

INSTITUTE OF ENVIRONMENTAL SCIENCE

University of Rajshahi

**Curriculum for Post-Graduate Program
2023-2024**

Contact

IES

Dr. M. A. Wazed Miah Academic Building

University of Rajshahi, Rajshahi 6205

Telephone: +02588866930

+880 721 711166

Fax : +02588866364, 02588866673

Website: www.ru.ac.bd/ies

The University reserves the right to revise information, requirements, regulations, etc. at any time.

Whenever changes occur, an effort will be made to notify those concerned.

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POST-GRADUATE CURRICULUM

Overview

The Institute of Environmental Science (IES) was established in 1999 as one of the academic seats of higher research with at the University of Rajshahi, Bangladesh. It is also the sole institute of its kind in Bangladesh as well. The institute maintains its aim to promote research in environmental science and environmental studies, produce experts in environmental science, and develop awareness in protecting the environment with its goal to contribute to national development to tackle the challenge of global climate change as the country's number one threat in the new millennium. The MPhil/PhD. program in Environmental Science is an advanced interdisciplinary research-oriented program intended for fellows interested in developing a scientific understanding of the environment as well as its management. The research component is highly focused on the specific environment-related problem(s). The institute offers regular MPhil and PhD. programs for research in the greater disciplines of science, biological science, social science, law, and business relating to the environment. Some focused areas of research include environmental change and its impact on social structure, climate change and poverty issues, environmental policy aspects, environmental issues and economic mitigation, climatology, biodiversity, climate change and sea-level rise, soil and water quality, energy, environmental impact assessment (EIA), environmental pollution and control, environmental microbiology, soil erosion, land use, and land degradation, urban environmental issues, and policies, disaster and disaster risk management, industrial pollution control, agricultural pollution, pest management, waste management, GIS and remote sensing application, etc. The program is composed of six months of mandatory course work consisting of 06 major and 01 optional course from diverse study areas in environmental sciences followed by their intensive research works. The fellows may select their research supervisors from the institute's full-time faculties or may carry out their research work under supervision from other regular faculties from other disciplines of same university or different universities, ministry, education and research organization from home and abroad. Teachers of the IES try to create and disseminate new knowledge through conducting regular research under different projects funded by the Ministry of Science and Technology, Ministry of Education, University Grants Commission of Bangladesh (UGC), Bangladesh Agricultural Research Council (BARC), Third World Academy of Sciences (TWAS), Food and Agriculture Organization (FAO), etc.

The MPhil/PhD and Post Doctoral program in Environmental Science is an advanced interdisciplinary research-oriented program intended for fellows interested in developing a scientific understanding of the environment as well as its management. The research component is highly focused on the specific environment-related problem(s).

The IES undertakes different extra-curricular events like field study, picnics, indoor games and cultural competitions; conducts theme-based seminars/symposium/workshops/briefing sessions, and observes national and international Days/Weeks related to environments. The Institute is producing skilled environmental scientists who led the profession at home and abroad since it started awarding degrees.

1. Vision

The vision of the IES is to be a world-class research organization that will provide leadership in environmental education, research, and development.

2. Mission

The mission of the Institute is to:

M 1: Achieve broaden multidisciplinary academic knowledge related to environment;

M2: Gain mastery of knowledge and advanced research skills in conducting research in emerging environmental issues;

M 3: Build up institutional capacity in workshop, training and outreach programs.

3. Program Educational Objectives (PEO)

PEO 1: The graduates will apply academic knowledge and conduct relevant research programs in core and emerging disciplines of environmental science.

PEO 2: The fellows will be able to develop the ability to formulate and implement an individual research project.

PEO 3: The fellows will be able to write research projects, reports, articles and dissertations.

PEO 4: The fellows will be able to demonstrate, disseminate and share knowledge in outreach programs.

Mapping: Mission and PEOs

Mission	PEO 1	PEO 2	PEO 3	PEO 4
M 1: to achieve broad multidisciplinary academic knowledge.	A	B		
M 2: to gain mastery of knowledge and advanced research skills in preparation for research projects.	B	A	A	A
M 3: to develop organizing capacity in workshops, training and outreach programs.			B	A

***Good contribution: A; Fair contribution: B; Weak contribution: C;**

4. Program Learning Outcomes (PLO/PO)

The graduates of the program will be able to:

PO 1: describe the physical, chemical, biological and social sciences as well as conduct research specific to air, water, and soil pollution and hazardous wastes, and their impacts on the environment;

PO 2: solve the problems relevant to the present and future environments in the cutting edge of scientific research;

PO 3: achieve professional skills by taking individual research topics to solve environmental problems;

- PO 4:** prepare research report and dissertation and publish articles in peer-reviewed international journals;
- PO 5:** develop collaborative research with research organizations, industries and other institutes;
- PO 6:** achieve the capability to work in academic and research organizations as well as industries.

Mapping: PEOs with POs

PEOs	Programs Outcomes (Pos)					
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
PEO 1	A	B	-	-	-	B
PEO 2	A	A	A	B	-	A
PEO 3	B	B	A	A	B	A
PEO 4	-	-	B	A	A	A

* **Good contribution: A; Fair contribution: B; Weak contribution: C; no contribution:-**

Degree Offered and Duration: Post-graduate study in the Institute of Environmental Science (IES), University of Rajshahi comprises of the MPhil (2 Years duration with maximum 05 years) and PhD (3 Years duration with a maximum of 06 years). But after passing the time duration candidate can get opportunity to re-admit 1 year for MPhil. and 2 years for PhD programme by the pay of double registration fee.

Eligibility and Admission Requirements: A recognized Master’s Degree or equivalent degree in any discipline related to the environment is the general entry requirement for the program. However, a student from Social Science, Law and Business disciplines must have a Science background at their Higher Secondary Certificate (HSC) level. The applicants must have to follow the rules of admission of the RU as well as IES.

Researchers seeking admission to a postgraduate degree program are required to submit their duly filled up application forms obtained directly from the IES or can be downloaded from the website: www.ru.ac.bd/ies along with previous academic transcripts, certificate, records of professional qualifications, and a synopsis of their tentative research plan. Only applicants who meet the required minimum entry qualifications will be allowed for admission examinations (both written and viva-voce) and finally be selected from the integrated result on the basis of merit.

Successful applicants are generally registered for the MPhil in the first instance and those who wish to study for the PhD are transferred at a later stage (normally after 2 years) subject to satisfactory progress both in course work and research.

Scholarship: Every selected fellow for MPhil/PhD degree will be awarded the University Scholarship. Additionally, they can be awarded other fellowships from the Institute of Environmental Science Fellowship, University Grant Commission (UGC), Ministry of Education (MoE), Ministry of Science and Technology (MoST), Bangladesh Council of Science and Industrial Research Fellowship (BCSIR), Bangabandhu Sheikh Mujibur

Rahman Fellowship, Bangladesh Agricultural Research Fellowship, Bangladesh Sociological Research Center (Ministry of Social Welfare) Fellowship, Banks, NGO's, etc. But a fellow can enjoy only one scholarship at a time.

Accommodation and Medical Facility: Fellows enrolled in any programs may get accommodation facilities on availability in any residential halls and international dormitory accordingly. In RU medical facilities are provided centrally from RU Medical Center.

Requirements of Degree Award: Post-graduate study in the Institute of Environmental Science (IES), University of Rajshahi comprises the M Phil and PhD Degrees. To obtain post-graduate degrees from the IES, in addition to completion of necessary coursework (32 credits), fellows and researchers must prepare a thesis under the guidance of respective supervisor/s and successfully defend the thesis through (2 for M Phil and 3 for PhD) public defense seminars. The thesis must concentrate on a specific environmental and related problem or issue that initiates, expands, strengthens or clarifies existing knowledge. Researchers require defining an appropriate problem for study, reviewing relevant information, developing a study plan incorporating techniques appropriate for the problem, implementing the plan, and relating the results to already existing theory, or a body of knowledge. For a Doctor of Philosophy (PhD) Degree, however, fellows must make an original contribution to their field of research.

Criteria of Supervisor/s: A teacher (Assistant Professor and above) from the IES or jointly with teacher/scientist from another related discipline or research organization relevant to the proposed research work supervises research work and if necessary, co-supervisor(s) can be assigned following rules of the University. Teachers or scientists from outside of the RU can involve only as co-supervisors. Assistant Professor or equivalent person can supervise only M Phil fellows but Associate Professor or equivalent with foreign Masters, MPhil or PhD and Professor can supervise both the MPhil and PhD fellows.

Academic Curriculum: These academic programs are designed for students from a multi-disciplinary educational background, professional experience, and environmental knowledge of Physical, Chemical and Biological Sciences, Medical and Engineering Sciences, Social Science, Economics, Laws and Business Disciplines.

The MPhil and PhD programs comprise 14 credits of course work, including 06 Compulsory ($6 \times 2 = 12$ credits) courses of Environmental Science and related disciplines, and 01 Optional course ($1 \times 2 = 2$ credits) for the specific need of their research works. Attendance of seminars / symposiums / conferences will cover 2 credits. In addition, 02(1+1) credits shall be allocated for MPhil/PhD registration and pre-submission seminars. After getting a successful recommendation for submitting the MPhil / PhD thesis, the candidate shall get 18/28 credits. To successfully complete the degree, the candidate should require 54 credits for MPhil and 76 credits for PhD. The MPhil/PhD candidate will have to attend at least 75% of conferences/seminars, workshops and

symposiums during her / his study. The transcript will be issued after successful completion of the degree concerned.

Credit distribution

Sl.no.	Course Content	MPhil (2 years)	Ph.D. (3 years)
1.	Compulsory 06 courses (6×2 =12) credits	12	12
2.	Optional 01 course (1×2 = 02) credits	02	02
3.	Research Activities		
	i) Field Work (2 credits)	02	02
	ii) Seminar Presentation (4 credits per year)	08	12
	iii) Seminar Participation (2 credits per year)	04	06
	iv) Research Article Publications (1 article = 4 credits)	04	08
4	Dissertation		
	i) Evaluation	18	28
	ii) Defense	04	06
	Total	54	76

Mapping: POs with COs

Pos	Programs Outcomes (POs)			
	CO1	CO2	CO3	CO4
PO 1	A	A	C	C
PO 2	-	B	B	B
PO 3	C	-	A	B
PO 4	C	-	A	B
PO 5	-	C	B	A
PO 6	B	B	B	A

* Good contribution: A; Fair contribution: B; Weak contribution: C

ENVC 701: Introduction to Environmental Sciences

1. **Course Title:** Introduction to Environmental Science
2. **Course Number:** ENVC 701
3. **Course Type:** Compulsory
4. **Course Level:** MPhil./PhD
5. **Course Term:** July-December
6. **Course Credit:** 02
7. **Total Marks:** 50 (Examination: 30; Assignment, Tutorial: 15 & Attendance: 5)
8. **Course Instructors:** Professor. Md. Abul Kalam Azad
9. **Course Over view**

This course will provide the fellows with a comprehensive overview of environmental science, issues, laws, and the EIA process. It focuses on the skills necessary to address the environmental issues that are facing today by examining scientific principles and the application of those principles to natural systems. This course will cover some of the environmental science topics at an introductory level, ultimately considering the sustainability of human activities on the planet. The course is designed to introduce the fellows to the basic terminology, techniques, and concepts of environmental science

10. Course Learning Objectives:

1. The fellow will describe the environment and its relationship to physical and biological factors.
2. The fellow will explain the significance of the study of environmental science.
3. The fellow will interpret how the pollution and different environmental issues both natural and manmade.
4. The graduate will recognize and understand the earths summits, environmental laws, and treaties
5. The graduate will quantitatively describe the environmental assessment procedures (IEE, EIA and EMP)

11. Course Learning Outcomes:

On successful completion of the course, the fellows will be able to

CO 1	Define the environment, environmental science, biodiversity, sustainable development, and related terms
CO 2	Describe the complex relationship of the environment with society, humans and nature
CO 3	Illustrate the greenhouse effects, atmospheric conditions and climate change
CO 4	Identify environmental issues and hazards both manmade and natural
CO 5	State environmental pollution
CO 6	Illustrate the renewable and non-renewable energy
CO 7	Explain the environmental laws, treaties, and protocols
CO 8	Deduce the EIA procedures for different development projects

12. Course Contents

COs	Course Contents	Lectures (hrs)
CO 1	This lesson introduces the definition and basic idea of environment, ecology, ecosystem, biodiversity, environmental science, and sustainable development and also discusses the history, scopes and significance of environmental science.	2
CO 2	This lesson states the biotic, abiotic, and edaphic factors, human interaction and influences on the ecosystem and environment.	2
CO 3	This lesson discusses green house effect, global warming and climate change, stratospheric ozone layer depletion, El-nino and La-nina.	3
CO 4	This lesson identifies the environmental problems and hazards (Industrial waste, salinity, saline water intrusion, top-dying in the Sundarbans, deforestation, desertification, acid rain, flood, cyclone and tsunami) and their effects on humans and society.	3
CO5	This lesson illustrates air, water, and soil pollution; toxic metal, groundwater arsenic contamination, agriculture, and agro-chemical pollution; industrial pollution and its impact on wetlands and fisheries.	3
CO 6	This lesson describes the various sources of renewable energy (renewable and non-renewable energy, solar energy, hydro-electric power, geothermal, and air-turbine) and their impacts on the environment.	2
CO 7	This lesson clarifies the laws, treaties and ethics, green court, environmental awareness and global environmental politics as well as the concepts of EPA, UNEP, CITE, WWF, IUCN, Green Peace, Montreal Protocol, Earth summits, Agenda 21, etc.	2
CO 8	This lesson describes the concept and origin of EIA, the nexus between development and the environment, EIA in project planning and EIA methodology (screening, scooping, checklist, matrix, impact identification, prediction and mitigation measures, IEE and EMP).	4

13. **Teaching and Learning Strategies:** An interactive class room including teaching learning-based instructions, audio-visual presentations, inquire-based education, field trips and seminars.

14. **Assessment Techniques of the course:** Formal Examination-35 marks, Class attendance: 5 Assignments, class test, quiz, oral presentation: 10 marks

References:

- Trivedi, R.N. 1997. A Text book of Environmental Science Anmol Pub.
Dhaliwal, G.S. 2000 Fundamentals of Environmental Science. Kalyani Pub.,
Cunningham, W.P., Cunningham, M.A. and Saigo, B.W. 2014. Principles of Environmental Science Tata McGraw Hill, India.
Arms, K. 1990. Environmental Science London Sundars College Pub.

