Ryan (eds) Quality in Postgraduate Education. London: Kogan Page.

Quality in the PhD: points at which quality may be assessed by Phillips, E. M. (1994b), in R. Burgess (ed.) Postgraduate Education and Training in the Social Sciences: Processes and Products. London: Jessica Kingsley Publishers.

The quality of a good thesis by Phillips, E.M. (1996). in O. Zuber-Skerritt (ed.) Frameworks for Postgraduate Education. Lismore: Southern Cross University Press.

The Doctoral Examination Process by Tinkler, P. and Jackson, C. (2004). Maidenhead: SRHE and Open University Press.

Notes on the supervision of PhDs by Wason, P. C. (1974), Bulletin of the British Psychological Society, 27: 25–9.

The selection of research students by Whitehand, J. W. R. (1966), Universities Quarterly, 21(1): 44–8.

# Optional Courses

Credit hour: 2 (Total Marks 50: Examination – 35, Assignment – 10, Attendance - 5)

**ENV O751 Biodiversity and Conservation**

**Biodiversity:** Concept, definition and different levels of biodiversity species diversity, population diversity, community diversity, microbial diversity and ecosystem stability.

Biodiversity with respect to niche structure and tropic level. Biological, economical and social importance of biodiversity. Valuing biodiversity resources and their contribution to agriculture, community health and environment. Ecotourism and its benefit.

Assessment and Measurements of biodiversity status, Sampling Methods, Biodiversity Indices and determination of IUCN threat categories – extinct, endangered, rare and vulnerable species, registering biodiversity.

Causes of biodiversity depletion. Different approach of biodiversity conservation and management: In-situ and ex-situ, Gene Bank, Biotechnology, National Park, Zoo and Herbarium. Techniques of species reintroduction and restoration of the degraded habitat. Status and Importance of Biodiversity of Sundarbans in the perspectives of Ecosystem Services and Economy of Bangladesh.

Biodiversity policy and legislation. Biodiversity and intellectual property right. Wildlife and biodiversity conservation and management status in Bangladesh. Agenda 21 (Convention on biodiversity), Convention on International Trade in Endangered Species(CIES), Dunkel's Report Relating to Intellectual Property Rights.

**Recommended Books:**


Biodiversity and Environment by Agarwal, S.K. and Dubey, P.S. 1996 published byA.P.H. Publication Corporate, New Delhi

Environmental Biodiversity and Conservation by Khan, M.A. 2000 published by A.P.H. Publication Corporate, New Delhi

Global Biodiversity Conservation Measures by Khan, T.I. 1999,Pointer Publications, India

Global Biodiversityby by Trivedi, P.R. 2000 published, Authors Press, Delhi.

Cultural and spiritual values of Biodiversity by Addison, P. D. 1999, Intermediate Technology Publication, London

Encyclopaedia of Biodiversity, **Vol-**1, 2, 3 by Prabhakar, V.K. 1999, Anmol Publication, New Delhi

Bangladesh State of Biodiversity by Chowdhury, Q. I. 2001, Published by Forum of Environment journalists of Bangladesh


**ENV O752 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.

**Recommended Books:**

Society: An Introductory Analysis by MacIver

Sociology by Joseph H. Fichter

Sociology by T.B. Bottomore

Population Dynamics by Anderson, R.M., Turnerand, R.D. and Taylor, L.R. 1994. Blackwell Pub.

Environmental Sociology by Hannigan, J.A. 1995. Routledge, London.

Sociology (5th Edition) by Horton, P.B. and Hant C.L. Mc-Graw Hill.

Habitats and the Environment by Fresland, P. 1997. Hodder and Stoughton. London.

**ENV O753 Climate Change and Human Adaptability**

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.

**Recommended Books:**

Climate Change: Picturing the Science by Gavin Schmidt, Joshua Wolfe, Jeffrey D. Sachs, W. W. Norton & Company, 2009.

Climate Change: The Science of Global Warming and Our Energy Future

by Edmond A. Mathez, Columbia University Press, USA, 2009.

An Introduction to Global Environmental Issues by Pickering, K.T. and Owen, L.A. 1997. Routledges.

Energy and Environment-Modeling and Simulation by Bala, B.K. 1997. NOVA Sci. Pub.

Environmental Science by Chiras, D. Daniel. 1985. A framework for Decision making. The Benjamin/Cummings Publishing Company, Inc California.

Environmental Science, 2nd Edition by Byrne, K.

