

**INSTITUTE OF FORESTRY AND
ENVIRONMENTAL SCIENCES
UNIVERSITY OF CHITTAGONG**

**SYLLABUS FOR
M. PHIL IN
ENVIRONMENTAL SCIENCE**

SESSION 2015-2016 To 2016-2017

COURSES FOR M. Phil IN ENVIRONMENTAL SCIENCE
SESSION 2015-2016 To 2016-2017

Selective Courses:

Course No	Course Title	TH	CR
ENV 801	Adaptation and Mitigation Approaches to Climate Change	100	4
ENV 802	GIS in Natural Resources Management	100	4
ENV 803	Research Methods in Environmental Sciences	100	4
ENV 804	Environmental Land Use Planning and Management	100	4
ENV 805	Common Property Resource Management	100	4
ENV 806	Climate Change and Forests: Theories and Response	100	4
ENV 807	Environmental Governance	100	4
ENV 808	Application of Remote Sensing in Environmental Science	100	4
ENV 809	Advanced Environmental Impact Assessment	100	4
ENV 810	Wastewater Management	100	4
ENV 811	Land Use	100	4
ENV 812	Co-management of Natural Resource Management	100	4
ENV 813	Green Banking	100	4
ENV 814	Ecotourism Management	100	4
ENV 815	Natural Resource Monitoring and Assessment	100	4
ENV 816	Viva-voce	100	4

ENV 802 GIS IN NATURAL RESOURCES MANAGEMENT

Theory: 100 (4 cr); **Total:** 100 (4 cr)

- 1. Natural Resource Management:** Natural Resources in Bangladesh-renewable and nonrenewable, spatial module in resources management; Philosophy of GIS;
- 2. Database and Database Management System:** Technical issues pertaining to digital representation of geographic data; Database and Database Management System; Raster geographic data representation; Vector data representation; Object-Oriented geographic data representation;
- 3. Referencing and Projection:** Coordinate systems and transformations; Geographic coordinate system; Map projection; Geo-referencing;
- 4. Data Quality and Data Standards:** Concepts of Data Quality; Assessment of Data Quality; Managing Spatial Data Errors.
- 5. Visualization of Geographic Information:** Cartography in the context of GIS; Visualization of geographic information; Digital terrain modeling; Acquisition of digital terrain data; Data processing, analysis and visualization; Application of digital terrain models.
- 6. Spatial Analysis and Modeling:** Acquisition of spatial data for the terrain: topographic mapping; attribute data for thematic mapping; Descriptive Statistics; Spatial autocorrelation; Quadrante counts and Nearest-Neighbor analysis; Trend Surface Analysis; GIS modeling

Recommended bibliography

- Al-Amin, M. 2012. Visualizing environment and forest considering climate change using GIS. USDA-IFESCU publication. University of Chittagong, Bangladesh. 107pp.
- Al-Amin, M. 2011. *Application of spatial data in forest ecology and management*. Book. LAP Lambert Academic Publications. Germany. 242 pp.
- Avery, T.F. and Berlin, G.L.. 1985. Interpretation of aerial photographs. 4th Edn. Burgess publishing co. Minneapolis, Minnesota.
- Buhmann, S. 1996. Geographic Information System. Bruenig, E.F. and Bossel, H. (eds.). Natural Resource Systems Analysis.
- Burrough, P. A. and McDonnel, R. A. 1998. Principles of Geographic Information Systems. Oxford University Press. 333 p.
- Chrisman, N. 1997. Exploring geographic information systems. John Wiley & Sons. 298p.
- Clarke, K. C., Parks, B. O. and Crane, M. P. 2002. Geographic Information Systems and Environmental Modeling. Prentice-Hall of India. 306 p.
- Colwell, R.N.; Esters, I.C. and Thorley, G.A. (eds.). 1983. Manual of Remote Sensing Vol. 2. Interpretation and Application. Amer. Soc. of Photogrametry, Virginia.
- De Mers, M.N. 1999. Fundamentals of geographic information systems. Second edition. New York. 498p.
- EGIS. 2000. Geo-spatial tools for analysis of floodplain resources. UPL. 100 p.
- ESRI. 2007. ArcGIS 9 using ArcGIS Desktop.380 New York Street, Redlands, USA. 435pp.
- IDRISI. 2005. IDRISI softwares. IDRISI resource center, Clark University, Worcester, MA, USA.
- Korte, P and George, B. The GIS Book. Onward press. 387 p.

- Lillesand, T.M. and Kiefer, R.W. 1987. Remote sensing and Image Interpretation. Second Edition. John Wiley and Sons. New York, USA.
- Lo, C. P. and Yeung A. K. W. 2002. Concepts and techniques of Geographic Information Systems. Prentice-Hall of India. 495 p.
- Moffit, F.H. and Muhlail, G.W. 1980. Photogrammetry. 3rd Edn. Harper and Row Publishers N. York.
- Paine, D.P. 1981. Aerial Photogrammetry and Image Interpretation for Resource Management. John Wiley & Sons. New York, USA.
- Sharma, M.K. 1986. Remote Sensing & Forest Surveys. International Book Distributors. Dehra Dun, India.
- Simonett, D.S. and Ulaby, F.T. (eds). 1983. Manual of Remote Sensing. Volume One. Second edition. American Society of Photogrammetry. USA.
- Walford, N. 1995. Geographical data analysis. John Wiley & Sons. 446p.