- EIA and Risk Assessment by Andrews RNL. 1988. **In:** P. Wathern (Ed) EIA: Theory and Practice, Routledge, London.
- Miller. 2004. Living in the Environment Thomson, USA.
- Bodkin, D. B. and Keller, E. A. 2000. Environmental Science – Earth as a Living Planet Third Edition. John & Wiley Sons, Inc. New York.
- Biswas AK and Gepiring Qu (eds.) 1987. Environmental Impact Assessment for Developing Countries. Tylooly Intl., London.
- ESCAP, 1985. Environmental Impact Assessment Guide line for Planners and Decision-Makers, Thailand.
- ESCAP, 1988. Environmental Impact Assessment Management Tool for Development Project, Thailand.
- Glasson J, Therivel R. and Chadwick A. 1998. Introduction to Environmental Impact Assessment UCL Press
- Lohani BN, Evans JW, Ludwig HF and Rees C. 1987. Hand Books of Environmental Impact Assessment in Developing Countries

Online Resources

Google search of global environmental issues and articles inform environmental science journals of Elsevier, Springer, Wiley and Sons, etc.

ENVC 702: Ecology

1. **Course Title:** Ecology
2. **Course Number:** ENVC 702
3. **Course Type:** Compulsory
4. **Course Level:** MPhil/PhD
5. **Course Term:** July- December
6. **Course Credit:** 02
7. **Total marks:** 50 (Examination: 30; Assignment, Tutorial: 15 & Attendance: 5)
8. **Course instructor:** Professor Md. Redwanur Rahman
9. **Overview/description**

Course Description

This course is designed for MPhil/PhD fellows that have an interest in broadening their studies in environment. Major topics include: an introduction to ecological principles and the functioning of aquatic and terrestrial ecosystems; individual-based ecology including behavior; population dynamics; community structure and dynamics; ecosystem production; energy flow and material recycling; and conservation biology.

10. Course Learning Objectives:

1. The fellow will describe the importance the study of ecology.
2. The fellow will interpret how the impacts of human ecology and ecosystem
3. Fellows will describe mechanisms that support biological diversity at the individual, community, landscape, and global scales.
4. The fellow will develop new knowledge about the ecology of population communities and ecosystems

11. Course Learning Outcomes:

On successful completion of the lesson, the Fellow will be able to:

CO 1	Develop an introductory understanding of ecology. This understanding will be in 4 major ecological sub-disciplines: population, community, ecosystem and global ecology.
CO 2	Become familiar with the impacts of humans on ecological systems.
CO 3	Be able to describe mechanisms that support biological diversity at the individual, community, landscape, global scales and carbon, nitrogen and others cycles.
CO 4	Be able to know different ecosystem
CO 5	Develop a sense of place by acquiring new knowledge about the ecology of populations communities and ecosystems of Bangladesh.

CO: Course Outline

12. Course Content:

COs	Course Content	Lectures
CO 1	Introduction: Concepts of Ecology & Ecosystems	2
CO 2	Properties of Populations: Growth, Life History and Population Regulation, Species Interactions: Competition, Predation, Parasitism and Mutualism, Species Interactions: Competition, Predation, Parasitism and Mutualism, Community Ecology: Structure and Factors Influencing Communities	4

CO 3	Carbon Cycle: Laws of Thermodynamics, Energy Flow and Food Webs	2
CO 4	Nitrogen, Phosphorus, Sulfur Cycles (and other cycles of interest)	2
CO 5	Aquatic Systems: Freshwater and Marine Ecosystems	2
CO 6	Terrestrial Ecosystems: Grasslands and Boreal Forest	2
CO 5	Field investigation of an ecosystem	2
CO 7	Lab expectations and evaluation/assignment requirements	2
CO 8	Select a critical ecological issue and training in scientific publishing	2

13. Teaching and Learning Strategies: Teaching is given both lectures and seminars

14. Assessment Techniques of the course: Formal Examination-35 marks, Class attendance: 5 Assignments, class test, quiz, oral presentation: 10 marks

15. References:

Text Books:

Odum, E.P. 1971. Fundamental Ecology, W.B. Saunders Co., London

Allee, W.C, Orlando, P., Alfred, P. and Karl, PS, 1949. Principles of Animal Ecology, W.B. Saunders Co., London

Smith M. S., R. L. Smith, and I. Waters. 2014. Elements of Ecology. 1st Canadian Edition. Pearson. Upper Saddle River, New Jersey.

The Textbook and Laboratory Manual for BIOL 228 is available at the www.usask.ca/consumer_services/bookstore/textbooks

Reference books:

The Global Ecology Handbook by Carson WH. 2000. Beacon Press, Boston

Ecology Principles and Application by Chapman JL and Reiss TI. 1999. Cambridge Univ. Press

Excellence in Ecology by Kinne O. 2003. Intl. Ecology Institute, Germany

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

Ecology by Krebs CJ. 1994. Harper Collins College Publication, NY

Advances in Ecology and Environmental Science by Mishra PC, Bhera N and Guru BC. 1995. APH Publ., New Delhi

Other Resources: Online search, articles published in different journals including Elsevier, Springer, and daily newspapers.

ENVC 703: Geoenvironmental Science and Disaster Management

- 1. Course Title:** Geoenvironmental Science and Disaster Management
- 2. Course Number:** ENVC 703
- 3. Course Type:** Compulsory
- 4. Course Level:** MPhil/PhD
- 5. Course Term:** July- December
- 6. Course Credit:** 02
- 7. Total marks:** 50 (Examination: 30; Assignment, Tutorial: 15 & Attendance: 5)
- 8. Course Instructor:** Professor. S. M. Shafiuzzaman

9. Overview

This course will provide a comprehensive overview of Geoenvironmental Science and Disaster Management. The course is designed to introduce the fellows to the details of information of the earth including earth evolutionary history, atmosphere, lithosphere, hydrosphere, biosphere, hazard, disasters, disaster management etc. The course is mainly focused on the geological environment of the earth which provides geologic information to protect the earth's environment. The course also explores the concern of environmental disaster resulting from natural and manmade processes, and its management. In keeping with the course design, the endeavor is to seek knowledge for the well-being of all living things, especially human beings, with a balanced and healthy earth environment. The class will use frontal lectures, narrated PowerPoint presentations, and video clips to introduce the course.

10. Course Learning Objectives:

1. The fellow will achieve the basic knowledge of the earth and its environmental issues, types, history, application, and significance.
2. The fellow will demonstrate about the atmospheric history, structure, and composition and its significance, effects on our global environment.
3. The fellow will achieve the lithosphere and the internal function of the earth that interpret how to solve geological disaster and phenomena.
4. The fellow will demonstrate about the sediments, soil, and its formation, process, and its significance, pollution, and management.
5. The fellow will achieve about the hydrosphere and its distribution, sources, mechanisms, uses, pollution, and management techniques to solving the water crisis.
6. The fellow will interpret about the earth's biosphere and its extent and life processes in our ecosystem.
7. The fellow will achieve about the knowledge of biogenic deposits and its origin, sources, composition, and distribution in nature that provide valuable information for the development of fossil fuel.
8. The fellow learns about the geo-environmental condition in Bangladesh.
9. The fellow will achieve about the knowledge of Hazard and Disaster- definition and classification; Environmental emergency; Extreme events, Vulnerability,

Risks, susceptibility.

10. The fellow will understand about Disaster's intensity, frequency and measurement; Risk assessment and analysis; Prediction, Forecasting and Warning; Preparedness, control and management; Effects and environmental refugee.
11. The fellow will achieve knowledge about earthquake and tsunami; its causes, effects, preparedness and management.
12. The fellow will achieve about knowledge landslides, subsidence, lahars, avalanches and river bank erosion; its causes, impacts and management techniques.
13. The fellow will achieve knowledge about volcanoes; volcanoes type, causes, impacts and management.
14. The fellow will achieve knowledge about floods, water logging and seawater intrusion; its causes, effects and management.
15. The fellow will achieve knowledge about storms, hailstorms, cyclones, tornadoes, lightning and thunderstorm; its causes, effects and management.
16. The fellow will achieve knowledge about drought, heat waves, frost fire and desertification: its causes, effects and management.
17. The fellow will achieve knowledge about manmade disasters- classification, causes, effects and prevention.
18. The fellow will achieve knowledge about disasters in Bangladesh perspectives; adaptation and management system in Bangladesh.

11. Course Learning Outcomes:

On successful completion of the lesson, the Fellows will be able to:

CO 1	Demonstrate fundamental knowledge of the earth and environment.
CO 2	Explain the atmospheric birth, history, structure and composition and sources that provide the significant information for improving the earth environment.
CO 3	Interpret about the earth's lithosphere, interior and its mechanism; geological processes and earth materials or land formation.
CO 4	Discuss about the weathering processes, sediment and soil formation, process, types and profile, pollution and importance of soil conservation and management.
CO 5	Describe about the total world water distribution and understand how the hydrologic cycle works and its different parts, pollution and management.
CO 6	Understand the extent and distribution of biosphere and its role in the ecosystem.
CO 7	Evaluate the occurrence of fossil fuels and its mode, formation, composition, sources and natural distribution.
CO 8	Understand the geoenvironmental status and significance of Bangladesh.
CO 9	Understand about the Hazards and Disasters and their key terms.
CO 10	Know the natural disasters and its causes, effects and management techniques.
CO 11	Know the various manmade disasters and its causes, effects and prevention.
CO 12	Understand the disasters in Bangladesh perspectives- adaptation and management system.

CO: Course Outline

12. Course Content:

COs	Course Content	Lecture
CO 1	Environment and Geo-environment; Importance of Geologic information in environmental science.	01
CO 2	Solar system; Birth and climatic history of the earth.	01
CO 3	Atmosphere- definition; structure, compositions and its significances; sources and uses of atmospheric gases; solar radiation, green house effects and Global warming.	01
CO 4	Lithosphere- definition and types; Earth interior, structure and composition; Continental drift and Plate tectonic theory.	01
CO 5	Rock- definition, formation, classification, composition and rock cycle.	01
CO 6	Sediments and soil- definition, formation process, types, soil profile, composition and management.	01
CO 7	Hydrosphere- water types and distribution; Hydrologic cycle; Surface water and its worldwide distribution, Ocean water, salinity and sources of sea salt.	01
CO 8	Groundwater and its vertical distribution; Aquifer and its types; composition of groundwater; sources of mineral constituents in groundwater; sea water intrusion.	01
CO 9	Biosphere- Extent and distribution; biotic and abiotic components- its relation and role in our ecosystem; nitrogen cycle; life processes- photosynthesis and metabolism etc.	01
CO 10	Biogenic deposits or petroleum- its sources and origin; natural gas, crude oil and coal- formation process, classification and composition.	01
CO 11	Geo-environmental characteristics of Bangladesh; Petroleum deposits; seawater intrusion in coastal area of Bangladesh.	01
CO 12	Hazard and Disaster- Definition and classification; Environmental emergency; Extreme events, Vulnerability, Risks, susceptibility.	01
CO 13	Disaster Management- Disaster's intensity, frequency and measurement; Risk assessment and analysis; Prediction, Forecasting and Warning; Preparedness, control and management; Effects and environmental refugee.	01
CO 14	Earthquake and Tsunami; its causes, effects, preparedness and management.	01
CO 15	Landslides, Subsidence, Lahars, Avalanches and River bank erosion; its causes, impacts and management techniques.	01
CO 16	Volcanoes; Volcanoes types, causes, impacts and management.	01
CO 17	Floods, water logging and seawater intrusion; its causes, effects and management.	01
CO 18	Storms, Hailstorms, Cyclones, Tornadoes, Lightning and Thunderstorm; its causes, effects and management.	01
CO 19	Drought, Heat waves, Frost fire, desertification: its causes, effects and management.	01
CO 20	Manmade disasters- classification, causes, effects and prevention.	01
CO 21	Disasters in Bangladesh perspectives; Adaptation and management system in Bangladesh.	01

13. Teaching and Learning Strategies: Teaching is given by frontal lecture, power point presentation, video clip presentation and on assignment seminar.

14. Assessment Techniques of the course: Formal Examination- 35marks, Assignment- 10 marks and class attendance- 05 marks.

15. References:

- Grotzinger, J. P. and Jordan, T. H. 2014. Understanding Earth, 7th edition, W.H. Freeman and Company, New York, NY10010, USA.
- J. M., Pasachoff, N. and Cooney, T. M. 1983. Earth science Pasachoff, Scott and Foresman and Company, USA.
- Burrus, T. L. and Spiegel, H. J. 1980. Earth in crisis The C.V. Mosby Company, USA.
- Byrne, K. 1997. Environmental Science, 2nd edition Thomas Nelson and Sons Ltd., UK.
- W.P. Cunningham and B.W. Saigo 1999. Environmental Science, 5th edition McGraw-Hill Inc, New York, USA.
- Cesare Emiliani 1992. Planet Earth Cambridge University press, UK.
- Dunbar, C. O., Waage, K. M. 1969. Historical Geology, 3rd edition John Wiley and Sons, Inc., USA.
- Howard, A.D. and Remson, I. 1978. Geology in Environmental Planning McGraw-Hill Book Company, New York, USA.
- Reiman, KU. 1993. Geology of Bangladesh Gebruder. Berlin, Stuttgart.
- Todd, D.K. 1989. Groundwater Hydrology, John Wiley and Sons Inc., USA.
- Herman bouwer, 1978. Groundwater Hydrology MC Graw-Hill Inc.
- Tissot, B.P. and Welte, D.H. 1984. Petroleum Formation and Occurrence. Springer-Verlag, berlin Heidelberg, New York.
- P. S. Rahman 2005. Environmental Science and Biogeography Published by ABOSAR, Dhaka. Bd.
- Imam, M. B. 1996. Mineral resources of Bangladesh. Bangla Academy, Dhaka, Bangladesh.
- Tony Moore and Raj Lakha, (Eds.) 2006. Tolley's Handbook of Disaster and Emergency Management, Taylor & Francis; 3rd edition, UK.
- Alexander, David 2002. Principles of Emergency Planning and Management Oxford University Press, USA.
- Tony Moore, 2008. Disaster and Emergency Management Systems. BSI Standards, UK.
- Abbott, Patrick L. 2008. Natural Disasters McGraw-Hill Science Engineering, New York, USA.
- David, Alexander 1993. Natural Disasters Routledge, London, UK.
- Toft, B. and S. Reynolds, 1994. Learning from Disasters: A Management Approach Butterworth Heinemann, Oxford, UK.
- Blaikie, Piers, Terry Cannon, Ian Davis and Ben Wisner, 2004. At Risk: Natural Hazards, People's Vulnerability and Disasters Routledge, London, UK.
- Levitt, Alan M., 1997. Disaster Plan and recovery – A guide for facility process John Wiley and Sons, Inc., USA.
- Stephan Baas, Selvaraju Ramasamy, Jenny Dey de Pryck, Federica Battista, 2008. Disaster Risk Management Systems Analysis Food & Agriculture Org. Rome Italy.