**ENV O754 Water Resources: Planning and Management**

Principles of water quality control, monitoring and sampling methods, Groundwater aquifer system in the Bengal Delta in Bangladesh, groundwater contamination, groundwater-surface water interaction, aquifer protection and rehabilitation.

Basic concepts in water resource planning and management: Precipitation, evaporation, transpiration, infiltration; Water resource development, and conservation in dry periods and in arid regions, Rainwater harvesting, Wetlands and water resources; Soil-water relationship, Human impacts on water resources: Irrigation and flood control system: Case studies of Farakka Barrage, Flood Action Plan and National Water Management Plan of Bangladesh.

**Recommended books:**

Water Resources by Asit K. Biswas, 1998. Tata McMraw-Hill, New Delhi, India.

Water Technology by N.F. Gray, 2011.. Taylor Francis Ltd, London, UK.

Water resources Systems Planning by M.C. Chaturvedi, 1997. Tata McGraw-Hill Publishing Company, New Delhi, India.

The Rainwater Technology Handbook by Klausw Konig, 2001. Wilo-Brain, USA.

Environmental Impacts Assessment of water Resources Projects by Editor- Radhey Shyam Goel, 2000. Oxford & IBH Pub. Co., New Delhi, India.

**ENV O755 Eco-toxicology and Environmental Microbiology**

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 counties.

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 monoxygenesis: Role of cytochrome P450 and its multiple form: Metal toxicity; chemical form, metal biomacromolecule interaction, teratogenecity and carcinogenecity: Cellular/Tissue injury; altered membrane permeability, free radical formation, lipid peroxidation, lysosomal degradation, superoxide dismutase.

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, cellulosics, aromatics, hydrocarbons, and wastewater treatment.

**Recommended Books:**

Environmental Science-A Global Concern by Cunningham, W.P., Cunningham, M.A. and Saigo, B.W. 2003. Seventh Edition. The McGrew-Hill Companies, Inc. New York, USA

Environmental Biology and Toxicology by Sharma, P.D. 2000. MacMillan, India.

Principles of Biochemistry by Lehninger, A.L. Nelson, D.L. and Cox, M.M. 1993. CBS Pub. and Distributors

Fundamentals of Environmental Chemistry by Manaham, E. Stanley. 1993. LEWIS Publishers. New York.

Environmental Biology by Mukherjee, B. 1996. Tata McGraw-Hill Publishing Company Limited.

Biological Indicators of Pollution by Richardson, DHS 1987. Royal Iris Academy.

Environmental Toxicology by Rose, J. 1998. Gordon and Beach.

Agriculture Pollution by Mishra, S.J. and Mani, D. 1994. Ashis Pub., New Delhi.

Water Pollution by Kudesia, V.P. Meeraut, Pragati Prokashon.

**ENV O756 Environmental Laws and Ethics**

Environmental laws and ethics, environmental awareness and global environmental politics. 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 Ac (2000), Wildlife Preservation Act, Fish Ac etc.

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.

**Recommended Books:**

Introduction to Environmental Laws of Bangladesh by Sattar, S.A.

Handbook of Environmental Law by UNEP 1997. UNEP, Kenya

Environment Law and Policy by Warren, L.M. and Gibson, J. 1999. Blackwell Science

Environmental Ethics by Elliot, R. 1995. OUP.

**ENV O757 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.

**Recommended Books:**

Environmental Science-A Global Concern by Cunningham, W.P., Cunningham, M.A. and Saigo, B.W. 2003. Seventh Edition. The McGrew-Hill Companies, Inc. New York, USA

Biological Indicators of Pollution by Richardson, DHS 1987. Royal Iris Academy.

Agriculture Pollution by Mishra, S.J. and Mani, D. 1994. Ashis Pub., New Delhi.

Environmental Management in Practice by Nath, B., Hens, L., Compton, P. and Devuyst. D. 1999. Volume – 2, Routledge Butler and Tanner Limited London.

Hazardous Waste Management by Wentz, C.A. 1989. McGraw-Hill Book Co.,

Environmental Water Pollution and Control by Chhatwall G.R. 1993. Anmol. Pub., New Delhi.