ENV 803 RESEARCH METHODS IN ENVIRONMENTAL SCIENCES
Theory: 100 (4 cr); Total: 100 (4 cr)

- 1. Development of Research Proposal:** Literature review; Contemporary research issues in Environmental Sciences; Developing research proposal or project about research issues based on Environmental Sciences.
- 2. Choice of Research Method:** Types of research methods; Choice of research methods to address multiplicity of research problems in Environmental Sciences; Strengths, limitations and validity of major research methods in Environmental Sciences.
- 3. Data, Data Sources and Statistical Modeling:** Types of data; Sources of data; Precautions and restrictions in handling of different types of data relating to Environmental Sciences; Processing and pre-analysis cleaning of data; Final analysis of data; Model specifications and selection of the best fitted model.
- 4. Interpretation of Results:** Interpretation of model fitting attributes and parameter estimates highlighting on data sources, data types, data collection methods and limitations of the model used; Uniqueness and limitations of the research work; Real world implication of the research outcomes with respect of contribution of the research work to existing body of knowledge, linking research outputs to problem solving, policy formulation and administration.
- 5. Writing the Research Manuscript:** Art and distinctiveness of scientific writings; Rules of writing dissertation/thesis; and of a peer reviewed research article.

Recommended bibliography:

- Ford, E.D. 2000. Scientific Method for Ecological Research. Cambridge University Press, Cambridge, U.K.(ONLINE) URL; <http://assets.cambridge.org/052166/005X/sample/o52166005xwse00.pdf>
.Procted areas, biodiversity and conservation.[online]URL
<http://WWW.UNEP.FR/shared/publications/other/3084/BP8-2.PDF>
.Alam,k,Shamsuddoha,M,Tanner,T.sultana, M.huq M.J abd Kabir,S.S. 2011.The Political Economy of climate Resilient Development Planning in Bangladesh
UNEP, 2011, Towards a green Economy; Pathways to sustainable Development and Poverty Eradication, www.unep.org/greeneconomy
UNFCCC, 2011.The official website of United Nations Framework Convention on Climate Change(UNFCCC), <http://unfccc.int/2860.php>,last seen on 6 July 2011
OECD, 2004.The benefits of climate change policies. Organization For Economic Co-operation and Development, Paris, France, 323p
World Bank 2008, Biodiversity, Climate Change and Adaptation. Nature-Based Solutions from the World Bank Portfolio. The World Bank, Washington, DC 20433 USA,112p

ENV 804 ENVIRONMENTAL LAND USE PLANNING AND MANAGEMENT
Theory: 100 (4 cr); Total: 100 (4 cr)

Course contents:

1. **Environmental Land Use Management:** Managing Human – environment interactions; Environmental planning.
2. **Land Use Planning For Environmental Management:** Land use and development; Land use and environmental protection; Framework for land use planning; Emerging approaches for environmental land use planning.
3. **Land Conservation for Working Landscapes, Open Space and Ecological Protection:** Dimensions and tools for land conservation.
4. **Soils, Topography and Land Use:** Land use properties of soils and soil quality; Land evaluation and site assessment; Soil erosion and assessment.
5. **Land Use, Stream Flow and Runoff Pollution:** Effects of land use on stream flow and water quality.
6. **Land Use and Ground Water:** Fundamentals of groundwater hydrology; Land use, Ground water recharge and contamination; Assessing groundwater resources; Groundwater source protection.
7. **Land Rights, Valuation and Conflict Management:** Land rights and land tenure, process of land valuation, land use conflicts, land reforms and some experiences.
8. **Landscape Ecology, Urban Forestry and Wetlands.**
9. **Land Use, Wildlife Habitats and Biodiversity:** Fundamentals of wildlife habitats and biodiversity.

Recommended Bibliography:

- Brammer, H. 2002. Land Use and Land Use Planning in Bangladesh. The University Press Limited, Dhaka.
- Davidson, D.A. 1982. Soil and Land Use Planning. Longman, London.
- Davies, K.P. 1976. Land Use. McGraw-Hill Inc. USA.
- FAO. 1993. Guidelines for Land-use Planning. Food and Agriculture Organization of the United Nations, Rome (<http://www.fao.org/docrep/T0715E/t0715e0c.htm>).
- OECD, 1976. Land use policies and agriculture. Organization for Economic Co-operation and Development, Paris.
- Randolph, J. 2004. Environmental Land Use Planning and Management. Island Press, Washington DC, USA.
- Stevens, P.R. 1987. A simplified field manual for site classification and site suitability assessment in Bangladesh forests. FAO/UNDP Project BGD/81/011- Assistance to the second Agricultural research Project.

ENV 805 COMMON PROPERTY RESOURCE MANAGEMENT

Theory: 100 (4 cr); **Total:** 100 (4 cr)

Course contents:

1. **Introduction to Common Property Resources:** Concepts, definition and types of common property resources; Common pool resources; Access, Rights-to-use and management of natural resources; Evolution of resource management systems; Common property resource management systems in Bangladesh.
2. **Theories of Collective Action, Cooperation and Common Property:** The problem of collective action; Repeated games and multiple equilibrium; Cross scale linkages among institutions; Experimental collective action, role of communication and enforcement; Prescriptions and remedies.
3. **Power, Influence and the Distribution of Benefits:** Critiques of decentralization and devolution; Equity and efficiency; Distribution of benefits under different governance structures; Endogenous bargaining power; Comparison of common property management regimes with agricultural and industrial cooperatives; Incorporating technical uncertainty and local knowledge into adaptive ecosystem management.
4. **The Tragedy of Commons:** Theories, debates and examples.
5. **Economics of Common Property Resource Management:** Economic behavior of common property resources and the sustainability.
6. **Case Studies:** Case studies related to common property resource management systems.