ENVC 704: Environmental Chemistry

- 1. Course Title:** Environmental Chemistry
- 2. Course Number:** ENVC 704
- 3. Course Type:** Compulsory
- 4. Course Level:** MPhil/PhD
- 5. Course Term:** July- December
- 6. Course Credit:** 02
- 7. Total marks:** 50 (Examination: 30; Assignment, Tutorial: 15 & Attendance: 5)
- 8. Course Instructors:** Professor. Md. Golam Mostafa

9. Overview

Environmental Chemistry will provide a broad overview of many important environmental issues. It will also give students the most reliable and recent scientific information available, so that they may draw independent and informed conclusions about these issues. The course addresses the chemistry of elements and compounds in the atmosphere, water, and soil and their consequences in the environment. This course is designed to provide fellows with a basic understanding of environmental chemistry and to apply to the study of environmental issues in Bangladesh.

10. Course Learning Objectives:

1. The fellow will be able to describe the importance of the study of environmental chemistry, interpret the chemistry of the atmosphere, water, and soil.
2. The fellow will learn to interpret how the pollutants, contaminants and toxic substances interact with the environment, and identify the sources of pollution; describe the metals, toxic metals, and nonmetals, and their fates and effects.
3. The fellow will be able to explain some of the analysis methods employed in environmental chemistry, and evaluate the practical chemistry in the pollution mitigation strategies.
4. The fellow will interpret data calculations accurately and present environmental scientific ideas and practices in publication and report writing.

11. Course Learning Outcomes:

On successful completion of the lesson, the Fellow will be able to:

CO 1	Describe the importance and scope of the study of environmental chemistry.
CO 2	Explain the chemistry of the atmosphere, water, and soil, and demonstrate the interactions between different sectors of the environment.
CO 3	Interpret the pollutants, contaminants, and toxic substances.
CO 4	Identify and explain the sources of pollution and how the pollutants are transported, their fates and effects on the environment.
CO 5	Describe the metals, toxic metals, and nonmetals and their impacts on the environment.
CO 6	Explain some analysis methods employed in environmental chemistry.
CO 7	Evaluate the practical chemistry in the anthropogenic impact of industrial processes and pollution mitigation strategies.
CO 8	Interpret data calculation and accurately portray and present environmental scientific ideas and practices in presentation, publication, and report writing.

CO: Course Outline

12. Course Content:

COs	Course Content	Lectures
CO 1	Concepts of Environmental Chemistry and their scopes	2
CO 2	Chemistry of atmosphere (Ozone Layer, Ozone Holes, Greenhouse Effect) hydrosphere (fundamentals of aquatic chemistry, gases in water, organic matter in water, metals in water), biosphere and lithosphere	3
CO 3	Pollutants, contaminants toxic substances, pesticides and therapeutic agents	3
CO 4	Detection of pollutants their sources, fates, and effects	3
CO 5	The Chemistry of transition metals, toxic heavy metals and non-metals, and their impacts on human health and the environment.	3
CO 6	Theoretical basis of quantitative inorganic analysis, volumetric, gravimetric, colorimetric, and spectrophotometric analysis	2
CO 7	Instrumental principles: Lambert Law, Beer Law, Atomic Absorption Spectrophotometer, other basic analytical instruments, and their applications in sampling and analysis	2
CO 8	Select an environmental issue and training in scientific presentation and publication.	3

13. Teaching and Learning Strategies: An interactive class room including teaching learning-based instructions, audio-visual presentations, inquire-based education, and seminars.

14. Assessment Techniques of the Course: Formal Examination-35 marks

Class attendance: 5 Assignments, class test, quiz, oral presentation: 10 marks

15. References:

OD Tragi, MM Mehra and M Mehta, 1996. A Text Book of Environmental Chemistry Anmol Publ., New Delhi.

Wright, John 2003. Environmental Chemistry, Routledge, Taylor & Francis Group, London and New York.

Stanley Manahan, 2017. Environmental Chemistry, 10th Edition CRC Press, ISBN 9781498776936 - CAT# K29755

Kudesia VP. 2003. Environmental Chemistry, Pragati Prakashan, New Delhi.

Benerji. SK. 1999. Environmental Chemistry PHI Learning Ltd., India.

Vogel AI. 1966. A Text Book of Quantitative Inorganic Analysis Longmans Green and Co., UK.

Trivedi PR. 2007. Environmental Water and Soil Analysis Akashdeep Publ. House, India.

Sharma PD. 2000. Environmental Biology and Toxicology MacMillan, India.

Manahan, Stanley E. (Eds.) 2013. Fundamentals of Environmental and Toxicological Chemistry: Sustainable Science, Fourth Edition, CRC Press, ISBN 9781466553163 - CAT# K15260

Other Resources: Online search, articles published in different journals including Elsevier, Springer, and daily newspapers.

ENVC 705: Environmental Pollution and Waste Management

1. Course Title: Environmental Pollution and Waste Management

2. Course Number: ENVC 705

3. Course Type: Compulsory

4. Course Level: MPhil/PhD

5. Course Term: July- December

6. Course Credit: 02

7. Total Marks: 50 (Examination: 30; Assignment, Tutorial: 15 & Attendance: 5)

8. Course Instructor: Associate Professor Zakiya Yasmin

9. Course Overview

This course is designed to provide fellows with a basic understanding of environmental pollution and waste management and to apply it to the study of environmental pollution and waste management issues in Bangladesh.

10. Course Learning Objectives:

- The fellow will understand the basic knowledge of environment, environmental pollution, waste and waste management techniques.
- The fellow will be able to describe different types of environmental pollution, sources, effects and how to control them.
- The fellow will understand about different types of wastes, sources and effects.
- They will also describe the management techniques, recovery of resources and disposal the wastes.

11. Course Learning Outcomes:

On successful completion of the lesson, the fellow will be able to:

CO1	Define environment, environmental science, ecology, ecosystem, bio-diversity, environmental pollution, pollutants etc.
CO2	Describe different types of environmental pollution, their sources, effects and management techniques.
CO3	Know about waste, types of wastes, sources and effects.
CO4	Know about waste management techniques, recovery of resources and disposal the wastes.

12. Course Contents:

CO _s	Course Contents	Lectures
CO1	Basic knowledge of environment, environmental science, environmental pollution, pollutants, ecology, ecosystem, bio-diversity.	1
CO2	Types of environmental pollution: definition of air, air pollution, composition of air, sources of air pollution, effects and control of air pollution.	1
CO3	Some major air pollutants, their sources, effects	1
CO4	Water pollution: definition of water pollution, its sources, effects and control of water pollution	1
CO5	Various types of water pollution: sea water pollution, ground water pollution etc	2
CO6	Soil pollution: definition of soil, soil pollution, composition of soil,	1

	types of soil, sources of soil, effects and control of soil pollution	
CO7	Sound pollution: definition of sound, sound pollution, sources, effects and control of sound pollution.	1
CO8	Radiation pollution: Definition of atom, atomic number, mass number, isotope, isobar, radioactivity, half life, radiation pollution, sources, effects and control of radiation pollution	2
CO9	Definition of waste, types of wastes, sources.	1
CO10	Domestic waste: sources, disposal and dumping, recovery of resources	2
CO11	Hazardous waste: sources, different types of treatment techniques	2

13. References

Trivedi RN. 1997. A Text Book of Environmental Science Anmolpubl.

Satter M.A. 1996. Text Book of Environmental Science.

Kudesia, V.P. 1980. Water Pollution Pragati Prokashon.

Tripathi AK. 1990. Water Pollution Ashish Publ. New Delhi.

Rao MN. 1989. Air Pollution Tata McGraw Hill Publ, Co.

Sparks DL. 1995. Environmental Soil Chemistry Academic Press.

Wentz C.A. 1989. Hazardous Waste Management McGraw Hill Co.

14. Teaching and Learning Strategies: Teaching is given by frontal lecture and on assignment seminar.

15. Assessment Techniques of the course: Formal Examination- 35marks, Assignment- 10 marks and class attendance- 05 marks.

ENVC 706: Research Methodology

1. Course Title: Research Methodology

2. Course Number: ENVC 706

3. Course Type: Compulsory

4. Course Level: MPhil/PhD

5. Course Term: July- December

6. Course Credit: 02

7. Total marks: 50 (Examination: 30; Assignment, Tutorial: 15 & Attendance: 5)

8. Course instructor: Professor Sabrina Naz

9. Overview/description

This course is designed to provide fellows with a basic understanding of research methodology including research design, survey, data acquisition and design, analysis and interpretation of data related to environmental issues of Bangladesh.

10. Course Learning Objectives:

1. Fellows will be able to explain the basic understanding of environmental, scientific, sociological and statistical methods of environmental researches.
2. The Fellow will be able to describe the application of environmental, scientific, sociological and statistical methods of environmental researches.
3. The Fellows will be able to interpret the scope and applicability of the individual methods of sampling, analysis and interpretation of individual methods in environmental assessment
4. Fellows will be able to describe how to achieve skills in presentation and group discussion.
5. Fellows will be able to describe and narrate illustrations, figures, graphs curves or models to make their thesis more acceptable.
6. The Fellow will have the knowledge to published their article in reputed peer review journals and have the experience to choose proper journals for publications.

11. Course Learning Outcomes:

On successful completion of the lesson, the Fellow will be able to:

CO 1	Describe the importance, components and processes of research. Narrate how they will formulate research hypothesis and proposal and its outcome for the wellbeing of the society.
CO 2	Narrate how to prepare questionnaire, conducting field survey, procedure of data acquisition, and finally data analysis, presentation, and interpretation
CO 3	Describe about literature review, structure and quality of PhD/M.Phil. thesis, and build up confidence for defense.
CO 4	Narrate the procedure and technique of data processing; handling models, software and Spreadsheet analysis.
CO 5	Discuss the different statistical methods to quantify the data and the authenticity of the data set fort acceptability of the results.
CO 6	Explain the elementary and basic skills on computing and relevant rules and regulation.
CO 7	Describe how to formulated project or research work, its planning and management, and skill development etc.
CO 8	Explain the accurate procedure of scientific writing editing and publishing.

CO: Course Outline

12. Course Content:

COs	Course Content	Lectures
CO 1	Introduction to research; components and processes of research, its social responsibility, facilitation, hypothesis, and research proposal	2
CO 2	Method of data acquisition, field surveys; questionnaire; data analysis, presentation, and interpretation	2
CO 3	Quality thesis and its literature review, structure of PhD thesis, facing viva-voce.	2
CO 4	Data processing: Mathematical modeling software and program-based studies on environmental problems; Microsoft Excel, Graphical representation, Data Entry, Spreadsheet Analysis.	3
CO 5	Statistical analysis: 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.	6
CO 6	Basic skills: basic computing, finding information, safety, ethics etc.	2
CO 7	Project development: training and guidance in planning and managing research work; Personal skills: skills in negotiations, team working, assertiveness and other transferable skills;	2
CO 8	Scientific article writing editing and publishing;	2
CO 9	GIS and Remote Sensing as a tool of Research.	

13. Teaching and Learning Strategies: An interactive class room including teaching learning-based instructions, audio-visual presentations, inquire-based education, field trips and seminars.

14. Assessment Techniques of each topic of the courses: Formal Examination- 35marks, Assignment- 10 marks and class attendance- 05 marks.

15. References:

- C.R. Kothari, 2008. Research Methodology, Methods and Techniques, 2nd Edition, New Age International Publishers, India.
- S.B. Mishra and S. Alok, 2000, Handbook of Research Methodology, A compendium for Scholars and Researchers,
- S. Rajasekar, P. Philominathan, and V. Chinnathambi, Research Methodology.
- P. Clough and C. Nutbrown. A Student guide to Methodology, 3rd Edition,
- J. Hartley, 2004. On writing scientific articles in English, Science Foundation in China, v.11 (2), p.53–6
- R. Murray, 2002. Buckingham, Open Univ. Press
- S. Delamont and P. Atkinson 2004. Successful Research Careers by Maidenhead: Open Univ. Press.

Other Resources: Online search, articles published in different journals including Elsevier, Springer. Training Workshop on GIS and Remote sensing;

Optional Courses

ENVO 701: Biodiversity

- 1. Course Title:** Biodiversity
- 2. Course Number:** ENVO 701
- 3. Course Type:** Optional
- 4. Course Level:** MPhil/PhD
- 5. Course Term:** July- December
- 6. Course Credit:** 02
- 7. Total marks:** 50 (Examination: 30; Assignment, Tutorial: 15 & Attendance: 5)
- 8. Course instructor:** Professor. Md. Redwanur Rahman
- 9. Overview/description**

This course will provide you a comprehensive overview of Biodiversity, biodiversity conservation nationally and internationally, legal context for biodiversity conservation management, protected area management plan and planning process. Throughout the course, we will examine environmental issue and investigate realistic solutions. The class will use narrated PowerPoint and video clips to introduce biodiversity topics. By the end of the course, you will have a greater understanding about the biodiversity and their effect in the world.

10. Course Learning Objectives:

The specific course objectives are to develop the abilities of students to:

1. The fellow will critically engage with concepts and theory in biodiversity science and management from interdisciplinary perspectives and at an advanced level;
2. The fellow will describe by whom and by what space and territory is produced and governed in biodiversity conservation over time;
3. The fellow will critically assess the modes through which biodiversity conservation builds and extends power and describe in detail the factors that explain the emergence and performance of different governance modes;
4. To understand about the appreciate role of ethics, values and norms in producing culturally attuned and effective conservation interventions;
5. To learn about the embrace of implications of new technological forces for the future of biodiversity science and management;
6. To acquire knowledge on link theory, hypothesis, methods, data and field work so as to identify and develop advanced research questions and design dissertation research that is identifiable with a professional research approach.