**ENV O758 GIS and Remote Sensing**

- Geography and GIS – basic concepts its origin GIS, CAC and CAD – map as model – paradigm shift in cartography
- Spatial location and reference – spatial patterns – geographic data collection and sources
- Concept of dbms – data tables
- GIS data structures – data base structure for managing data – GIS data models – vector versus raster
- Introduction to Cartalinx and Arcview
- Data input. storage and editing input devices digitization different types of errors
- Introduction to GPS and its integration into GIS
- The concept of remote sensing – its use in mapping and geographic analysis – history and development of remote sensing
- Energy used in feature photography/imaging – its properties – radiation principles – energy interaction in the atmosphere – energy interaction with earth surface features
- Elements of photographic system conventional camera – film – aerial film camera panoramic camera stereoscopic viewing digital camera system
- Preparing maps from aerial photographs rule of thumbs of photo/image interpretation feature grouping – classification image interpretation equipment

- Earth observing satellites – different types – satellite orbits – sensing coverage – data sources
- Satellite sensor systems – MSS – thermal – hyperspectral
- Digital image processing – data restoration – rectification
- Image enhancement and image contrast manipulation – multi image manipulation
- Image classification – unsupervised – supervised – hybrid
- Application of remote sensing different fields – land use – forestry – agriculture – environment – coastal ecosystem urban etc.

**Recommended Books:**

Remote Sensing and Gis by Bhatta, B. Google books.

Basics of Remote Sensing and Gis by Kumar, S. Google books.

Quantitative Techniques in Geography: An Introduction by Robert Hammond, Patrick S. McCullagh, Oxford University Press; 2nd edition, 1978.

Principal of Geomorphology by Thornbury W.D. 1969. New Age Intern's Ltd., India.

Environmental Management in Practice by Nath, B., Hens, L., Compton, P. and Devuyst. D. 1999. Volume – 2, Routledge Butler and Tanner Limited London.

Energy and Environment-Modeling and Simulation by Bala, B.K. 1997. NOVA Sci. Pub

**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, eutrophicaion 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.

**Recommended Books:**

Wetlands by William J. Mitsch and James G. Gosselink, John Wiley & Sons, 2007.

Freshwater Wetlands in Bangladesh : Issues and Approaches for Management Edited by Ainun Nishat, Zakir Hussain, Monoj K. Roy and Ansarul Karim, IUCN-The World Conservation Union, 1993.

Applied Principles of Hydrology by Manning, J.C. 1987. Merrill Publishing Company, USA.

Geology of Bangladesh by Khan, F.H. 1991. Wiley Eastern Limited, New Delhi, India.

Hydrogeology by Davis, S.N. and Dewiest R.J.M. 1966. John Wiley and Sons Inc., USA.

Environmental Science-Earth as a living planet. Third Edition by Botkin, D.B. and Keller, E.A. 2000. John & Wiley sons. Inc. New York.

Environmental Water Pollution and Control by Chhatwall G.R. 1993. Anmol. Pub., New Delhi.

Environmental Management of Developing Countries by Tharun, G., Thanh, N.G. and Bidwell, R. Vol. 1, 2, & 3. Asian Institute of Technology, Bangkok, Thailand.

A Text Book of Environmental Science by Sattar, M.A. 1996.

Water Pollution by Kudesia, V.P. Meeraut, Pragati, Prokashon.

**ENV O760 Geophysical Modeling**

Introduction – the need for environmental modeling: Modeling elements and model classification, physical model, mathematical model, and management model. Model structure and computation: parameter estimation and test for building confidence in the mode: Mathematical modeling – software and program based studies on environmental problems: Computer modeling.

Ecological modeling – biogeochemical cycle models, nutrient cycle models, ecosystem models, modeling on fate of pesticide: Modeling on energy and environment – fundamentals of LEAP, developing the baseline energy demand scenario, biomass supply analysis, environmental analysis: Modeling air pollution: Ground and surface water modeling.

Numerical methods to the solution of ordinary and partial differential equations, particularly those including kinetic, diffusive and advective processes; programming in Fortran/C/C++ , tests of models, use analytical data etc.

**Recommended Books:**

Quantitative Techniques in Geography: An Introduction by Robert Hammond, Patrick S. McCullagh, Oxford University Press; 2nd edition, 1978.

Remote Sensing and Gis by Bhatta, B. Google books.

Basics of Remote Sensing and Gis by Kumar, S. Google books.

Principal of Geomorphology by Thornbury W.D. 1969. New Age Intern's Ltd., India.

Environmental Management in Practice by Nath, B., Hens, L., Compton, P. and Devuyst. D. 1999. Volume – 2, Routledge Butler and Tanner Limited London.