Recommended Bibliography:

- Berkes, F. 1989(ed.). *Common Property Resources: Ecology and Community-based Sustainable Development*. International Book Distributors, Dehra Dun, India.
- Bray, Merino and Barry, 2006. *The Community Forests of Mexico: Managing for Sustainable Landscapes*. University of Texas Press: Austin.
- Camille Antinori and Rausser, Gordon, 2007"Collective Choice and Community Forestry Management in Mexico: An Empirical Analysis", *Journal of Development Studies*, 43:3, pp. 512-536.
- David Mosse, "Collective Action, Common Property, and Social Capital in South India: An Anthropological Commentary," EDCC 2006.
- Garrett Hardin, "The Tragedy of the Commons" (*Science*, 1968).
- Gordon Rausser and Pinhas Zusman, *Political Power and Endogenous Policy Formation*, Cambridge University Press: New York, Forthcoming.
- Ostrom, Elinor. 1990. *Governing the Commons: The Evolution of Institutions for Collective Action*. New York: Cambridge University Press.
- Peter Taylor (2000). "Producing More with Less? Community Forestry in Durango, Mexico in an Era of Trade Liberalization", *Rural Sociology* 65:2, pp 253-274.

ENV 806 CLIMATE CHANGE AND FORESTS: THEORIES, INITIATIVES AND RESPONSES

Theory: 100 (4 cr);

Total: 100 (4 cr)

Course contents:

1. **Earth's Climate System:** The Atmosphere; the Climate; the Science and the Politics of Global Climate Change; Global Warming; Greenhouse Effect; Greenhouse Gases
2. **Earth's Carbon Cycle.**
3. **Historical Perspectives of Climate Change:** Theories and debates on climate change; Is the Climate changing?
4. **Global Initiatives, Negotiations, Policies, Treaties and Protocols Related to Climate Change.**
5. **Climate Vulnerability:** Global Climate Risk Index 2011.
6. **Projection of Climate Variables:** Temperature, rainfall and sea level.
7. **Evidence of Climate Change on Different Physical and Biological Processes Around the Globe and in Bangladesh.**
8. **Future Effects of Climate Change.**
9. **Climate Change Impact on Different Systems, Sectors or Region:** Ecosystems; Coastal systems; Water systems; Agriculture; Arctic region; etc.
10. **Climate Change and Forests:** Threats and opportunities; Effects on biodiversity, growth, composition and structure of forests; Mitigation and adaptation role of forests on climate change; Forests in REDD/REDD++ and CDM.
11. **Bangladesh's Response in Climate Change Mitigation and Adaptation:** Government, non-government and community level initiatives.
12. **Organizations or Institutions Working on Climate Change** in Bangladesh or Global

Recommended Bibliography:

- ADB, 2004. Country Environmental Analysis: Bangladesh. 3rd Draft. Asian Development Bank, July 2004, v+74 pp.
- Alam, K., Shamsuddoha, M., Tanner, T., Sultana, M., Huq M.J. and Kabir, S.S. 2011. The Political Economy of Climate Resilient Development Planning in Bangladesh. *IDS Bulletin*, 42(3): 52-61, May 2011. Institute of Development Studies, Blackwell Publishing Ltd, Oxford, UK and Malden, MA, USA.
- CBD, 2007. Biodiversity and Climate Change. International Day for Biological diversity, Convention on Biological Diversity (CBD). Available at: <http://www.cbd.int/doc/bioday/2007/ibd-2007-booklet-01-en.pdf>
- DARA, 2010. Climate Vulnerability Monitor- The State of the Climate Crisis. Report of the Climate Vulnerability Initiative 2010, DARA and The Climate Vulnerable Forum.
- Dobias, B. 2010. ADB Climate Change Program Evolution and Strategic Priorities. Asian Development Bank, Kathmandu, Nepal. [<http://www.scribd.com/doc/34211829/ADB-Climate-Change-Program-Evolution-and-Strategic-Priorities>] website found on 22 June 2011.
- Harmeling, S. 2011. Global Climate Risk Index 2011: Who Suffers Most from Extreme Weather Events? Weather-related Loss Events in 2009 and 1990 to 2009, Germanwatch Briefing Paper, Bonn: Germanwatch, 24p.

- IPCC, 1997. The Regional Impacts of Climate Change: An Assessment of Vulnerability. Summary for Policymakers. A special Report of IPCC Working Group II. Published for the Intergovernmental Panel on Climate Change, November 1997.
- Mohnen, V.A., Goldstein, W. and Wang, W.C. 1991. The conflict over global warming: The application of scientific research to policy choices. Global Environmental Change, Butterworth-Heinemann Ltd.
- OECD, 2004. The benefits of climate change policies. Organization for Economic Co-operation and Development, Paris, France, 323 pp.
- UNEP, 2011, Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication, www.unep.org/greeneconomy
- UNFCCC, 2011. The official website of United Nations Framework Convention on Climate Change (UNFCCC), <http://unfccc.int/2860.php>, last seen on 6 July 2011.
- World Bank 2008. Biodiversity, climate change, and adaptation. Nature-Based Solutions from the World Bank Portfolio. The World Bank, Washington, DC 20433 USA, 112p.