11. Course Learning Outcomes:

On successful completion of the lesson, the Fellow will be able to:

CO 1	Know the importance relevant key term and understanding the legal context for biodiversity conservation management;
CO 2	Know the main elements of a protected area and the legal framework that underpins biodiversity conservation and management plan nationally and internationally;
CO 3	Know the various national and international categories and designations that can apply to protected areas, and how they affect biodiversity conservation;
CO 4	Understand the meaning of the term 'stakeholder' and the roles that various stakeholders can plan in biodiversity conservation management;
	Understand the meaning of the term 'governance' and the relevance of

	governance to biodiversity conservation.
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CO: Course Outline

12. Course Content:

COs	Course Content	Lectures
CO 1	Concepts of Biodiversity and scopes	2
CO 2	<p>Definition, Important terminology</p> <p>This lesson introduces about the defining important terms with examples of their relevance to biodiversity conservation management. Some important terms as: Abiotic (physical) environment, Biome, Biogeographic region, Ecological community, Climate, Ecosystem, Species, Topography, Micro-habitat, Metapopulation, Macro-habitat, Landform, Land use, Biotic resource use. Physical resource use, Landscape (ecological), Landscape/ Seascape, Hydrography, Habitat, Climate, Weather, Geology, Higher Plants, Lower Plants, Mammals, Fish, Amphibians, Reptiles, Birds, Macroinvertebrates, Macroinvertebrates, Fungi, Monera & Protista.</p>	3
CO 3	<p>Legislation and designations of Biodiversity Conservations</p> <p>This lesson states the biodiversity conservation rules and legislations. For example: What does the law say about the purpose and role of protected areas? What does the law say about biodiversity conservation? Why was the Protect Area (PA) established? What does the documentation say? What is the reason for establishment and the main values of the park? What is the category of the PA (national and international)?</p>	2
CO 4	<p>Main categories of information for biodiversity conservation management</p> <p>This lesson discusses about the information of biodiversity conservation management. The important context are follows in bellow: Establishing document of the PA, Boundaries of the PA, Legal status of the PA, Stakeholder analysis, Land tenure and rights, Land and resource use, Neighboring land users, Management history and records, Research and educational use, Map coverage Physical Environment: Geology/Landforms, Hydrography, Climate, Soil Biotic Environment: Biogeographical areas, Flora, Fauna, Mammals, Birds, Fish, Reptiles and Amphibians, Invertebrates, Ecosystems and habitats, Landscapes</p>	2
CO 5	<p>Identifying and mapping ecological units</p> <p>This lesson illustrates the key of mapping ecological units. The important keys as follows: The main types of ecological unit used for subdividing protected areas and landscapes at different scales (e.g., biome, landscape, ecosystem, habitat, community etc.), The standard ecological units used in the country or region (e.g., Corine biotopes). Sources of information about ecological units. Simple techniques for identifying and mapping ecological units. Deciding the most appropriate 'resolution' of information required for starting effective management.</p>	2

14. Assessment and Evaluation Policy:

Field Trip: 5, Assessment - 5, Presentation - 5, Attendance - 5 and Semester Final: 50

References:

- See E. O. Wilson, ed., *Biological Diversity* (1988); N. Eldredge, *Life in the Balance* (1998).
The Columbia Encyclopedia, 6th ed. Copyright© 2018, The Columbia University Press.
- Dudley, N. et al (2013) Guidelines for applying protected area management categories. IUCN, Gland, Switzerland.
- Marega, M and Uratarič, N. *Guidelines on Stakeholder Engagement in Preparation of Integrated Management Plans for Protected Areas*. Institute of the Republic of Slovenia for Nature Conservation, Ljubljana
- Bibby, C., Jones M. and Marsden, C. (2000) Expedition Field Techniques. Bird Surveys. Expedition Advisory Centre, Royal Geographical Centre, London.
- Hill, D., Fasham, M., Tucker, G., Shewry, M. and Shaw, P. (2005). Handbook of Biodiversity Methods. Survey, Evaluation and Monitoring. Cambridge University Press, Cambridge.

Reference Books:

- Lausche, B. (2011). Guidelines for protected area legislation. IUCN, Gland, Switzerland.
<https://portals.iucn.org/library/efiles/documents/eplp-081.pdf>
http://www.natreg.eu/uploads/Guidelines_stakeholder%20engagement_final.pdf
- Stanciu, E. and Ioniță, A. Governance of Protected Areas in Eastern Europe. Overview on different governance types, case studies and lessons learned. Bundesamt für Naturschutz, Bonn.
<http://propark.ro/images/uploads/file/publicatii/Skript360.pdf>
- Worboys et. Al (2015) Protected area governance and management. ANU Press, Canberra.
<http://press.anu.edu.au/titles/protected-area-governance-and-management-2/protected-area-governance-and-management/>
http://www.conservationleadershipprogramme.org/media/2014/09/Bird_Surveying_Manual.pdf
- Bonar, S. (2007) *The conservation professional's guide to working with people*. Island Press. Washington DC.
https://books.google.co.uk/books/about/The_Conservation_Professional_s_Guide_to.html?id=BQqqypfx1mIC&redir_esc=y
- Encyclopedia of Biodiversity v.1-3 by Prabhakar VK. 1999, Anmol Publ., New Delhi

Online Resources:

- Google search of global biodiversity issues and articles of biodiversity journals of Elsevier, Springer, Willey and Sons, etc.

ENVO 702: Limnology and Aquaculture

1. **Course Title:** Limnology and Aquaculture
2. **Course Number:** ENVO 702
3. **Course Type:** Optional
4. **Course Level:** MPhil/PhD
5. **Course Term:** July- December
6. **Course Credit:** 02
7. **Total marks:** 50 (Examination: 30; Assignment, Tutorial: 15 & Attendance: 5)
8. **Course instructor:** Professor Sabrina Naz
9. **Overview/description:** The course is designed to give a comprehensive overview physical, chemical and biological characteristics of fresh water body; they will be able to know the inter relationship among biotic factors carbon dynamics; it will enable their knowledge regarding water pollution and its management. I will provide them to achieve knowledge on aquaculture of Bangladesh.
10. **Course Learning Objectives:**
 1. Fellows will be able to explain the basic of Limnology and Aquaculture.
 2. The fellow will be able to describe define wetlands, Flood plain characteristics, its application and importance in Bangladesh perspective.
 3. Fellows will be able to discuss the major components of inland water;
 4. Fellows will be able to identify and measure the trace elements, heavy metals and agrochemical residue found in water. Types of pollution and its management;
 5. Fellow will be able to identify sources of arsenic pollution in water, arsenic in nutrient cycle of aquatic environment, threats of pollution and mitigation;

11. Course Learning Outcomes (CO):

CO No.	Expected Course Outcomes
	Upon completion of this course, the students will be able to: learn the trends on
1	basic knowledge on the significance and potentiality of applied limnology and aquaculture.
2	identify phytoplankton and zooplankton, and to mark the similarities and dissimilarities between different taxa.
3	enable them to exploit different areas (environmental, industry, food and aquaculture) of life from above mentioned perspective.
4	apply the skills related to pollution identification and management; aquatic plant diversity management and conservation; practices related to aquaculture.

COs	Course Content	Lectures
CO 1	Wetland definition; Importance of wetlands; Flood plain wetlands and water bodies; Bangladesh: Chalan Beel, a case study;	06
CO 2	Lake energetics: Source, type, utilization, underwater light climate; water movement; photosynthetic behavior of natural photosynthesis (Neoblackman model), periodicity and vertical distribution of productivity	02
CO 3	Carbon dynamics in eutrophic lakes, location of DOC in the aquatic ecosystem; pelagic carbon cycling (phytoplankton EOC _n release).	02
CO 4	Phytoplankton, zooplankton, fish, and benthic community interactions.	02
CO 5	Applied limnology: a) Pollution; sources and types of pollution, b) Sewage & its treatment, origin & composition, mechanical, biological treatment c) Contaminated waters: self-purification, process; indicator organism, rehabilitation of water; biomanipulation; bioaccumulation and effects of persistent pollutants.	4
CO 6	Trace elements of water; the role of agrochemicals and heavy metals in water pollution; impact on ecosystem health.	3
CO 7	Arsenic pollution in Bangladesh; accumulation in water bodies and food chain; impacts.	2
CO 8	Aquaculture: Definition and history; trends of Aquaculture in Bangladesh.	2
CO 9	Culture types: Monoculture, Polyculture; definition, pattern and techniques of composite culture, mixed and integrated fish farming in Bangladesh.	2
CO 10	Pond fertilization: Definition of fertilizer, manure, organic and inorganic fertilizers in fish ponds, drying of ponds, liming of ponds, water quality and fertilizers; impact on aquatic ecosystem; sustainability.	05
CO 11	Aquatic vegetation: Types of aquatic plants, role of aquatic plants in fish culture; conservation of aquatic biodiversity.	04

12. Assessment and Evaluation Policy: Field Trip: 5, Assessment - 5, Presentation - 5, Attendance - 5 and Semester Final: 50

13. Learning Resources:

- Wetzel, R.G. 1983. Limnology 2nd ed, W.B. Saunders Co., Philadelphia USApp767.
 Welch, S.Paul. 1948. Limnological methods. McGraw Hill Book Company, New York, pp.377.
 Agrawal, S.C. 1999. Limnology. AP.H Publishing Corporation New Delhi. India.
 Islam, Anowarul. Mocher Pukurer Pani (evsjv GKv‡Wgx)
 Khondker, Moniruzzaman 1995. Limnology (cÖKvkK, XvKv wek|we`vjq, XvKv|)
 Das, Bishnu Motsho Babosstapona (Vol. I-IV)
 Nishat Ainun, Hossain Zakir, Roy Monoj Kanti and Karim Ansarul(1993), Freshwater Wetlands of Bangladesh: Issues and Approaches. IUCN.

ENVO 703: Environment, Media and Society

1. **Course Title:** Environment, Media and Society
2. **Course Number:** ENVO 703
3. **Course Type:** Optional
4. **Course Level:** MPhil/PhD
5. **Course Term:** July- December
6. **Course Credit:** 02
7. **Total marks:** 50 (Examination: 30; Assignment, Tutorial: 15 & Attendance: 5)
8. **Course instructor:**
9. **Overview/description**

This course is designed to provide fellows with a basic understanding to explore how media and communication process are central to know about and make sense of our environment and to the ways in which environmental concern are generated, elaborated, manipulated and contested. Environmental education (EE) can help people become aware of the consequences of their actions, provide information to help solve environmental problems, and build the human capacity necessary to solve and prevent environmental problems. Communication is a central aspect how we come to know, and to know about, the environment and environmental issues, and communications media are central public arena through which we become aware of environmental issues and the way in which they are addressed, contested, and, perhaps, resolved.

10. Course Learning Objectives:

1. Fellows will be able to explain the basic understanding of environmental, social and role of media.
2. The Fellow will describe how environmental discourses influence understandings and response to contemporary environmental problems.
3. The Fellow will narrate economic, political, cultural and ethical perspectives on environmental problems.
4. Fellows will be able to discuss about different types of social transitions - transformations that are considered necessary for creating a resilient and sustainable future.
5. Fellows will discuss how this interdisciplinary subject, both natural and human environments have been shaped by media representations and contemporary technologies.
6. Fellow will talk about the specific roles of media both in shaping modern environmental advocacy, movements and in setting broader conditions for the perception of the environment.

11. Course Learning Outcomes:

On successful completion of the lesson, the Fellow will be able to:

COs	Course Content
CO 1	Describe the relationships among environment, traditional media, media technologies, and the society.
CO 2	Narrate the human-environment relationships, power and society and it

	influence on system.
CO 3	Describe about how representation of media influencing our society relating to the contemporary environmental issue.
CO 4	Describe how media will influences public perception, politics and policy.
CO 5	Narrate new environmental knowledge and technology related theory and practice.
CO 6	Explain how social transformations are require for the resilience and sustainable development.

CO: Course Outline

12. Course Content:

COs	Course Content	Lectures
CO 1	Introduction to the relationships among environment, media and the society, including the representation of nature in traditional media such as newspaper, television, radio and film. The material entanglements of media technologies.	2
CO 2	Understandings of human-environment relationships, social change, conceptions of power, and the role of individual and collective action in systems-scale change.	3
CO 3	Representation of media and influence our society, especially in connection with environmental issues and its outcomes.	3
CO 4	Influence and impact of media over environmental politics and policy, environmental public perceptions.	3
CO 5	New technologies, ecological urbanism, popular culture, environmental risks and problems, environmentalism, and environmental knowledge related theory and practice.	4
CO 6	Different types of social transitions and transformations that are considered necessary for creating a resilient and sustainable future.	3

13. Teaching and Learning Strategies: An interactive class room including teaching learning-based instructions, audio-visual presentations, inquire-based education, field trips and seminars.

14. Assessment Techniques of the course: Formal Examination-35 marks, Class attendance: 5 Assignments, class test, quiz, oral presentation: 10 marks

15. References:

Environment media and Communication, 2019. Anders Hansen. 2nd edition, Routledge, London.
Controversies in Environmental Sociology (ed) by Rob White; 2004, Cambridge University Press, U.K.

Culture, society and the media by M Gurevitch, T Bennett, J Curran and J Woollacott; 2005, Routledge, London.

Media, Environment and the Network Society by Alison G. Anderson; 2014, Palgrave Macmillan, U.K.

Voice and Environmental Communication (ed) by J Peeples, S Depoe; 2014, Palgrave Macmillan UK.

Communication Theory: Media, Technology, Society by David Holmes; 2005, SAGE, London

Media Art and the Urban Environment: Engendering Public Engagement with Urban Ecology (ed) by Francis T. Marchese; 2015, Springer, New York.

Environmentalism and the mass media: The North-South divide by G Chapman, K Kumar, C Fraser and I Gaber; 1997, Routledge, London.

ENVO 704: Climate Change and Adaptability

1. Course Title: Climate Change and Adaptability

2. Course Number: ENVO 704

3. Course Type: Optional

4. Course Level: MPhil/PhD

5. Course Term: July- December

6. Course Credit: 02

7. Total marks: 50 (Examination: 30; Assignment, Tutorial: 15 & Attendance: 5)

8. Course instructor: Professor Sabrina Naz

9. Overview/description

This course seeks to impart a broad understanding of the theory, methods, tools and skills required for conducting analyses of vulnerability and adaptation to climate variability and change (including extreme climatic events); and other environmental changes. Additionally, the course emphasizes the integration of disciplines and covers a range of subject matter, from climate science, biophysical environmental impacts to socio-economic effects.