Energy and Environment-Modeling and Simulation by Bala, B.K. 1997. NOVA Sci. Pub

**ENV O761 Environmental Planning 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.

**Recommended Books:**

Earth in crisis by Burrus, T. L. and Spiegel, H. J. 1980. The C.V. Mosby Company, USA.

Environmental Science, 2nd edition by Byrne, K. 1997. Thomas Nelson and Sons Ltd., UK.

Geology in Environmental Planning by Howard, A.D. and Remson, I. 1978. McGraw-Hill Book Company, New York, USA.

Geology of Bangladesh by Khan, F.H. 1991. Wiley Eastern Limited, New Delhi, India.

**ENV O762 Environmental Psychology**

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

Effects of Environmental stresors: 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.

**Recommended Books:**

Advances in Environmental Psychology by Blum, A., Singer, J.E. and Valins, S. Poublished by the N.Y. Erlbaum. 1978.

Population Psychology, Basic Book by Fawcett, James T., New York.

Environmental Psychology by Bell, Paul A., Greene, Thomas C, Fisher, Jeffery D. Lawrence Erlbaum Assoc Inc, 2005.

Environmental Psychology: Behaviour and Experience In Context by Tony Cassidy, Published by the Taylor & Francis, 2013.

The Psychology of Environmental Problems by Winter, D. D. N., & Koger, S. M. Published by the Mahwah, NJ: Lawrence Erlbaum Associates, 3rd ed. 2010.

**ENV O763 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).

**Recommended Books:**

Energy Resources of Bangladesh by Badrul Imam, 2005. University Grants Commission of Bangladesh, Dhaka.

Energy and Environment-Modeling and Simulation by Bala, B.K. 1997. NOVA Sci. Pub

Geology of Petroleum by Levorsen, A. I. 1970. Vaskils, Feffer and Simons Private Ltd.

Petroleum Formation and Occurrence by Tissot, B.P. and Welte, D.H. 1984. Springer-Verlag,berlin Heidelberg, New York.

Environmental Science-A Global Concern by Cunningham, W.P., Cunningham, M.A. and Saigo, B.W. 2003. Seventh Edition. The McGrew-Hill Companies, Inc. New York, USA

**ENV E764 Agriculture and Environment**

Historical perspective of agriculture environment factors and adaptation of agricultural plants: Basic principles of agricultural crop production: Background of agro-chemicals: Concept of sustainable agriculture: Agriculture in Bangladesh.

Relationship between environment and agriculture: concept of ecosystem ecological destruction due to use of agro-chemicals like pesticides, fertilizers, herbicides etc., reduction of soil fertility with the cultivation high-yielding varieties (HYVs) and farm mechanization: Environment friendly agriculture choice of technology, identification of indigenous technology (IT), cropping system to maintain the soil nutrient, use of organic manures, agroforestry and social forestry practices.

Environmental issues and agricultural extension: Awareness for environment by use of mass media, motivation for environment sound agricultural practices, transfer and adoption of agricultural technology with environmental considerations.

Maintenance of soil fertility and techniques to control soil erosion. Principles of land use and environmental considerations.

**Recommended Books:**

Climate, Water and Agriculture in Tropics by Jackson, I.J., Longman, London. 1982.

Responses of Plants to Environmental Stresses by Levit, J., Academic Press, New York. 1980.

Insect Pest Management by Dent, D., CAB International, UK.

Research in Pesticides by Chishester, C.O. Academic Press, New York.

Introduction to Integrated Pest Management by Flint, M.L. and Van deu-Boseh. R., Plenum Publ. Crop. New York. 1981.

Introductory Soil Science by Das, D.K., Kalyani Publishers, India.

Environmental Science-A Global Concern by Cunningham, W.P., Cunningham, M.A. and Saigo, B.W. 2003. Seventh Edition. The McGrew-Hill Companies, Inc. New York, USA

Agriculture Pollution by Mishra, S.J. and Mani, D. 1994. Ashis Pub., New Delhi.

**ENV O765 Environmental Economics**

Economic theory and analysis in resource management (land, water, forest, wildlife and recreational resources).

An Overview of Depletable and Renewable Resource Use. Depletable Energy Resources: Oil, Gas, Coal and Uranium. recyclable Resources: Minerals, Paper, Glass. Renewable Energy Resources: Solar, Wind, and Water. Petroleum and OPEC. Water as a depletable resource. Agriculture as a private property resource. The forests as a storable resource. The Fisheries as a common-property resource. Generalized Resource Scarcity.