ENV 807 ENVIRONMENTAL GOVERNANCE
Theory: 100 (4 cr); Total: 100 (4 cr)

Course contents:

1. Introduction:

Define Governance, Governance components and principles; Debate on theory of governance; Governance in Practice; Natural resource governance in Bangladesh.

2. Decentralization of Forest Governance:

Forest governance: mainstream and critical views; Forest governance in decentralized systems; Forest governance in Asian countries, Forest governance and REDD+; Forest governance reform.

3. Collaborative Governance:

Collaborative governance: theory and practice, Collaborative action framework; Partnership as collaborative governance mechanisms.

4. Environmental Governance:

Emerging global environmental governance; Themes in environmental governance; Mechanism and strategy of environmental governance; Neoliberal environmental governance; Global environmental governance; Integrated climate governance; Good governance and environmental compliance and enforcement.

5. Governance of Ecosystem Services:

Instruments for governance of ecosystem services, spatial planning in governance of ecosystem services.

6. Assessment and Monitoring of Governance:

Framework for assessing and monitoring governance.

Recommended Bibliography:

- Bonfiglioli, A. 2004. Lands for the poor: Local environmental governance and the decentralized management of natural resources. UNCDF, New York.
- Castro, A. P. and Nielsen, E. (editors). 2003. Natural resource conflict management studies: An analysis of power, participation and protected areas. FAO, Rome.
- Colfer, P, C.J. and Capistrano, D. (editors). 2005. The politics of decentralization: Forests, people and power. Earthscan, London.
- Contreras-Hermosilla, A., Gregersen, H. M. and White, A. 2008. Forest governance in countries with federal systems of government: Lessons for decentralization. CIFOR Governance Brief.
- Edmunds, D. and Wollenberg, E. (editors). 2003. Local forest management: The impacts of devolution policies. Earthscan, London.
- Glasbergen, P., Biermann, F. and Mol, A.P.J. (editors) 2007. Partnerships, governance and sustainable development: Reflections on theory and practice. Edward Elgar Publishing Limited, the UK.
- Kishor, Nalin and Kenneth Rosenbaum. 2012. *Assessing and Monitoring Forest Governance: A user's guide to a diagnostic tool*. Washington DC: Program on Forests (PROFOR).
- Miller, W. L., Dickson, M. and Stoker, G. 2000. Models of local governance: Public opinion and political theory in Britain. Palgrave, New York.

- Moeliono, M., Wollenberg, E. and Limberg, G. (editors). 2009. The decentralization of forest governance: Politics, economics and the fight for control of forests in Indonesian Borneo. Earthscan, London.
- Noel et al., 2009. A Companion to Environmental Geography. Wiley-Blackwell.
- Patti Moore, Xuemei Zhang, and Ronnakorn Triraganon (2011). Natural Resource Governance Trainers' Manual. IUCN, RECOFTC, SNV, Bangkok, Thailand.
- Rashid K.Y. et al., 2012. Natural resource governance: Best practices and lesson learned. IUCN, Dhaka.
- Rhodes, R. A. W. 1997. Understanding governance: Policy networks, governance, reflexivity and accounting. Open University Press, Philadelphia.
- Swiderska, K., Roe, D., Siegele, L. and Grieg-Gran, M. 2008. The Governance of Nature and the Nature of Governance: Policy that works for biodiversity and livelihoods. IIED.
- Thomas Greiber and Simone Schiele (eds.) (2011), *Governance of Ecosystem Services*. Gland, Switzerland: IUCN.
- Van Bodegon, A.J., Klaver, D., van Schoubroeck, F and van der Valk, O. 2008. FLEGT beyond T. Exploring the meaning of 'Governance' concepts for the FLEGT process. Wageningen University & Research Center, the Netherlands.
- Webb, E. L. and Shivakoti, G. P. (editors). 2008. Decentralization, forests and rural communities: Policy outcomes in South and Southeast Asia. SAGE Publications, India.

ENV 808 APPLICATION OF REMOTE SENSING IN ENVIRONMENTAL SCIENCES

Theory: 100 (4 cr); **Total:** 100 (4 cr)

Concepts of Remote Sensing: Introduction; Ideal RS system; Aerial photo, Satellite Imageries.

Satellite imagery: Types of imagery, Satellite technology, and imagery production; digital and manual image analysis; multi-concept of remote sensing and MSS data.

Photogrammetry: Geometric elements, Image parallax, Ground control, Stereoscopic measurements;

Thermal and Multispectral scanning: Sensing Radiant Temperatures, Atmospheric effect, Thermal scanner, MSS operation, Imaging Spectrometry

Digital Image Processing: Supervised and Unsupervised classification; Image rectification and restoration, Classification, training and output stage; Data merging.

Spatial data analysis: Acquisition of data from different resources, analytical tools and analysis, Digital terrain model and satellite data processing, spatial data set management using GIS; GPS technique

Recommended bibliography

Buhmann, S. 1996. Geographic Information System. Bruenig, E.F. and Bossel, H. (eds.). Natural Resource Systems Analysis.