10. Course Learning Objectives:

This course is designed to provide fellows with

1. Fellows will acquire a basic understanding of climate change,
2. Fellows will be able to narrate the consequences of climate change
3. Fellows will be able to formulate policies for sustainable development, and
4. They will explain the study of climate change and environmental issues in Bangladesh.
5. Fellows will describe how to transfer knowledge to the community

11. Course Learning Outcomes

On successful completion of this course, Fellows should be able to:

COs	Course Content	Lectures
CO 1	Describe the potential of Climate change issues, its impact in both regional and global scale	2
CO 2	Narrate the causes, source and emissions of Green House Gas (GHG) and impact on climate change on water, air, agriculture, foods, biodiversity, health etc.:	4
CO 3	Recount the natural hazard of flood, drought, water and sea level, salinity	3
CO 4	Relate climate change issues from Bangladesh perspectives	3
CO 5	Describe the regulations, legislation, policy, act, convention at national and international level.	3
CO 6	Narrate the public response relating to climate change and GHG	2
CO 7	Discuss about adaptation, mitigation and conservation of renewable and nonrenewable sources.	2
CO 8	Narrate the ongoing Climate Change issues at international spheres	3

CO: Course Outline

12. Course Content:

COs	Course Content	Lectures
CO 1	Climate change: local and global issues, its vulnerability and evidences; Key climate issues	2
CO 2	Greenhouse: its sources and emissions; Global warming and its impacts; causes of climate change, impacts of climate change on water, air, agriculture, foods, biodiversity, health etc.:	4
CO 3	flood, drought, water and sea level, salinity	3
CO 4	Bangladesh perspectives: climate change issues and adaptation.	3
CO 5	Policy and legislations relevant to climate change and environmental sustainability;	3
CO 6	Responses - emission control of greenhouse gases, social responses to threat of global climate change	2
CO 7	impacts and adaptation policies, climate convention, food security, energy and fossil fuel conservation	2
CO 8	Convention on Climate Change.	3

13. Teaching and Learning Strategies: Teaching is given both lectures and seminars

14. Assessment Techniques of the course: Formal Examination-35 marks, Class attendance: 5 Assignments, class test, quiz, oral presentation: 10 marks

15. References:

Climate Change: Picturing the Science by G Schmidt J Wolfe JD Sachs, WW Norton & Company, 2009.

Climate Change: The Science of Global Warming and Our Energy Future by EA Mathez, Columbia Univ. Press, USA, 2009.

An Introduction to Global Environmental Issues by Pickering KT and Owen LA. 1997. Routledges.

Inter governmental Panel on Climate Change (IPCC): Special report on carbon dioxide capture and storage. Cambridge University Press, UK. 422p.

National Environment Management Action Plan (NEMAP) Ministry of Environment and Forest, GoB, 1995.

Environmental aspects of agricultural Development in Bangladesh, by S Huq, A Atiq Rahman, GR Coorway, 1990.

Climate Change Adaptation Actions In Bangladesh Disaster Risk Reduction: Method, Approaches and Practices. Rajib Show, Fuad Mallick and Aminul Islam (edts) Springer, 2013.

Experiencing Climate Change in Bangladesh. Vulnerability and Adaptation in Coastal Regions by Salim Momtaz Masud Shameem, 2017. Elsevier Publ. ISBN: 978-0-12-803404-0

Brammer, H., Asaduzzaman M. & Sultana, P., 1993. Effects of Climate and Sea-level Changes on the Natural Resources of Bangladesh. Briefing Document No. 3, Bangladesh Unnayan Parishad (BUP), Dhaka.

Dalby, S., 2002. Environmental Change and Human Security, ISUMA, pp.71-79.

Elliott, L., 2004. The Global Politics of the Environment, Palgrave Macmillan, New York.

Islam, M.S., 2001. Sea-level Changes in Bangladesh: The Last Ten Thousand Years. Asiatic Society of Bangladesh.

ENVO 705: Water Resources Planning and Management

1. **Course Title:** Water Resources Planning and Management
2. **Course Number:** ENVO 705
3. **Course Type:** Optional
4. **Course Level:** MPhil/PhD
5. **Course Term:** July- December
6. **Course Credit:** 02
7. **Total marks:** 50 (Examination: 30; Assignment, Tutorial: 15 & Attendance: 5)
8. **Course instructor:**
9. **Overview**

Bangladesh is globally known as one of the most vulnerable countries to climate change. Increasing populations and climatic change are causing increasing demands for water. The water resources are closely linked with climatic factors and the most damaging effects of climate change are predicted to be floods, salinity intrusion, and droughts. The course will look at water management in detail through the analysis of the different types of rights and obligations. This course is designed to develop a basic understanding of how to plan, develop and manage water resources.

10. Course Learning Objectives:

1. The graduate will describe the importance of groundwater and surface water resources and evaluate water supply-demand issues.
2. The graduate will explain the concept of water resource planning, sustainable yield of the water resources and interpret how the barrages and dams' impact on the environment
3. The graduate will interpret the existing flood action plan and national water management plan of Bangladesh and explain how to implement IWRM the principles in different regions
4. The graduate will interpret data calculation accurately and present scientific ideas and practices in publication and report writing.

11. Course Learning Outcomes:

On successful completion of the lesson, the Fellow will be able to:

CO 1	Describe the potential of groundwater and surface water resources
CO 2	Interpret water Supply/Demand issues including water demand management
CO 3	Explain the concept of water resource planning and sustainable yield of the water resources and how to determine the needed storage of water reservoirs.
CO 4	Interpret the barrages and dams and their impacts on the environment
CO 5	Learn about the existing flood action plan and national water management plan of Bangladesh
CO 6	Explain IWRM principles and implement in water resources management
CO 7	Interpret data calculation and accurately portray and present environmental scientific ideas and practices in presentation, publication, and report writing.

CO: Course Outline

12. Course Content:

COs	Course Content	Lectures
CO 1	Water resources, ground and surface resources; types of aquifers, ground-surface water interaction.	3
CO 2	Water balance, available renewable water resources, water scarcity, water demand.	4
CO 3	Planning concepts of water resources, data requirements for water resources planning, determination of sustainable yield, storage reservoirs, aquifer protection and rehabilitation.	4
CO 4	Functions of water resources management, Farraka barrage, water scarcity and its impacts	
CO 5	Flood action plan and national water management plan of Bangladesh.	3
CO 6	Definition of IWRM, IWRM Principles, Implementation of IWRM in watershed and river basin Management.	3
CO 7	Select a water resource relevant issue and training in scientific data analysis, presentation and publication.	4

13. Teaching and Learning Strategies: An interactive class room including teaching learning-based instructions, audio-visual presentation, inquire-based education and seminars.

14. Assessment Techniques of the course: Formal Examination-60 marks

Class attendance: 10 Assignments, Class test, quiz, oral presentation: 30 marks

15. References:

Water Resources: Environmental Planning, Management, and Development by AK Biswas, 1998. Tata McGraw-Hill, New Delhi.

Water Resources Systems Planning and Management: An Introduction to Methods, Models and Applications by Daniel P. Loucks and Eelco van Beek, 2005, UNESCO, 7, place de Fontenoy F-75352 Paris 07 SP

Water resources Systems Planning by MC Chaturvedi. 1997. Tata McGraw-Hill Publ., New Delhi.

Reference Books:

Water Technology by NF Gray. 2011. Taylor Francis, London, UK.

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

Environmental Impacts Assessment of Water Resources Projects by RS Goel. 2000. Oxford & IBH Publ., India.

Water Resource Planning and Management, edited by R. Quentin Grafton and Karen Hussey, 2011, Cambridge University Press, Australia.

Water Resources management by David Stephenson, 2003. CRC Press

Other Resources: Online search, articles published in different journals including Elsevier, Springer, and daily newspapers.

ENVO 706: Environmental Microbiology

1. **Course Title:** Environmental Microbiology
2. **Course Number:** ENVO 706
3. **Course Type:** Optional
4. **Course Level:** MPhil/PhD
5. **Course Term:** July- December
6. **Course Credit:** 02
7. **Total Marks:** 50 (Examination: 30; Assignment, Tutorial: 15 & Attendance: 5)
8. **Course Instructors:**
9. **Course Overview:**

This course will provide information about basic microbiology, microbial ecology, and pollution microbiology including bioremediation and wastewater treatment. Through this course students will understand the basic microbiology as well as the potential of use microorganisms to solve the water pollution and solid waste problems in the environment.

10. Course Learning Objectives:

This course will help to fellows

- To state the concepts of environmental microbiology
- To differentiate the environmentally beneficial and harmful microbes
- To use of microbes in waste water treatment and biodegradation of toxic compounds
- To apply the microbes for biogas and bioethanol production

11. Course Learning Outcomes:

On successful completion of the lesson, the fellows will be able to

CO 1	Describe microbial structure, function and energy transfer system
CO 2	State nitrogen, sulfur and iron cycles involving microbes in ecosystems
CO 3	Identify the harmful microbes and coliform in water
CO 4	State the microbial decomposition of pesticides and xenobiotics in nature
CO 5	Use of microbes for renewable fuel and wastewater treatment

12. Course Contents:

COs	Course Contents	Lectures (hrs)
CO 1	Microbial cell structure and function – cell membranes. Oxidation-reduction reactions, electron carriers, high energy compounds. Anaerobic respiration.	4
CO 2	Aquatic and terrestrial ecosystems for microorganisms. Abiotic factors affecting ecosystems. Biogeochemical cycles (Nitrogen, sulfur, and iron cycles).	4
CO 3	Pathogenic microbes in domestic water, coliform bacteria and role of bacteria in waste water treatment process.	4
CO 4	Decomposition of toxic compounds; use of bacteria and fungi to detoxify wastes, and conversion into usable substances. Biodegradation of pesticides, cellulose, aromatics and	5

	hydrocarbons.	
CO 5	Bio-gas and bio-ethanol production. Microbial role in wastewater treatment and solid waste management.	4

13. Teaching and Learning Strategies: Oral lecture, field trip and seminar

14. Assessment Techniques of the course: Formal Examination-35 marks, Class attendance: 5 Assignments, class test, quiz, oral presentation: 10 marks

15. References:

Text Books:

Microbiology by Pelczer. 2015. TMH, India.

Principles of Environmental Science by Cunningham, W.P., Cunningham, M.A. and Saigo, B.W. 2014. Tata McGraw Hill, India.

Microbial Ecology: Fundamentals and Applications, 4th Ed. by Atlas and Bartha, Benjamin Cummings, 1998

Reference Books

Microbiology: An Evolving Science, 2nd Ed. By Slonczewski and Foster, Norton Publishing, 2011

Biochemistry, 4th Ed. by Stryer, Freeman Press, 1995

ENVO 707: Environment and Education

1. **Course Title:** Environment and Education
2. **Course Number:** ENVO 707
3. **Course Type:** Optional
4. **Course Level:** MPhil/PhD
5. **Course Term:** July- December
6. **Course Credit:** 02
7. **Total marks:** 50 (Examination: 30; Assignment, Tutorial: 15 & Attendance: 5)
8. **Course instructor:**
9. **Overview/description**

This course is designed to provide fellows a clear knowledge how environmental education addresses the dimension of sustainable development. The environmental education includes both science and the democratic process, attempting to educate future citizens in the craft of making informed personal and social decisions in their lives. The environmental issue as an educational context still offers the greatest potential for educators to address sustainable development

10. Course Learning Objectives:

1. Fellows will be able to explain the essential knowledge and skills to design, develop, and evaluate approaches to Environment and Education (E&E)
2. The Fellow will describe how both local and global perspectives of E&E that will help them to identify appropriate ways to implement E&E curriculum with a view to sustainable development.
3. The Fellow will narrate the about natural resources, environment, ecosystem, pollution and their management.
4. Fellows will be able to demonstrate the importance of E&E.
5. Fellows will discuss about the possibilities of E&E in Bangladesh at different education levels.
6. Fellows will be able to discuss about the contemporary issues of environment and discourse at both local and international level.

11. Course Learning Outcomes:

On successful completion of the lesson, the Fellow will be able to:

COs	Course Content
CO 1	Describe the relationships among environment and education
CO 2	Narrate the Environmental literacy, concepts, knowledge the and responsibilities of civilians.
CO 3	Describe about types of natural resources, natural and man induced environmental problems and their sustainable management.
CO 4	Describe how education may help to boost up family life and to control population growth and the role of government and non-government organizations.
CO 5	Narrate the approach and goals of environmental education at different education levels to.
CO 6	Explain what is going on in national and international level relating to the mitigation, resilience and sustainable development.

CO: Course Outline

12. Course Content:

COs	Course Content	Lectures
CO 1	Concept, importance, visions, aims and objectives o of Environmental Education (EE), History and Development of EE.	2
CO 2	Environmental literacy, concepts, knowledge, skill and attitudes to understand and address environmental issues. Personal and civic responsibilities.	3
CO 3	Renewable and nonrenewable natural resources, conservation of biodiversity and ecosystems, antrpogenig and geogenic impact on environment, pollution, environmental management, protection, and restoration.	3
CO 4	Population, health and family life education, role of government and non-government organizations.	3
CO 5	Goals and approaches of EE in Bangladesh. Development of an effective EE program. Integrating EE into national curriculum. EE in Bangladesh- Primary, Secondary and Higher education. EE Beyond the Classroom. Identifying and evaluating EE materials and resources. EE in Non-formal approach.	4
CO 6	Major international conferences, agreements and discourse on EE.	3

13. Teaching and Learning Strategies: An interactive class room including teaching learning-based instructions, audio-visual presentations, inquire-based education, field trips and seminars.

14. Assessment Techniques of the course: Formal Examination-35 marks, Class attendance: 5 Assignments, class test, quiz, oral presentation: 10 marks

15. References:

- Agarwal, S.P. and Aggarwal, J.C. (1996) Environmental Protection, Education and Development. New Delhi: New Concepts.
- Kumar, A. (2009). A text book of environmental science. New Delhi: APH Publishing Corporation.
- Palmer, J.A. (1998). *Environmental Education in the 21st Century: Theory, Practice, Progress, and Promise*. Routledge.
- Sharma, R. A. (2008). *Environmental Education*. Meerut: R.Lall Books Depot.
- Sytnik, K. M., Unesco., & United Nations Environment Programme. (1985). *Living in the environment: A sourcebook for environmental education*. Kiev: Unesco/UNEP.
- Tomar, A. (2007). *Environmental education*. Delhi: Kalpaz Publications
- Unesco-UNEP International Environmental Education Programme., Unesco Institute for Education., & Unesco. (1985). *A Comparative survey of the Incorporation of Environmental Education into School Curricula*. Hamburg: Unesco Division of Science, Technical and Vocational Education
- Unesco-UNEP International Environmental Education Programme, 1994, A prototype environmental educational curriculum for the middle school. Environmental Educational Series 29

ENVO 708: Remote Sensing and GIS

- 1. Course Title:** Remote Sensing and GIS
- 2. Course Number:** ENVO 708
- 3. Course Type:** Optional
- 4. Course Level:** MPhil/PhD
- 5. Course Term:** July- December
- 6. Course Credit:** 02
- 7. Total marks:** 50 (Examination: 30; Assignment, Tutorial: 15 & Attendance: 5)
- 8. Course instructor:**
- 9. Overview/description**

This course is designed to provide fellows with a basic understanding of Remote Sensing (RS) and Geographic Information System (GIS) techniques and to apply it to the study of environmental issues. RS and GIS application are currently applied as essential tools for environmental management. Introduction to and learning now-how to such tools as a potential qualification in studying environmental science.