Economic aspects of watershed management, fish and wildlife management, and outdoor recreation. Major topics include theories of valuation and application to nonmarket goods, cost analysis for nonmarket goods, and techniques for valuing nonmarket goods and services.

Theory of Economic Valuation of Environmental Goods and Services. Revealed Preference Techniques. Contingent Valuation Methods and Discrete Choice Methods. The Hedonic Price Approach and Meta-analysis. The Travel Cost Methods and Recreation Demand Models. Techniques of Market Price and Cost Measures of Value. Cost-benefit Analysis of Environmental Policy and Management, and Multi-criteria Methods for Quantitative, Qualitative and Fuzzy Evaluation Problems. Benefit Transfer and Policy Implication.

**Recommended Books:**

Environmental Economics: An Introduction by Field, B.C., 2nd Edition, McGraw-Hill. 2000.

The Economics of Natural Resource Use by Hartwick, J.M. and Olewiler, N.D., 2nd Edition, Addition-Wesley. 1988.

Environmental Economics in Theory and Practice by Hanley, N., Shogren, J.F. and White, B., Mcmillan. 1997.

Economics of Natural Resources and the Environment by Pearce, D. and Turner, K., Harvester Wheatsheaf, London. 1990.

Environmental Economics: Theory and Applications by Singh, K. and Shishodia, A. Sage Publications, New Delhi. 2007.

**ENV O766 Environment and Governance**

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. Environmental politics-actors, interests and policy formulation. Institutions, organizations and strategic actions for environment policy-management. Resource allocation for environmental management-review of different Five-year plans. Peoples participation in governance of environmental issues-experience of northern and southern countries. Go-NGO partnership in environmental management. Gender environment and governance. Tools and techniques of monitoring evaluation of environmental projects Environmental challenges and governmental responses.

**Recommended Books:**

Foreign Policy in World Politics by Roy C. Macridis

Political Economy of Development and Under Development by Charkes K. Wilbar

Bangladesh: Problems of Governance by Rehman Sobhan

The Impact of Science and Society by Bertrand Russel

Human Right; Principles and Practice by Hoque A.N.S.

Political Science and Government by Garner

Challenges of Governance in Bangladesh by Ataur Rahman

**ENV O767 Environment, Mass Media and Awareness**

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.

**Recommended Books:**

Mass Communication by Charles R. Wright

Many Voices, One World by Williams R.

People, Society and Mass Communication by Dexter L.W.W. and White, D.M.

Communications Issues in Bangladesh by Rahman M.G.

Perspectives in Communication Policy and Planning by Syed A. Rahim

Communication Planning Model, Methods and Organization by Syed A. Rahim

**ENV O768 Environmental Accounting and Auditing**

Origin, significance and importance of environmental accounting. Is this type accounting possible in Bangladesh? Role of environmental accounting in improved environmental management.

Nature of environmental auditing – definition, characteristics, types. Environmental audit methodology – I: audit preparation, objectives and scope, audit team and familiarization, pre-audit planning. Environmental audit methodology – II: on-site audit activities, inspection techniques, document review, interviews and meeting: Environmental audit methodology – III: post-audit activities, audit report, corrective action, program and follow-up activities.

Environmental auditing for government and non-governmental organizations; types of environmental administration, natural resource management, energy consumption, water consumption, firms, various environmental research organization. Audit case study – site visit, report writing and presentation.

**Recommended Books:**

Environmental Accounting: Emergy and Environmental Decision Making by Howard T. Odum, Published by the Wiley (1st edition), 1995.

Environmental Auditing by Jim Newton, Pudvan Publishing Co., Northbrook, IL., 1989

Environmental Management by Chary S.N. and Vyasulu V. , Published by the Macmillan, 2000.

Environmental Accounting: Concepts and Practices by Arup Choudhuri. Published by the ICFAI

Environmental Accounting: A Conceptual Introduction by Stefan Schaltegger, Kaspar Muller, Henrietta Hindrischen

**ENV O769 Coastal Ecology**

An introduction to coastal ecosystem. Chemical, physical and biological characteristics of estuaries and coastal wetlands. Structure, dynamics and bioproductivity of coastal ecosystems. Plankton and benthos of limnologic significance. Relations among coastal processes, estuarine ecology and human activities. Case studies of management of Bangladesh's estuarine habitats and coastal ecosystems with special emphasis on the Sunderbans.