Chrisman, N. 1997. Exploring geographic information systems. John Wiley & Sons. 298p.

Colwell, R.N.; Esters, I.C. and Thorley, G.A. (eds.). 1983. Manual of Remote Sensing Vol. 2. Interpretation and Application. Amer. Soc. of Photogrammetry, Virginia.

De Mers, M.N. 1999. Fundamentals of geographic information systems. Second edition. New York. 498p.

Lillesand, T.M. and Kiefer, R.W. 1987. Remote sensing and Image Interpretation. Second Edition. John Wiley and Sons. New York, USA.

Moffit, F.H. and Mihalil, G.W. 1980. Photogrammetry. 3rd Edn. Harper and Row Publishers N. York.

Paine, D.P. 1981. Aerial Photogrammetry and Image Interpretation for Resource Management. John Wiley & Sons. New York, USA.

Sharma, M.K. 1986. Remote Sensing & Forest Surveys. International Book Distributors. Dehra Dun, India.

Simonett, D.S. and Ulaby, F.T. (eds). 1983. Manual of Remote Sensing. Volume One. Second edition. American Society of Photogrammetry. USA.

Walford, N. 1995. Geographical data analysis. John Wiley & Sons. 446p.

Korte, P and George, B. The GIS Book. Onward press. 387 p.

Clarke, K. C., Parks, B. O. and Crane, M. P. 2002. Geographic Information Systems and Environmental Modeling. Prentice-Hall of India. 306 p.

Burrough, P. A. and McDonnel, R. A. 1998. Principles of Geographic Information Systems. Oxford University Press. 333 p.

EGIS. 2000. Geo-spatial tools for analysis of floodplain resources. UPL. 100 p.

Walford, N. 1995. Geographical data analysis. John Wiley and Sons. 446 p.

Lo, C. P. and Yeung A. K. W. 2002. Concepts and techniques of Geographic Information Systems. Prentice-Hall of India. 495 p.

ENV 809 ADVANCED ENVIRONMENTAL IMPACT ASSESSMENT

Theory: 100 (4cr);

Total: 100 (4 cr)

Course Contents:

- 1. EIA Process Overview:** Definition and history of EIA, Objectives and Significance of EIA, Related law necessary for EIA, Strategic Environmental Assessment (SEA), Tools for assess environmental impact, Public Involvement and consultation, Ecological evaluation for EIA.
- 2. Measurement of Environmental Impacts:** Measurement of Physical Environmental Variables, Measurement of Social Variables, Measurement of Economic Variables, Environmental Indices.
- 3. Considerable Aspects of EIA in Natural Resource Management:** Vegetation & Wildlife, Water (Ground & Surface), Land Use Development, GHG/Climate Change considerations, Social & Neighborhood Effects, Energy, Traffic & Transportation, Historic & Archeological Resources, Floodplains & Coastal Areas, Flood Risk, Wetlands, Relocations-Resettlements-Refugees, Environmental Justice, Environmental Safety, Public Health.
- 4. EIA process in Various Countries and Organizations:** Examples from developed and developing countries (UK, USA, EU, Japan, India and China). Examples from FAO, WB and UNEP.
- 5. EIA Process in Bangladesh:** Screening, Initial Environmental Examination (IEE) and Detailed EIA.
- 6. Application of Environmental Auditing:** Structure of Successful Environmental Auditing, Environmental Auditing in Private Sector, Environmental Auditing in Public Sector.

Recommended Bibliography:

- Barthwal, B. R. 2002. Environmental Impact Assessment. New Age International (P) Limited, New Delhi.
- DoE, 1997. EIA Guidelines for Industries. Department of Environment, Ministry of Environment and Forest, Government of People's Republic of Bangladesh.
- EPA, 1997. Environmental Audit Program Design Guidelines For Federal Agencies. U.S. Environmental Protection Agency, Washington. Available on <http://www.epa.gov/compliance/resources/policies/incentives/auditing/envaudproguidemas.pdf>
- FAO, 2012. Environmental Impact Assessment. Food and Agriculture Organization of the United Nations. Italy. Available on <http://www.fao.org/docrep/016/i2802e/i2802e.pdf>
- Frisch, M. 1996. The Application of Environmental Auditing Techniques to Cities and Regions. Available on <http://dspace.mit.edu/bitstream/handle/1721.1/66371/35841008.pdf?sequence=1>
- Geneletti, D. 2002. Ecological Evaluation for Environmental Impact Assessment. Available on https://www.itc.nl/library/Papers/phd_2002/geneletti.pdf
- Glasson, et al. 2005. Introduction to Environmental Impact Assessment. Routledge, London and New York.
- Lawrence, D. P. 2003. Environmental Impact Assessment Practical Solutions to Recurrent Problems. John Wiley & Sons, Inc., Hoboken, New Jersey.
- Scottish Natural Heritage, 2013. A Handbook on Environmental Impact Assessment. Available on <http://www.snh.gov.uk/docs/A1198363.pdf>
- UNEP, 2004. Environmental Impact Assessment and Strategic Environmental Assessment: Towards an Integrated Approach. United Nations Environment Programme, Geneva. Available on <http://www.unep.ch/etu/publications/textONUbr.pdf>

ENV 810 WASTEWATER MANAGEMENT

Theory: 100 (4cr);

Total: 100 (4 cr)