10. Course Learning Objectives:

1. Fellows will be able to explain different types of satellites and their data extraction procedures
2. Fellows will be able to acquired knowledge provide theoretical basis on data processing and application in the field of RS and GIS.
3. Fellows will be able to learn on data acquisition system in RS and decision making processes.
4. They will explain their practical knowledge on theory and application on GIS as tool in interpreting environmental issues
5. Fellows will interpret RS and its explanation in environmental science

11. Course Learning Outcomes:

On successful completion of the lesson, the Fellow will be able to:

COs	Course Content
CO 1	RS: Understand the fundamentals of remote sensing viz., basic principles, history, remote sensing process and Electro Magnetic Radiation (EMR) .
CO 2	Describe Earth observing satellites and its working principle
CO 3	Discuss aerial photography system, types and geometric characteristics.
CO 4	Explain feature extraction of satellite images, aerial photographs and Visual and digital image interpretation and pertinent work viz. rectification, correction and enhancement
CO 5	Interpret the application of remote sensing relating to land use, forestry, agriculture, environment, coastal ecosystem urban etc.
CO 6	GIS: Describe the elementary and introductory matters of GIS.
CO 7	Explain the types, characteristics, coordinate system, spatial data model- vector and raster GIS data structure and models.
CO 8	Distinguish between primary and secondary, spatial and non-spatial data sources.
CO 9	Describe the Geo-referencing, data input, storage and editing and integration of GPS

CO: Course Outline

12. Course Content:

COs	Course Content	Lectures
CO 1	RS: Fundamentals of remote sensing: definition, basic principles and history, remote sensing process, Electro Magnetic Radiation (EMR) .	2
CO 2	Earth observing satellites: its types, satellite orbits, sensing coverage, data sources, satellite sensor systems.	2
CO 3	Fundamental elements of aerial photography: photographic system, types and geometric characteristics.	2
CO 4	Interpretation and feature extraction of satellite image and aerial photographs: Visual and digital image interpretation.: Image rectification/corrections, image enhancement, classification techniques and validation/accuracy assessment.	3
CO 5	Application of remote sensing:, land use, forestry, agriculture, environment, coastal ecosystem urban etc.	6
CO 6	GIS: Introduction to geographic information system: definition, concept, components, subsystems, applications of GIS.	2
CO 7	GIS data structure and models: types, characteristics, coordinate system, spatial data model- vector and raster.	2
CO 8	Data sources: primary and secondary, spatial and non-spatial data sources.	2
CO 9	Database creation: Geo-referencing, data input, storage and editing. Introduction to GPS and its integration into GIS.	4

13. Teaching and Learning Strategies: An interactive class room including teaching learning-based instructions, audio-visual presentations, inquire-based education, field trips and seminars.

14. Assessment Techniques of the course: Formal Examination-35 marks, Class attendance: 5 Assignments, class test, quiz, oral presentation: 10 marks

15. References:

Text 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 R Hammond, PS McCullagh, Oxford Univ. Press; 1978.

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

Energy and Environment-Modeling and Simulation by Bala BK. 1997. NOVA Sci. Publ.

Remote Sensing and Image Interpretation by Lillesand, T.M. and Kiefer, R.W.

Remote Sensing: Principles and Interpretation by Sabins, F.F. Jr.

An Earth Resource Perspective by Jensen, J.R.

Introduction to Remote Sensing by Campbell, J.B.

Introduction to Geographic Information Systems by Kang-tsung Chang

Other Resources: Online search, articles published in different journals including Elsevier, Springer.

ENVO 710: Environment, Sanitation and Health

- 1. Course Title:** Environment, Sanitation and Health
- 2. Course Number:** ENVO 710
- 3. Course Type:** Optional
- 4. Course Level:** MPhil/PhD
- 5. Course Term:** July- December
- 6. Course Credit:** 02
- 7. Total Marks:** 50 (Examination: 30; Assignment, Tutorial: 15 & Attendance: 5)
- 8. Course Instructors:**
- 9. Course Overview:**

Water supply, sanitation and health are closely related. Through this course students will know how the poor hygiene, inadequate quantities and quality of drinking water and lack of sanitation facilities cause diseases to the people in rural and urban areas. The ways about the hygienic sanitation system and pollution control measures will also be addressed in this course.

7. Course Learning Objectives:

This course will help to fellows

- To state the rural and urban sanitation systems
- To identify the diseases related to sanitation systems particularly water-borne and vector-borne diseases
- To assess the treatment techniques for air and water pollution

8. Course Learning Outcomes:

On successful completion of the lesson, the fellows will be able to

CO 1	Differentiate the sanitation systems suitable for urban and rural area
CO 2	State vector-borne and water-borne diseases
CO 3	Describe health criteria in community and working places
CO 4	Demonstrate the effects of toxic substances and pollutants
CO 5	Judge the use of microbes for wastewater treatment and solid waste management

9. Course Contents:

COs	Course Contents	Lectures
CO1	Rural, urban, industrial and institutional sanitations; hygienic sanitation system.	3
CO2	Environment and diseases, Transmission of disease, transmission mechanisms (water-borne, water-washed, water based and insect	4

	vector). Type 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, zoonotic diseases and their control. Principles of toxicology.	
CO3	Development of health criteria and its application to home, work and community environments. Comprehensive planning, Health administration.	4
CO4	Environmental factors and quality of human health. Types of toxic substances affecting human health. Adverse effects of air and water pollution, and land degradation.	5
CO5	Water pollutants removal and purification techniques, water supply and different type of sanitary toilets and waste management and air pollution control. Environmentally sound sanitation and settlement planning.	5

10. Teaching and Learning Strategies: Oral lecture, field trip and seminar

14. Assessment Techniques of the course: Formal Examination-35 marks, Class attendance: 5 Assignments, class test, quiz, oral presentation: 10 marks

15. References

Text Books

Hazardous Waste Management by Wentz CA. 1989. McGraw-Hill Co.,
Environmental Water Pollution and Control by Chhatwall G.R. 1993. Anmol. Publ., New Delhi.

Reference Books

Environmental Science-A Global Concern by Cunningham WP, Cunningham MA and Saigo BW. 2003. McGrew-Hill, NY.
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 Devuyt D. 1999. v.2, Routledge Butler and Tanner Ltd. London.

ENVO 711: Environmental Planning and Sustainable Development

- 1. Course Title:** Environmental Planning and Sustainable Development
- 2. Course Number:** ENVO 711
- 3. Course Type:** Optional
- 4. Course Level:** MPhil/PhD
- 5. Course Term:** July- December
- 6. Course Credit:** 02
- 7. Total marks:** 50 (Examination: 30; Assignment, Tutorial: 15 & Attendance: 5)
- 8. Course instructor:**
- 9. Overview/description**

The course is designed to provide fellows with a fundamental understanding of the need for a proper planning to promote a more sustainable development for the future generation and to protect the earth from different anthropogenic and geogenic activities. Many challenges affect modern society, in terms of social issues and ecological and environmental themes viz., mainly focused on the responsible use of natural resources; the management of climate change, waste, and pollution reduction; and the preservation of biodiversity. The courses of the specialization cover the most essential steps in planning and sustainable management, applied to the field of environment.

10. Course Learning Objectives:

Learning outcomes for the environmental planning and sustainable development can be defined as educational goals that aim to support students' full planning, development and well-being in holistic and sustainable perspective. Fellows should gain from the course the following:

1. An understanding of environmental planning and management approaches in Bangladesh and internationally.
2. The ability to analyze and planning environmental management in relation to the major principles of sustainable development, defined broadly as: biodiversity conservation; conservations, economic sustainability, and Intergenerational equity.
3. The capacity to translate generic concepts and methods into critical reviews of contemporary, real-world environmental planning and management practices.
4. The capacity to critically assess theoretical and conceptual issues relating to environmental planning and management utilizing dialectical analysis approaches.
5. The ability to work effectively to create environmental management analysis outputs of professional quality, both independently and within team environments.

11. Course Learning Outcomes:

On successful completion of the lesson, the Fellow will be able to:

COs	Course Content
CO 1	RS: Understand the fundamentals of remote sensing viz., basic principles, history, remote sensing process and Electro Magnetic Radiation (EMR) .
CO 2	Describe Earth observing satellites and its working principle
CO 3	Discuss aerial photography system, types and geometric characteristics.
CO 4	Explain feature extraction of satellite images, aerial photographs and Visual and digital image interpretation and pertinent work viz. tatification, correction and enhancement
CO 5	Interpret the application of remote sensing relating to land use, forestry, agriculture, environment, coastal ecosystem urban etc.
CO 6	GIS: Describe the elementary and introductory matters of GIS.
CO 7	Explain the types, characteristics, coordinate system, spatial data model- vector and raster GIS data structure and models.
CO 8	Distinguish between primary and secondary, spatial and non-spatial data sources.
CO 9	Describe the Geo-referencing, data input, storage and editing and integration of GPS

CO: Course Outline

12. Course Content:

COs	Course Content	Lectures
CO 1	Environmental planning in sustainable development, Planning processes and methodologies: elements of planning and team work,	2
CO 2	Protection and restoration of natural system, Design plan–implementation process, comprehensive plan, zoning plan, industrial performance, history preservation, flexible zoning, specific plan.	2
CO 3	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.	2
CO 4	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.	6
CO 5	Environmental governance, current environmental debates, complexities, contradictions, Environmental laws and ethics, approaches to environmental governance, climate change politics and policy, environmental regulation,	4
CO 6	Multi-level challenges for community-based natural resource management, resource allocation for environmental management, GO-NGO partnership in environmental management, environment and gender issues, tools and techniques of monitoring evaluation of environmental projects, environmental challenges and governmental responses;	2
CO 7	Bangladesh perspectives.	2

13. Teaching and Learning Strategies: An interactive class room including teaching learning-based instructions, audio-visual presentations, inquire-based education, field trips and seminars.

14. Assessment Techniques of the course: Formal Examination-35 marks, Class attendance: 5 Assignments, class test, quiz, oral presentation: 10 marks

15. References:

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 R Hammond, PS McCullagh, Oxford Univ. Press; 1978.

Environmental Management in Practice by Nath B, Hens L, Compton P and Devuyt D. 1999. v.2, Routledge Butler and Tanner Ltd London.

Energy and Environment-Modeling and Simulation by Bala BK. 1997. NOVA Sci. Publ.

Remote Sensing and Image Interpretation by Lillesand, T.M. and Kiefer, R.W.

Remote Sensing: Principles and Interpretation by Sabins, F.F. Jr.

An Earth Resource Perspective by Jensen, J.R.

Introduction to Remote Sensing by Campbell, J.B.

Introduction to Geographic Information Systems by Kang-tsung Chang

Other Resources: Online search, articles published in different journals including Elsevier, Springer.

ENVO 712: Wild life and Wetland Management

1. **Course Title:** Wild life and Wetland Management
2. **Course Number:** ENVO 712
3. **Course Type:** Optional
4. **Course Level:** MPhil/PhD
5. **Course Term:** July- December
6. **Course Credit:** 02
7. **Total marks:** 50 (Examination: 30; Assignment, Tutorial: 15 & Attendance: 5)
8. **Course instructor:** Professor. Md. Redwanur Rahman (redwan_rahman@ru.ac.bd)

9. Overview/description

Provides students with a working knowledge of the application of basic concepts in ecology and animal behavior to the management of wildlife resources to achieve diverse objectives of conservation, control, or cropping.

10. Course Learning Objectives:

The specific course objectives are to develop the abilities of fellows to:

1. Improve the ability of students to read and understand scientific literature
2. Provide fellows with practical experience using social media in a professional setting
3. Develop an understanding of the basic needs of all species of wildlife
4. Examine the application of theory to manage wildlife and habitats
5. Further the student's understanding of wildlife ecology
6. Develop the student's ability to think critically.

11. Course Learning Outcomes:

On successful completion of the lesson, the Fellow will be able to:

CO 1	Describe the importance and scope of the study of wild life
CO 2	Explain the importance of wildlife and the interactions between different sectors of the ecosystem and the effect on the natural environment.
CO 3	Know the main elements of a protected area and the legal framework that underpins wildlife conservation and management plan nationally and internationally
CO 4	Identify and explain the application of theory to manage wildlife and habitats.
CO 5	Describe the understanding of wildlife ecology and their impacts on the environment
CO 6	Evaluate the anthropogenic impact of wildlife and management to think critically

CO: Course Outline

12. Course Content:

COs	Course Content	Lectures
CO 1	<p>Exploring the History and the Importance of Wildlife Conservation:</p> <p>Instruction in this lesson should result in fellows achieving the following subtitles: Explain the history of wildlife conservation, Describe the national policies that impact wildlife conservation, identify historical people related to wildlife conservation, Describe the values of wildlife, Define wildlife conservation and wildlife management.</p>	2
CO 2	<p>Wildlife Biology and Ecosystems:</p> <p>Instruction in this lesson should result in fellows achieving the following subtitles: Explain important life processes of wildlife organisms, Describe the life span stages of wildlife, distinguish between the feeding groups, describe how ecosystems are important in wildlife biology.</p>	2
CO 3	<p>Understanding the Food Chain and Natural Selection</p> <p>Instruction in this lesson should result in fellows achieving the following subtitles: Describe scientific classification and naming of animal wildlife, identify life-sustaining processes in animal wildlife, distinguish wildlife reproductive processes, Explain the major nutrient needs of animal wildlife, Describe the basic habitat requirements for wildlife species.</p>	2
CO 4	<p>Conserving Wildlife and Wildlife Habitat</p> <p>Instruction in this lesson should result in fellows achieving the following objectives: Explain effects of pollution on wildlife, describe several ways habitat is destroyed, identify national conservation policies affecting wildlife, identify examples of wildlife conservation management, Describe the steps in developing a wildlife management plan, Describe several small area management practices.</p>	2
CO 5	<p>Managing Wildlife Populations</p> <p>Instruction in this lesson should result in fellows achieving the following objectives: Explain the relationship of populations to habitat, Explain the concept of population status, explain habitat factors that affect wildlife populations, Describe the role of disease and predation on animal wildlife.</p>	2
CO 6	<p>Evaluating Wildlife Habitats</p> <p>Instruction in this lesson should result in students achieving the following objectives: Explain the four basic habitat requirements, Identify the stages of habitat growth, Identify the goals of habitat management.</p>	2

13. Teaching and Learning Strategies: Teaching is given both power point presentation and seminars

14. Assessment Techniques of the course: Formal Examination-35 marks, Class attendance: 5 Assignments, class test, quiz, oral presentation: 10 marks

15. References:

- Charles Lagus BSC. Wild Critical Species. Conservation and Wildlife. Archived from the original on 19 May 2012.
- Diamond, J. M. 1989. Overview of recent extinctions. Conservation for the Twenty-first Century. D. Western and M. Pearl, New York, Oxford University Press: 37-41.
- Dirzo, Rodolfo; Hillary S. Young; Mauro Galetti; Gerardo Ceballos; Nick J. B. Isaac; Ben Collen 2014. Defaunation in the Anthropocene" (PDF). Science. **345** (6195): 401–406.
- Film History. Archived from the original on 13 November 2012.
- Harris, J. D.; Brown, P. L. 2009. Wildlife: Destruction, Conservation and Biodiversity. Nova Science Publishers.
- Naik, Gautam, 2014. Wildlife Numbers Drop by Half Since 1970, Report Says. Archived from the original on 29 March 2018.
- Shepherd, Chris R.; Thomas, R., 2008. Huge haul of dead owls and live lizards in Peninsular Malaysia". Traffic.
- Usher, M. B. 1986. Wildlife conservation evaluation: attributes, criteria and values. London, New York: Chapman and Hall.
- Other Resources:** Online search, articles published in different journals including Elsevier, Springer, and daily newspapers.