Oceanography: introduction, a brief history of the study of the sea, physiography of the ocean basins, ocean sediments, oceanic circulation, waves and tides, productivity of oceans, oceanography of Bay of Bengal, marine pollution – Bangladesh perspective.

**Recommended Books:**

An Introduction to the World's Oceans by Duxbury, A. C. and Duxbury, A. 1984. Addison-Wesly Publishing company, Inc., Canada.

Applied Principles of Hydrology by Manning, J.C. 1987. Merrill Publishing Company, USA.

Environmental Science-Earth as a living planet. Third Edition by Botkin, D.B. and Keller, E.A. 2000. John & Wiley sons. Inc. New York.

A Text Book of Environmental Science by Sattar, M.A. 1996.

Fundamentals of Environmental Science by Dhaliwal, G.S.2000. Kalyani Pub.

Environmental Science by Jackson, A.K.W. and Jackson, J.M. 1996. Longman.

Water Pollution by Kudesia, V.P. Meeraut, Pragati, Prokashon.

Water Pollution by Tripathi, A.K. 1990. Ashish pub. New Delhi.

**ENV O770 Environmental Biochemistry and Toxicology**

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 – emphasis on physiological effects.

Toxic substances, pesticides and therapeutic agents. Mutagenesis – physically and chemically induced. Mutagens – distribution, biochemistry and abuse: Bioaccumulation, biomagnification and biomonitoring of toxic substances. Toxicological case studies in developed and under developed counties.

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 monoxygenesis: Role of cytochrome P450 and its multiple form: Metal toxicity; chemical form, metal biomacromolecule interaction, teratogenecity and carcinogenecity: Cellular/Tissue injury; altered membrane permeability, free radical formation, lipid peroxidation, lysosomal degradation, superoxide dismutase.

**Recommended Books:**

Principles of Biochemistry by Lehninger, A.L. Nelson, D.L. and Cox, M.M. 1993. CBS Pub. and Distributors

Fundamentals of Environmental Chemistry by Manaham, E. Stanley. 1993. LEWIS Publishers. New York.

Environmental Science-A Global Concern by Cunningham, W.P., Cunningham, M.A. and Saigo, B.W. 2003. Seventh Edition. The McGrew-Hill Companies, Inc. New York, USA

Environmental Biology and Toxicology by Sharma, P.D. 2000. MacMillan, India.

Environmental Biology by Mukherjee, B. 1996. Tata McGraw-Hill Publishing Company Limited.

Biological Indicators of Pollution by Richardson, DHS 1987. Royal Iris Academy.

Environmental Toxicology by Rose, J. 1998. Gordon and Beach.

**ENV 0771 Silviculture and Sustainable Forest Management**

Introductory background of the forest ecology and ecosystem. Survey of forest trees and stand ecology. Silviculture concepts and implications for treatment of forest stands for various values. Field evaluation of forest

stands, site and history variables, and treatment alternatives. Common silvicultural methods under different management scenarios, and techniques for analyzing forest stands and developing prescriptions for their treatment. Use of indigenous knowledge and community participation for sustainable management of forest resources and maintenance of forest ecosystem.

**Recommended Books:**


Forest Wildlife Ecology and Habitat by David R. Patton, Published by Taylor & Francis Group, 2010.

Economics, Sustainability, and Natural Resources : Economics of Sustainable Forest Management by Kant, Shashi, Berry, R. Albert, Published by the Springer, 2010.

Advances in Ecology and Environmental Science by Mishra, P.C., Bhera, N. and Guru, B.C. 1995. A.P.H. Publication Corporation, New Delhi

Principles of Animal Ecology by Allee, W.C., Orlando, P., Alfred, E. E., Thomas, P. and Karl, P.S. 1949. W.B. Saunders Company, Philadelphia and London

Fundamentals of Ecology by Odum,E.P.1971. W.B. Saunders Company, Philadelphia and London

Ecology Principles and Application by Chapman,J. L. and Reiss,T.I. 1999. Cambrigdge University Press Excellence in Ecology by Kinne,O. 2003. International Ecology Institute, Germany

Advances in Ecology and Environmental Science by Mishra, P.C., Bhera, N. and Guru, B.C. 1995. A.P.H. Publication Corporation, New Delhi

Environmental Science-A Global Concern by Cunningham, W.P., Cunningham, M.A. and Saigo, B.W. 2003. Seventh Edition. The McGrew-Hill Companies, Inc. New York, USA