1. **Basic Concepts on Wastewater Treatment:** Needs for wastewater (WW) management, Importance of WW management with respect to health and environmental concern, WW characteristics, WW treatment methods, current status, new directions and concerns, WW reclamation and reuse, Biosolids and residuals management. WW constituents, Physical characteristics, Inorganic and Organic constituents, Biological characteristics.
2. **Operational Unit processes:** Physical Processes: Screening, coarse solid reduction, Flow equalization, Mixing and Flocculation, Grit separation theory, Grit removal, Primary sedimentation, Aeration systems, Removal of volatile organic compounds by aeration, Chemical Processes: Role of Chemical processes, Fundamentals of chemical coagulation, chemical precipitation for removal of heavy metals and dissolved inorganic substances, Chemical oxidation, Chemical neutralization and storage.
3. **Reactors for Industrial Wastewater Treatment Process:** Reactor types, Batch reactor, Continuous-Flow Stirred-Tank Reactor with effluent recycle, Plug-Flow reactor with effluent recycle, Reactor with recycle of settled cells, SBR, reactors in series, engineering design of reactors.
4. **Fundamentals of biological WW treatment (BWWT):** Overview of BWWT, composition and classification of microorganisms, Microbial metabolism, aerobic biological oxidation, biological nitrification and denitrification, Biological phosphorus removal, Anaerobic fermentation and oxidation, Biological removal of heavy metals. *Activated Sludge Process:* Characteristics, process configuration, Design and operating criteria, aeration systems, Bulking problems, centrifugal separations, membrane separations.
5. **Nitrification, Denitrification and Phosphorus removal Process:** Biofilm nitrification, activated sludge nitrification, ANAMMOX process, physiology of denitrifying bacteria, tertiary denitrification, one-sludge denitrification, Phosphorus Removal : Normal phosphorus uptake into biomass, Precipitation by metal-salts addition to a biological process, Enhanced biological phosphorus removal
6. **Advanced Wastewater treatment:** Needs for advanced WW treatment, technologies used for advanced treatment, membrane filtration processes, adsorption, Gas stripping, Ion exchange, advanced oxidation processes, Distillation.
7. **Disinfection processes:** Requirements for WW disinfection, Disinfection theory, Disinfection with Chlorine, Disinfection with CO₂, Dechlorination, Disinfection with Ozone, UV radiation disinfection, comparison of alternative disinfection technologies
8. **Sludge Management:** Characteristics of solids, solid processing flow diagram, primary operations, Thickening, stabilization, anaerobic digestion, general consideration for anaerobic treatment processes, Process chemistry and microbiology, aerobic digestion, composting, dewatering, drying, incineration, biosolids conveyance and storage.

9. **WW reclamation and reuse:** WW reclamation and reuse applications, need for water reuse, public health and environmental issues in water reuse, risk assessment, water reclamation technologies, storage of reclaimed water, industrial water use, groundwater recharge with reclaimed water, Planning for WW reclamation and reuse.

Recommended Bibliography:

- Rittmann, B. E and McCarty, P. L. (2001). Environmental Biotechnology: Principles and applications. McGraw Hill companies, Inc., New York, NY 10020, 754pp.
- Metcalf and Eddy. (2004). Wastewater engineering, treatment and reuse. Mc Graw Hill co. Inc., 1221, Newyork, NY 10020,1819pp.
- Mino, T., Van Loosdrecht, M. C. M., Heijnen, J. J. 1998. Microbiology and biochemistry of enhanced biological phosphate removal process. Water Res., 32:3193– 207.
- Satoh H., Iwamoto Y., Mino T., Matsuo T. 1998. Activated sludge as a possible source of biodegradable plastic. Wat. Sci.Tech., 37: 579-582.
- APHA. 2005. Standard methods for the examination of water and wastewater, 21st ed. American Public Health Association, American Water Works Association, and Water Environment Federation ,Washington, DC.
- Comeau, Y., Hal, K. J., Huncok, R. E. W., Oldham, W. R. 1986. Biochemical model for enhanced biological phosphorus removal. Water Res, 20:1511 –21.

ENV 811 LAND USE**Theory: 100 (4 cr);****Total: 100 (4 cr)*****Course contents:***

Land and soil basic knowledge of geology, soil science and forestry to describe land, soil profile and plant communication of a watershed; characteristics and qualities of a land and their evaluations land capability classes in a country and land classes that put under forests, land use policy, and use change and need for land use planning in Bangladesh; Classification of land based on flooding depth, factors determining land use, major land uses such as agriculture, forest, shrimp culture, urbanization, water bodies, brick field, etc. in Bangladesh, multiple land uses, land use conflicts, changes in land use conversion of forest into other land uses and their impacts on hilly watershed like CHT's soil characteristics under forest compared to other vegetation type, deforested, clear felled, shifting cultivated, burn/fired and barren land, hill cuttings in land degradation and in ecosystem change.