ENVO 713: Agriculture and Environment

1. **Course Title:** Agriculture and Environment
2. **Course Number:** ENVO 713
3. **Course Type:** Optional
4. **Course Level:** MPhil/PhD
5. **Course Term:** July- December
6. **Course Credit:** 02
7. **Total Marks:** 50 (Examination: 30; Assignment, Tutorial: 15 & Attendance: 5)
8. **Course Instructors:**
9. **Course Overview:**

The Agriculture and Environment course will introduce to students about the causes and consequences of agricultural activities to soil degradation and environmental pollution. The techniques commonly used to evaluate the environmental implications of agricultural pollutants will be explored along with their advantages, disadvantages and limitations. Sustainable agriculture practices will be addressed to protect the air, water and soil from pollutants.

10. Course Learning Objectives:

This course will help to fellows

- To discuss the nexus of agriculture, food and environment
- To explain the agrochemicals impacts on environment
- To appraise the needs of sustainable agriculture practices
- To describe the ecological, political, economic and social aspects of food production and distribution.

11. Course Learning Outcomes:

On successful completion of the lesson, the fellows will be able to

CO 1	State basic principles of agricultural crop production
CO 2	Recognize the land degradation and soil erosion problems
CO 3	Analyze the pesticides in soil and crops
CO 4	Demonstrate the environmental issues related to agriculture
CO 5	Appraise the eco-friendly sustainable agriculture practices
CO 6	Formulate the environmental awareness program to protect the environment from agro-chemicals

12. Course Contents:

COs	Course Contents	Lectures
CO1	Agricultural practice and environments: Basic principles of agricultural crop production	3

CO2	Degradation of land and soil erosion	3
CO3	Agro-chemicals, inter-relationship of environment and agriculture: ecological destruction due to use of agro-chemicals (pesticides, fertilizers, herbicides etc.), cultivation high-yielding varieties (HYVs)	4
CO4	Principles of land use and environmental considerations. Agricultural practices in Bangladesh and environmental issues.	3
CO5	Farm mechanization, soil fertility, and environment friendly agriculture technology, indigenous technology, cropping system and soil nutrient, organic manures, agro-forestry and social forestry practices.	4
CO6	Environmental issues and agricultural extension: environment awareness; mass media, motivation.	4

13. Teaching and Learning Strategies: Oral lecture, field trip and seminar

14. Assessment Techniques of the course: Formal Examination-35 marks, Class attendance: 5 Assignments, class test, quiz, oral presentation: 10 marks

15. References

Jackson IJ, Longman, London. 1982. Climate, Water and Agriculture in Tropics

Mishra SJ and Mani D. 1994. Agriculture Pollution Ashis Publ., New Delhi.

Levit J 1980. Responses of Plants to Environmental Stresses, Academic Press, NY.

Dent D Insect Pest Management, CAB Intl, UK.

Chishester CO. Research in Pesticides Academic Press, NY.

Flint ML and Van deu-Boseh, R., Plenum 1981. Introduction to Integrated Pest Management Publ. NY.

Das DK, Kalyani Introductory Soil Science Publ., India.

Cunningham WP, Cunningham MA and Saigo BW. 2003. Environmental Science-A Global Concern McGrew-Hill, NY.

ENVO714: Environmental Economics

- 1. Course Title:** Environmental Economics
- 2. Course Number:** ENVO 714
- 3. Course Type:** Optional
- 4. Course Level:** MPhil/PhD
- 5. Course Term:** July- December
- 6. Course Credit:** 02
- 7. Total marks:** 50 (Examination: 30; Assignment, Tutorial: 15 & Attendance: 5)
- 8. Course Instructor:**
- 9. Overview/description**

The environment is one of the most important and most debated modern policy issues. This course provides an economic perspective on this debate. We will discuss the reasons behind why environmental problems exist, why unregulated markets sometimes fail in this context, and potential economic solutions to these problems, which include regulations, taxes, subsidies, and pollution permit trading schemes. We will also cover methods for determining the benefits and costs of environmental preservation. The course will equip students with the necessary knowledge to take part in the discussion about environmental policy from an economic perspective.

10. Course Learning Objectives:

1. The graduate will understand the theoretical basis upon which the sub-discipline has been built.
2. The graduate will demonstrate the recognize situations in which markets are likely to be inefficient and be able to prescribe a variety of intervention tools to correct the inefficiency.
3. The graduate will understand the critically review how economists attempt to measure environmental benefits, including the issue of time and discount rates in project analysis.
4. The graduate will achieve comprehend the economic treatment of natural resources with regard to specific examples such as water, fossil fuels and renewable resources such as fisheries.
5. The graduate will evaluate the rationale of current environmental initiatives including climate change and water reform.

11. Course Learning Outcomes:

On successful completion of the course, the Fellows should be able to:

CO 1	Demonstrate fundamental knowledge of environmental economics and responsible resources management.
CO 2	Explain the non-renewable renewable resources and its extraction in competitive and monopolistic markets.
CO 3	Interpret about the theories of Economic valuation of environmental goods and services and its application to nonmarket goods.

CO 4	Discuss about the Techniques of Market Price and Cost Measures Values, Cost-benefit Analysis of Environmental Policy and Management and Benefit Transfer and Policy Implication.
CO 5	Describe about the Physical and economic meanings of pollution, classification, sustainable development, green GDP and relationship between income and pollution levels.
CO 6	Understand the major environmental problems and economic losses of Bangladesh and Government policy and initiatives to address environmental protection and development.

CO: Course Outline

12. Course Content:

COs	Course Content	Lectures
CO 1	Economic theory and analysis in resource management, Resource and environmental economics; natural and environmental resources; Basic terminologies- ambient quality; environmental quality; residuals: emissions; pollutant; environmental media; user cost etc.	3
CO 2	Non-renewable resources; optimal depletion of non-renewable resources; resource extraction in a perfectly competitive and monopolistic markets; Renewable resources; open access resources Vs common property resources; Open access and profit maximizing fishery models; resources scarcity mitigation- recycling and substitution.	4
CO 3	Major topics include theories of valuation and application to nonmarket goods, cost analysis for nonmarket goods, and techniques for valuing nonmarket goods and services; 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.	4
CO 4	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.	3
CO 5	Physical and economic meanings of pollution; classification of pollution; marginal damage and marginal abatement cost functions; efficient level of pollution; pollution control policy- property rights; bargaining and the Coase theorem; economically efficient pollution abatement and cost- effective pollution abatement; taxation and optimal pollution- the pigovian tax; pollution charge and property rights. Sustainable development; green GDP; relationship between income and pollution levels- the environmental Kuznets curve.	4
CO 6	The major environmental problems and economic losses of Bangladesh; Government initiatives to address environmental protection and development; policies and laws for environmental protection.	3

13. Teaching and Learning Strategies: Teaching is given both lectures and seminars

14. Assessment Techniques of the course: Formal Examination-35 marks, Class attendance: 5 Assignments, class test, quiz, oral presentation: 10 marks

15. References:

Environmental Economics: An Introduction by Field BC, McGraw-Hill. 2000.

The Economics of Natural Resource Use by Hartwick, JM and Olewiler N, Wesley, 1988.

Environmental Economics in Theory and Practice by Hanley N, Shogren JF and White B, McMillan. 1997.

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

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

Natural Resource and Environmental Economics by Perman, R., Y. Ma, McGilvray, J. and Common M., 2nd Edition. 1999.

Environment and Natural Resource Economics by Tietenberg, T., 5th Edition, Addison-Wesley. 2000.

Other Resources: Online search, articles published in different journals including Elsevier, Springer, and daily newspapers.

ENVO 715: Marine Environment and Blue Economy

1. **Course Title:** Marine Environment and Blue Economy
2. **Course Number:** ENVO 715
3. **Course Type:** Optional
4. **Course Level:** MPhil/PhD
5. **Course Term:** July- December
6. **Course Credit:** 02
7. **Total marks:** 50 (Examination: 30; Assignment, Tutorial: 15 & Attendance: 5)
8. **Course instructor:**
9. **Overview/description**

The objective of the course is to promote long-term and sustainable use of marine resources for economical benefit of the people with safeguarding the sustainability and environmental protection. Oceans are vital, not only to a wide array of biodiversity and ecosystems, but also to the food chains, livelihoods and climate regulation for a human population heading towards nine billion people. That is why this course is essential because it introduces the concept of the blue economy and explore how countries can benefit from it thus the livelihoods and wellbeing of people living on coastal areas and islands.

10. Course Learning Objectives:

Upon completion of this course Fellows should be able to:

1. Explain the Blue Economy concept.
2. Recognize the importance to sustainably manage the marine resources.
3. Identify ways in which entrepreneurs can create innovative business opportunities.
4. Describe the economic benefits of the Blue Economy.
5. Describe the relationship between the Blue Economy and sustainable development

11. Course Learning Outcomes

On successful completion of this course, Fellows should be able to:

COs	Course Content
CO 1	Describe the preliminary ideas on Coastal ecosystem, estuaries and structure, dynamics and productivity,
CO 2	Explain the state of coastal process, hazard, management, and the strata of plankton and benthos.
CO 3	Discuss about coastal ecosystems, Mangrove ecosystem of Bangladesh.
CO 4	Explain the physiography of ocean basins and related processes
CO 5	Describe the consequence of sea level rise and salinity and pollution of seas
CO 6	Overview of Bangladesh's Blue economy with the Exclusive Economic Zone (EEZ) and beyond the zone. Prospect of Blue economy in Bangladesh.

CO: Course Outline

12. Course Content:

COs	Course Content	Lectures
CO 1	Introduction to Coastal ecosystem, characteristics of estuaries and coastal wetlands, structure, dynamics and bioproductivity of coastal ecosystems,	2
CO 2	plankton and benthos of limnology significance, coastal processes and hazards, its management,	4
CO 3	coastal ecosystems of Bangladesh, Mangrove ecosystem, Sunderban-the world heritage.	3
CO 4	Physiography of the bay and ocean basins, oceanic current, waves and tides, ocean sediments and mineral resources, productivity of oceans,	3
CO 5	Sea level rise and salinity; Oceanography of Bay of Bengal, marine pollution–Bangladesh perspective.	3
CO 6	Prospect of Blue economy in Bangladesh.	2

13. Teaching and Learning Strategies: Teaching is given both lectures and seminars

14. Assessment Techniques of the course: Formal Examination-35 marks, Class attendance: 5 Assignments, class test, quiz, oral presentation: 10 marks

15. References:

- An Introduction to the World's Oceans by Duxbury AC and Duxbury A. 1984. Addison-Wesley Publ., Canada.
- Climate and the Oceans. 2012, Geoffrey K. Vallis - Publisher: Princeton University Press. Place NJ.
- Mankind and the Oceans. Contributors: Nobuyuki Miyazaki - Editor, Zafar Adeel - Editor, Kouichi Ohwada - Editor. Publisher: United Nations University Press. Place of publication: Tokyo. Publication year: 2005.
- Snelgrove, P. (Convenor), Berghe, E.V., Miloslavich, P., et al. (2016) Global Patterns in Marine Biodiversity, Chapter 34.
http://www.un.org/depts/los/global_reporting/WOA_RPROC/Chapter_34.pdf
- Pauli, G. (2010) The Blue Economy: 10 Years, 100 Innovations, 100 Million Jobs. Paradigm Publications, United States, 386.
- World Bank (2012) The Living Oceans.
<http://go.worldbank.org/A2MYFIUQM0>
- Blue Economy Concept Paper (2012) The Rio+20, United Nations Conference on Sustainable Development, 2012, Rio de Janeiro, Brazil.
<https://sustainabledevelopment.un.org/content/documents/2978BEconcept.pdf>
- UNESCO, IMO, FAO, UNDP (2011) A Blueprint for Ocean and Coastal Sustainability. Paris. <http://unesdoc.unesco.org/images/0021/002150/215002e.pdf>

ENVO 716: Environmental Accounting and Auditing

- 1. Course Title:** Environmental Accounting and Auditing
- 2. Course Number:** ENVO 716
- 3. Course Type:** Optional
- 4. Course Level:** MPhil/PhD
- 5. Course Term:** July- December
- 6. Course Credit:** 02
- 7. Total marks:** 50 (Examination: 30; Assignment, Tutorial: 15 & Attendance: 5)
- 8. Course instructor:**
- 9. Overview/description**

This course aims to develop students' understanding of the relationship between the environmental issues within the field of accounting, including financial reporting, analysis and disclosure, cost management and managerial decision making, capital investment analysis, auditing, and taxation considering the sustainability. The interest in environmental accounting and auditing issues has grown rapidly in recent years and the issues impact the various specializations within the field of accounting, including financial reporting, analysis and disclosure, cost management and managerial decision making, capital investment analysis, auditing, and taxation.

10. Course Learning Objectives:

1. Fellows will be able to explain the Understand environmental issues under the conventional model of accounting;
2. The Fellow will describe how environmental issues under the expanded model of accounting;
3. The Fellow will devolve ability to critically evaluate businesses' approaches to environmental accounting, both nationally and globally;
4. The fellow will Understand trends and potential future directions for environmental accounting, both nationally and globally.