Recommended Bibliography:

- Brammer, H. 2002. Land use and land use planning in Bangladesh. The university press limited. 554pp.
- Davidson, D.A. 1982. Soil and land use planning. Second impression, Longman. London, UK. 120pp.
- Davidson, J. and Khan, M.N. 1985 Computerized matching of tree species to sites, working Paper No. 1, FAO/UNDP project BGD/79/017.113pp.
- Davis, P. 1976. Land use, Mcgraw Hill Book Company, New Delhi, India. 324pp.
- FAO, 1988. Land Resource Appraisal of Bangladesh for Agriculture development, UNDP/FAO project BGD/81/035, Technical Reports – 1-7, FAO, Rome.
- FAO/UNDP, 1971. Bangladesh soil resources, soil survey project, AGL: SF/PAK 6 Technical report 3, p. 185-198.
- Muller, D. and Ellenberg. D.H. 1974. Aims and methods of vegetation ecology John Wiley and sons, London.
- Richard, B.N. and Hassan, M.M. 1989. Dendroecological Regions of Bangladesh: A land capability Assessment for tree species. OF: DP/BGD/83010. Working paper No. pp48.
- Sinthurahat, S. 1985. Land evaluation for rubber applied to some areas in Thailand, M. Sc in Soil science thesis, International training centre for Post graduate soil scientists, state University of Gent, Belgium. 55pp.
- Stevens, P.R. 1987. A simplified field manual for site classification and site suitability Assessment in Bangladesh forest. BGD/83/010, Working paper No. 1, 14pp.

FOR 812 CO-MANAGEMENT OF NATURAL RESOURCE MANAGEMENT

Theory: 100 (4 cr);

Total: 100 (4 cr)

Introduction: Definition and scope, Rationale of natural resource co-management, Evolution of the concept of co-management of natural resources, Co-management in context of participatory natural resource, community based forest management, Co-management of other natural resources management.

History: Historical development of the concept of Co-management, Formal and informal approaches towards co-management, driving forces behind the development of the concept of co-management, different versions of forest co-management, History of co-management in other countries.

Legal setting: The current legal framework of co-management of natural resources/forests in Bangladesh, Formation and maintenance of a co-management system, Stakeholders in a co-management system, Role of GOs and NGOs in the co-management structure in Bangladesh, Strength and weaknesses of the current legal framework, Political dimension in co-management, Community based organizations in co-management system

Geographical scope: Co-management in Bangladesh and in other countries, Co-management of natural resources in Bangladesh – the geographical aspects, Cases of co-management of natural resources in Bangladesh,

Financing co-management: External and internal funding sources, Challenges of funding the co-management system, Revolving loan fund, Co-operative structure of CBOs on the co-management and their financial aspects

Problems and prospects: Challenges of establishing a co-management system in general, Challenges of establishing a co-management system in Bangladesh,

Recommended Bibliography:

- Fox, J., Mustafa, M.G., Bushley, B. R., Brennan, S. M. and Durand. L. (eds.). 2013. Connecting communities and conservation: co-management initiatives implemented by ipac in wetlands and forests of Bangladesh, Integrated Protected Area Co-Management Project, USAID, Dhaka, 206 pp
- Huda, K. S. 2005. Co-management of protected areas in Bangladesh: a strategy for establishing an institutional framework, Nishorgo Support Project, USAID, Dhaka, 39 pp
- Sharma, R. 2005. Co-management of protected areas in south Asia with special reference to Bangladesh, Nishorgo Support Project, USAID, Dhaka, 20 pp
- DeCosse, P. J. and Jayawickrama, S. S. 1996. Co-management of Resources in Sri Lanka : Status, Issues and Opportunities. USAID's Natural Resources and Environmental Policy Project, IRG, Sri Lanka.
- Borrini-Feyerabend, G.; Michel, P.; Farvar, M. T.; Kothari, A. and Renard, Y. 2004. Sharing Power. Learning by doing in co-management of natural resources throughout the world. IIED and IUCN/CEESP/CMWG, Cenesta, Tehran.
- Anar Koli. 2010. Protected Area Co-management in Bangladesh - Can enhance the adaptation of the forest communities? BENJapan, Proc. of International Conference on Environmental Aspects of Bangladesh (ICEAB10), Japan, Sept. 2010, Tsukuba University, Japan
- Chowdhury, M.S.H.; Koike, M. and Muhammed, N. 2009. Embracing Collaborative Protected Area Management for Conservation: An Analysis of the Development of the Forest Policy of Bangladesh. International Forestry Review 11(3):359-374. 2009

ENV 813 GREEN BANKING

Theory: 100 (4 cr);

Total: 100 (4 cr)

Financial Systems: Role of financial systems; financial intermediaries, securities and markets. Taxonomy of financial institutions. Structure of financial markets (direct and indirect finance, dealers and brokers, banks, mutual funds, pension funds, and insurance companies), Bank-based systems against market-based systems; Types of banking - Retail, private, corporate, investment, Islamic, International; Role of banks, theories of financial intermediation, current issues in banking

Regulation of Banks: Legal aspects. Regulation of banks (free banking, arguments for or against regulation, traditional regulation mechanisms, alternatives to traditional regulation). Risks in Banking - Market risks, Liquidity risk, interest rate risk, foreign exchange risk. Credit risk: Screening and monitoring, credit rationing, collateral.

Green banking: Definition, history, current status in global context, Current status in Bangladesh context, CSR in context of green banking

Country status: Legal and policy aspects related to green banking in Bangladesh, Bangladesh bank and its initiatives, Initiatives by other banks, the role of customers, businesspeople and media in green banking.

Indicators of Green banking: need for indicators, Types of indicators, Methods of development of indicators. LCA in the context of green banking, Comparing among banks, among branches of banks and among different products in terms of greenness, paperless vs paper based banking

Recommended Bibliography:

- Masukazzaman, M. and Aktar, S. 2013. Green Banking in Bangladesh: A Commitment towards the Global Initiatives, Journal of Business and Technology (Dhaka), Volume VIII: 1 and 2, 17-40 p
- Ullah, M. 2013. Green Banking in Bangladesh- A Comparative Analysis World Review of Business Research, Vol. 3(4), 74 – 83 pp

ENV 814 ECOTOURISM MANAGEMENT

Theory: 100 (4 cr);

Total: 100 (4 cr)

Course contents:

1. **Nature and Scope of Ecotourism:** History of ecotourism and its definitions; Nature based tourism, Characteristics of ecotourism; Benefits of ecotourism; Environmental, socio-cultural and economic impacts of ecotourism;
2. **Ecotourism Management:** Concept and procedures; Recreation and the environment; recreational impacts on the environment; ethical and legal concerns; code of practice for ecotourism operators; incorporating ecotourism principles into activities; interpretation; visitor guidelines; planning for minimal impact; quality control; Waste management – concept, needs, design and implementation.
3. **Ecotourism and Protected Areas:** Protection of the ecosystems; Conservation of forests, biodiversity, local cultures and heritage; Assessing Eco-Tourism Potential of a particular area/forest; Role of private sectors in Ecotourism and forest conservation; Co-management of protected areas and Ecotourism in Bangladesh
4. **Ecotourism and Development Issues:** Ecotourism as a growth sector within the tourism industry; Ecotourism and community development;
5. **Marketing Ecotourism:** The ecotourism market; Situation analysis; Market research; Promotion; Advertising; Sales; Trends in international tourism; Understanding the needs of the consumer; Consumer expectations; Development, Promotion and Marketing of ecotourism in Bangladesh; Ecotourism branding, certification and labeling.
6. **Ecotourism Facility Development:** Infrastructures and signage; Interpretations; Accommodation facilities including camp sites, cabins, resorts, etc.; Layout of facilities; Accepted practices for service facilities; Identifying catering options for different ecotourism activities; Tourism attractions and infrastructures in Bangladesh.
7. **Safety in Ecotourism:** Safety strategy, hazards and first aid; Identify/establish safety precautions/requirements/procedures for an ecotourism enterprise.
8. **Sustainability of Ecotourism:** Maintenance of Carrying Capacity; Environmental education program; Community livelihoods; Legal and policy supports from the government;
9. **Ecotourism Management Plan (EMP):** Concept, procedures and implementation of EMP.
10. **Planning an Ecotourism Activity:** A special project where the student plans out an ecotourism activity including: budget, accommodation, licenses, meals, destination, etc.

Recommended Bibliography:

- Drumm, A. & Moore, A. (2005). Ecotourism Development: An Introduction to Ecotourism Planning (Vol. I). (A. Singer, Ed.) Arlington, VA, USA: The Nature Conservancy.
- Drumm, A. & Moore, A. (2004). Ecotourism Development: Volume II - The Business of Ecotourism Development and Management (Vol. II). Arlington, VA, USA: The Nature Conservancy.
- Mowforth, M., & Munt, I. (2009). Tourism and sustainability (3rd Edition). London, UK: Routledge.
- Newsome, D., Moore, S.A., & Dowling, R.K. (2002). Natural area tourism. Bristol, UK: Channel View Publications.
- Weaver, D. (2008). Ecotourism (2nd Edition). Hoboken, NJ: JS Wiley.

ENV 815 NATURAL RESOURCE MONITORING AND ASSESSMENT

Theory: 100 (4 cr);

Total: 100 (4 cr)

Course contents:

1. Natural Resource : Definition; Approaches to define natural resources; Models of natural resource development and their significance in plantation forestry;
2. Natural Resource Assessment: Inventory designs for resource assessment; Natural resource assessment by FAO and data input methods (country), Open Foris software and data management procedure; data compilation and assessment.
3. Natural Resource Monitoring: Periodical Monitoring using survey, remote sensing and GIS techniques; Model and protocol development.

Recommended Bibliography:

- Al-Amin, M. 2011. *Application of spatial data in forest ecology and management*. Book. LAP Lambert Academic Publications. Germany. 242 pp.
- Buhmann, S. 1996. Geographic Information System. Bruenig, E.F. and Bossel, H. (eds.). Natural Resource Systems Analysis.
- Burrough, P. A. and McDonnel, R. A. 1998. Principles of Geographic Information Systems. Oxford University Press. 333 p.
- EGIS. 2000. Geo-spatial tools for analysis of floodplain resources. UPL. 100 p.
- Paine, D.P. 1981. Aerial Photogrammetry and Image Interpretation for Resource Management. John Wiley & Sons. New York, USA.
- Walford, N. 1995. Geographical data analysis. John Wiley & Sons. 446p.
- Avery, T.E. Forest Measurements. McGraw-Hill Comp., New York.
- Dilwarth, J.r. and Bell, J.F. Variable probability sampling. Variable Plot and Three P. OSU Book stores Inc. USA.
- Lauly,J.P. Manual of Forest Inventory with special reference to Mixed Tropical Forests. FAO. Rome.
- Loetsch, F. and Haller, K.E.. Forest Inventory. Vol. 1 & Vol. 2. HGV Verlagsgessellschaft muucheu, Beru Wien.
- Philip, M. S. Measuring trees and Forests. Division of Forestry, Univ. of Dar es Saalaam.