11. Course Learning Outcomes:

By the end of this course students will be able to:

COs	Course Content
CO 1	Evaluate the basics of environmental accounting and auditing, its type, origin and significance
CO 2	Describe the audit preparation, objectives and scope, audit team and familiarization, pre-audit planning.
CO 3	Evaluate on-site audit activities, inspection techniques, document review, interviews and meeting
CO 4	Describe post-audit activities, audit report, corrective action, program and follow-up activities.
CO 5	Analyze critically the similarities and differences between corporate, Government, Firms and NGO models of organizational accountability.
CO 6	Critically evaluate the role of audit in relation to social and environmental reporting

CO: Course Outline**12. Course Content:**

COs	Course Content	Lectures
CO 1	Nature of environmental auditing – definition, characteristics, types. Origin, significance and importance of environmental accounting.	2
CO 2	Environmental audit methodology–I: audit preparation, objectives and scope, audit team and familiarization, pre-audit planning.	3
CO 3	Environmental audit methodology–II: on-site audit activities, inspection techniques, document review, interviews and meeting.	3
CO 4	Environmental audit methodology–III: post-audit activities, audit report, corrective action, program and follow-up activities.	3
CO 5	Environmental auditing for government and non-governmental organizations; types of environmental administration, natural resource management, energy consumption, water consumption, firms, various environmental research organization.	4
CO 6	Conventional and expand auditing model Audit case study–site visit, report writing and presentation.	3

13. Teaching and Learning Strategies: An interactive class room including teaching learning-based instructions, audio-visual presentations, inquire-based education, field trips and seminars.

14. Assessment Techniques of the course: Formal Examination-35 marks, Class attendance: 5 Assignments, class test, quiz, oral presentation: 10 marks

15. References:

Environmental Accounting: Energy and Environmental Decision Making by HT Odum, Wiley, 1995.

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

Environmental Management by Chary SN and Vyasulu V, MacMillan, 2000.

Environmental Accounting: Concepts and Practices by Arup Choudhuri, ICFAI

Environmental Accounting: A Conceptual Introduction by S Schaltegger, K Muller, H Hindrischen--

ENVO 717: Environmental Psychology

- 1. Course Title:** Environmental Psychology
- 2. Course Number:** ENVO 717
- 3. Course Type:** Optional
- 4. Course Level:** MPhil/PhD
- 5. Course Term:** July- December
- 6. Course Credit:** 02
- 7. Total marks:** 50 (Examination: 30; Assignment, Tutorial: 15 & Attendance: 5)
- 8. Course instructor:**
- 9. Overview/description**

The course gives an introduction to theory, research, and methods in the study of human perception and behavior in the field of environmental psychology. It focuses on approaches within psychology that study information processing, judgment and appraisal processes, behavior, and communication.

10. Course Learning Objectives:

1. Fellows will be able to explain the relation between individuals and their physical environment.
2. The Fellow will describe the need of the study of human behavior that interacts with the natural environment.
3. The fellow will understand how humans play an essential role in both producing and potentially mitigating climate change.
4. The fellow will know research methods applied to study human-environment relations and can communicate research in the field of environmental psychology

11. Course Learning Outcomes:

By the end of this course students will be able to:

COs	Course Content
CO 1	Evaluate the inherent relations between environment and the human psychology
CO 2	Describe the environmental stress due to man made activities, noise and pollution
CO 3	Evaluate application sides, institutional design, residential design, environmental disaster, and technological catastrophe.
CO 4	Describe the human perception & environmental design

CO: Course Outline

12. Course Content:

COs	Course Content	Lectures
CO 1	The Environment: Current Events influencing environment, Methods used in environment psychology, environmental perception, cognition, attitudes	2
CO 2	Effects of Environmental stress: temperature, humidity, sunshine, wind, Ion concentration, chemical pollution, noise, pollution density, urbanization, crowding, territoriality, privacy, personal space.	6
CO 3	Application of Environmental Psychology: Institutional design, residential design, environmental disaster, and technological catastrophe.	3
CO 4	Human Perception & Environmental Design	3

13. Teaching and Learning Strategies: An interactive class room including teaching learning-based instructions, audio-visual presentations, inquire-based education, field trips and seminars.

14. Assessment Techniques of the course: Formal Examination-35 marks, Class attendance: 5 Assignments, class test, quiz, oral presentation: 10 marks

15. References:

Advances in Environmental Psychology by Blum A, Singer JE and Valins S. 1978. NY Erlbaum.

Population Psychology, Basic Book by Fawcett, James T., NY.

Environmental Psychology by Bell PA, Greene TC, Fisher JD. Lawrence Erlbaum Assoc., 2005.

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

The Psychology of Environmental Problems by Winter DDN & Koger SM. Mahwah NJ: Lawrence Erlbaum Assoc., 2010.

ENVO 718: Environmental Biochemistry

- 1. Course Title:** Environmental Biochemistry
- 2. Course Number:** ENVO 718
- 3. Course Type:** Optional
- 4. Course Level:** MPhil/PhD
- 5. Course Term:** July- December
- 6. Course Credit:** 02
- 7. Total marks:** 50 (Examination: 30; Assignment, Tutorial: 15 & Attendance: 5)
- 8. Course instructor:**
- 9. Overview/description**

The course will provide information to students about xenobiotics, toxic metals and mutagens in the environment and their impacts on living things. This course describes how organisms cope with environmental stresses at the biochemical level. This course will also discuss about detoxification process to remove or neutralize the toxic pollutants from living organisms.

10. Course Learning Objectives:

This course will help to fellows

- Discuss about the organisms coping with different environmental contaminants everyday
- Explain the toxicity of different xenobiotics, mutagens and agrochemicals
- Analyze the pollutants interaction in cell and organism
- Demonstrate the detoxification pathway to prevent the toxic effects of xenobiotics from environment.

11. Course Learning Outcomes:

On successful completion of the lesson, the fellows will be able to

CO 1	Identify the mutagens, pathogens and xenobiotics in the environment
CO 2	Manage the control of environmental diseases
CO 3	State the toxicity of metal and its degradation in living things
CO 4	Analyze the xenobiotics and agro-chemicals
CO 5	Examine the interaction of pollutants in cells and tissues
CO 6	Demonstrate the detoxification pathway in living organisms

CO: Course Content

12. Course Contents:

COs	Course Contents	Lectures
CO1	Distribution of toxic, mutagens and pathogens in the environment. Pathways of insertion of toxic compounds into living systems and its impact on human, fishes, birds and animals.	3
CO2	Major transformation of toxic compounds in living system and environment. Seasonality and pollution impact on environmental diseases. Control and management of environmental and pathogenic diseases.	4
CO3	Chemical form, metal biomacromolecule interaction, teratogenicity	4

	and carcinogenicity: Cellular/Tissue injury; altered membrane permeability, free radical formation, lipid peroxidation, lysosomal degradation, superoxide dismutase.	
CO4	Study the agrochemicals and xenobiotics source and distribution and toxicity.	2
CO5	Pollutant interaction with biological system at different levels e.g., organisms, organs and tissues, cells. Cellular interaction with the pollutants: Active vs inactive processes.	4
CO6	Pathway of human intoxication process. Biochemical degradation of pollutants inside the cell: Enzymatic degradation by monooxygenesis: Role of cytochrome P450 and its multiple form.	4

13. Teaching and Learning Strategies: Oral lecture, field trip and seminar

14. Assessment Techniques of the course: Formal Examination-35 marks, Class attendance: 5 Assignments, class test, quiz, oral presentation: 10 marks

15. References

Donald Voet and Judith G. Voet. 1995. Biochemistry Wiley.

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

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

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

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

Satynarayana, V. 2014. Biochemistry; Amazon.

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

ENVO 719: Eco-toxicology and Bio-monitoring

1. Course Title: Eco-toxicology and Bio-monitoring

2. Course Number: ENVO 719

3. Course Type: Optional

4. Course Level: MPhil/PhD

5. Course Term: July- December

6. Course Credit: 02

7.Total Marks: 50 (Examination: 30; Assignment, Tutorial: 15 & Attendance: 5)

8.Course Instructors:

9.Course Overview:

This course will introduce to students about toxicants and pollutants in the environment. Under the course of eco-toxicology and bio-monitoring students will learn how human impact upon aquatic and terrestrial ecosystems. This course will duly address the active and passive bio-monitoring to measure the burden of pollutants on the environment.

10.Course Learning Objectives:

This course will help to fellows

- To define the terms toxicants, pollutants, bio-monitoring and toxicology
- To discuss about the biomagnification of toxic compounds
- To classify the methods about toxicity tests
- To compare the active and passive biomonitoring
- To identify the eco-friendly pesticides

11.Course Learning Outcomes:

On successful completion of the lesson, the fellows will be able to

CO 1	Classify the pathogens, toxicant and environmental pollutants
CO 2	Estimate the bioaccumulation and biomagnification of toxic substances in the environment.
CO 3	Deduce the methods of study of toxic compounds in the living things and environment
CO 4	Apply the methods of LD ₅₀ and MIC for toxicity tests
CO 5	Outline the active and passive bio-monitoring of pollutants in the environment
CO 6	Formulate the eco-friendly bio-pesticides to conserve the nature

12. Course Contents:

COs	Course Contents	Lectures
CO1	Concepts of toxicology, toxicant and environmental pollutants. Toxic hazardous compounds: biotoxins (urushiol's, nicotine, shellfish poisons, aflatoxins, toadstool toxins) poly aromatic hydrocarbons (benzo-pyrene) and toxic metals (As, Pb, Hg, Cd, Ni, Cr).	5
CO2	Effect of chemical pesticides and therapeutic agents in environment. Bioaccumulation and biomagnification of toxic substances.	3

CO3	Principles and methods of study of toxic compounds in ecosystem. Some case studies of toxic compounds.	3
CO4	Toxicity test of toxic compounds to human cell (MTT Cell Cytotoxicity), mice, brine shrimp, insect and microbes (disc diffusion and MIC). LD50 and LC50 measurements.	3
CO5	Bio-monitoring of toxic substances (active and passive monitoring). Insect toxicity tests of botanical pesticides: residual bioassay with leaf disc, growth inhibition, contact, fumigation and spray. US-EPA Probit analysis for toxicology study.	4
CO6	Importance of eco-friendly botanical pesticides and bio-pesticides for human health and environment.	3

13. Teaching and Learning Strategies: Oral lecture, field trip and seminar

14. Assessment Techniques of the course: Formal Examination-35 marks, Class attendance: 5 Assignments, class test, quiz, oral presentation: 10 marks

15. References

Principles of Environmental Toxicology by Shaw I.C. & Chadwick J. 1998. Taylor & Francis, London

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

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

Lester J.N. and Birkett. E, 1999. Microbiology & Chemistry for Environmental Scientists & Engineers London.

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

Zia Uddin Ahmed et al. 2008. Encyclopedia of Flora and Fauna of Bangladesh Asiatic Society of Bangladesh.

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

Bio Pest Management (Nematodes, Microbes, and Bioagents) by Gupta. 2010. Agrotech Pub India.

ENVO 720: Atmospheric Sciences

1. Course Title: Atmospheric Sciences

2. Course Number: ENVO 720

3. Course Type: Optional

4. Course Level: MPhil/PhD

5. Course Term: July- December

6. Course Credit: 02

7. Total marks: 50 (Examination: 30; Assignment, Tutorial: 15 & Attendance: 5)

8. Course instructor:

9. Overview/description

The course atmospheric science is introduced to provide knowledge about the basic of atmosphere, meteorological principles, weather systems, relationships to the changing atmosphere, climate and ozone depletion and other contemporary issues.

10. Course Learning Objectives:

1. Fellows will be able to explain the physical laws governing the structure and evolution of atmospheric phenomena spanning a broad range of spatial and temporal scales.
2. Fellows will apply mathematical tools to study atmospheric processes.
3. Fellows will explain the principles behind, and use of, meteorological instrumentation.
4. Fellows will describe, analyze and create graphical depictions of meteorological information.
5. Fellows will demonstrate critical and analytical skills to interpret and predict weather systems using weather products (model results, maps, satellite imagery, etc.).
6. Fellows will present and communicate weather analyses and forecasts in a team or individually.

11. Course Learning Outcomes:

On successful completion of the lesson, the Fellow will be able to:

COs	Course Content
CO 1	Explain how the human activities alter the composition of the atmosphere and the consequences of deforestation, burning of fossil fuels, industrial and vehicle emissions, use of CFCs.
CO 2	Describe the possible causes of atmospheric pollution cause by anthropogenic activities and the fate of ozone layer
CO 3	Narrate the implications of changes in the atmosphere and climate and its consequences on the human and ecosystems.
CO 4	Discus the strategies to abate and control atmospheric pollution
CO 5	Describe the need for international action and changing consequences of the damage to the atmosphere
CO 6	Explain the strategies to reduce the negative impact of both geogenic and anthropogenic atmospheric changes

CO: Course Outline

COs	Course Content	Lectures
CO 1	Human activities which alter the composition of the atmosphere and climate deforestation, burning of fossil fuels, industrial and vehicle emissions, use of CFCs.	2
CO 2	Causes of atmospheric pollution carbon dioxide, CFCs, methane, Sulphur and nitrogen oxides, lead. Damage to the ozone layer and links to atmospheric pollution.	2
CO 3	The implications of changes in the atmosphere and climate effects on health, food production, water supply, ecosystems. The impact of climatic hazards on human communities' damage, loss of life, danger to health in aftermath, loss of production	2
CO 4	Strategies to reduce atmospheric pollution and climatic change CFC replacement, reduction of pollutant emissions, reforestation.	3
CO 5	The need for international action and changing attitudes to deal with the causes and consequences of the damage to the atmosphere	6
CO 6	Strategies to reduce the negative impact of climatic hazards improved forecasting, appropriate settlement patterns and buildings, disaster relief	2

12. Course Content:

13. Teaching and Learning Strategies: An interactive class room including teaching learning-based instructions, audio-visual presentations, inquire-based education, field trips and seminars.

14. Assessment Techniques of the course: Formal Examination-35 marks, Class attendance: 5 Assignments, class test, quiz, oral presentation: 10 marks

15. References:

Deborah R.Coen 2018 Climate in Motion Science, Empire, and the Problem of Scale
University of Chicago Press: 1427 E. 60th Street Chicago, IL 60637 USA, ISBN:
9780226555027

- Kshudiram Saha, 2008. *The Earth's Atmosphere: Its Physics and Dynamics*. Springer-Verlag Berlin Heidelberg
- John E. Hobbs, 1980. *Applied Climatology: A Study of Atmospheric Resources*. Butterworths, London, UK Boston
- David Allan Randall, 2015. *An Introduction to the Global Circulation of the Atmosphere* Princeton University Press, Princeton and Oxford.
- Flannery Tim, 2015. *Atmosphere of Hope: Searching for Solutions to the Climate Crisis*. HarperCollins Publishers.
- Sir S Critical Issues, 1990. *Atmosphere Crisis: The Greenhouse Effect and Ozone Depletion*. Social Issues Resources Series, SBN 0897778413
- John M Wallace and Peter V Hobbs, 2006. *Atmospheric Science: An Introductory Survey*.