CURRICULUM

One Year
Masters of Science (MS)
Degree in Oceanography

For the Academic sessions
2022-2023

DEPARTMENT OF OCEANOGRAPHY
FACULTY OF EARTH AND ENVIRONMENTAL SCIENCES
UNIVERSITY OF DHAKA
DHAKA-1000
BANGLADESH

Contents

About the University of Dhaka

On the first day of July 1921 the University of Dhaka opened its doors to students with Sir P.J. Hartog as the first Vice-Chancellor of the University. The University was set up in a picturesque part of the city known as Ramna on 600 acres of land.

The University started its activities with 3 Faculties, 12 Departments, 60 teachers, 877 students and 3 dormitories (Halls of Residence) for the students. At present the University consists of 13 Faculties, 83 Departments, 12 Institutes, 20 residential halls, 3 hostels and more than 56 Research Centres. The number of students and teachers has risen to about 37018 and 1992 respectively.

The main purpose of the University is to create new areas of knowledge and disseminate this knowledge to the society through its students. Since its inception the University has a distinct character of having distinguished scholars as faculties who have enriched the global pool of knowledge by making notable contributions in the fields of teaching and research.

The University of Dhaka is dedicated to the advancement of learning, and is committed to promoting research in all fields of knowledge. As there are plans for further expansion of facilities, plans for new avenues and opportunities, the course curricula are updated and new research projects are undertaken every year. As the pioneer and the largest seat of learning in the country, the University of Dhaka has taken the task to foster the transformation processes of the individual students and the country as a whole through its educational and research facilities keeping up with demands of the day. The University of Dhaka is at this moment one of the leading institutions of higher education in Asia.

The University of Dhaka is well prepared to meet the challenges of the future days with its spirit of freedom, justice and truth as a foundation concomitant to the objectives envisaged by the founding fathers.

The open-minded character of the University of Dhaka embodying the features of beauty and historical origins can be seen as one enters the campus.

About the Faculty of Earth and Environment Sciences

The Faculty of Earth and Environmental Sciences (FEES) is one of the newest faculties in the almost a century old University of Dhaka. The FEES started functioning in 2008 with a vision to create new hub of teaching and research in various fields of earth and environmental sciences to face the major challenges environmental challenges of 21st Century and achieving sustainable development. Although the Faculty is new, it has an accumulation of about 200 years of teaching and research experiences through its constituting departments. The faculty started with two departments, Geology and Geography and Environment, and subsequent three more, Disaster Sciences and Management, Oceanography, and Meteorology, have been included. Currently FEES teaching and research programs includes all the major branches of earth and environmental sciences encompassing aspects covering space to the centre of the Earth. The faculty is led by a dean, elected by all the teachers of constituting departments once in every two years.

Teachers and students in the Faculty of Earth and Environmental Sciences study the physical, chemical, and biological systems of the earth. Using modern observational, analytical, and computational methods, they examine how the planet's interior, surface, hydrosphere, biosphere, and atmosphere have evolved since Earth was born in the solar system 4.6 billion years ago. Topics commonly studied in the constituting departments include how plate movements cause earthquakes, volcanoes, and mountain building; global climate change and how climate change and catastrophic events cause changes in biodiversity; mass extinctions and patterns of evolution through Earth history; how and where economic resources are generated on Earth; how these resources are located and used in modern society; aspects of blue economy; harnessing marine resources; sustainable urbanization; disaster management; spatial planning.

Dean's Award

Students who have obtained CGPA 3.75 without having any improvement, no F grade and no academic loss during his/her eight semesters and having at least 90% attendance shall be presented as Dean's Award.

About the Department

Department of Oceanography have started its journey in 2012 with Master of Science (MS) programme and introduced Bachelor of Science (BS) programme in 2014. The Department currently offers degrees in Bachelor of Science (BS) with Honours, Master of Science (MS), Master of Philosophy (MPhil) and Doctor of Philosophy (PhD) in Oceanography. The BS (Hons.) is a four-year integrated programme consisting 150 credit hours of theory courses, lab, field work and viva voce. Under the semester system, the four-year B.S Honors (integrated) Degree in Oceanography at the University of Dhaka is a programme of eight semesters. Length of each semester is six months. Students are required to take all courses equivalent to 150 credit hours. The MS degree is a one and half year programme based either on course work with thesis or on course work with project. The MS programme consists of 52 credits and divided into three semesters. The MPhil is a two-year programme of course work and research. The PhD programme essentially involves research work. The Department enrolls 25 students in each academic year as first-year honours students.

The Department of Oceanography at the University of Dhaka, aims to advance our knowledge of all facets of the ocean environment around Bangladesh. Emphasis will be given to the physical, chemical, biological, geological and atmospheric aspects of the oceans around Bangladesh, but the intention is to use this new knowledge to draw conclusions which are globally relevant. Future research is expected to pave the way to the science underpinning operational oceanography. Department of Oceanography promotes research in diverse area related to oceanography including physical oceanography, chemical oceanography, biological oceanography, satellite oceanography, marine geology, marine resource management, living and non-living resources, marine fisheries, ocean dynamics, paleontology and paleoceanography etc.

Department of Oceanography officially signed Memorandum of Understanding (MoU) with many international universities and institutions including Western Sydney University, Australia; National Marine environment Forecasting Center, State Oceanic Administration, People's Republic of China; National Institute of Oceanography, India; Council of Scientific and Industrial Research, India etc. to promote collaborating research. One of the department's faculty and a few of its' students are currently enrolled in PhD programme within this collaborating organizations.

Facilities Available

Ocean Cruise and Fieldwork

Department of oceanography has arranged 5 cruises to Bay of Bengal with the help of Bangladesh Navy and collected huge rare data from Bay of Bengal for the first time in Bangladesh and has published many qualities paper in both national and international journal based on those data. In a research cruise, generally following data of ocean water are collected: Turbidity, Fluorescence, Chlorophyll content, Water Depth, Sediment Sample, Water Sample, Zooplankton sample, Phytoplankton sample, Nutrient sample etc. Department

of Oceanography has also arranged field works in subject related location like- Cox's Bazar, Saint Martin, Sundarban, Kuakata etc to teach undergraduate student the basic of conducting research field work so that they could be able to do their own research field in postgraduate level.

Photograph: Ocean Cruise and Fieldwork

Library

The department seminar has a modest collection of books, journals and maps. The library provides reading facilities only for students.

Computer Laboratory

The department has a good number of PCs which provide support for research in the field of satellite oceanography, GW modeling and other oceanographic research. Recently, the department has established a computer-based GIS laboratory equipped with laser printer and latest version of PCs.

Physical Oceanography Laboratory

Physical oceanography focuses on describing and understanding the evolving patterns of ocean circulation and fluid motion, along with the distribution of its properties such as temperature, salinity and the concentration of dissolved chemical elements and gases. The objectives of the Physical Oceanography Laboratory are to document the state of the ocean and its variability to better understand the physical and biogeochemical processes that govern ocean currents, the structuring of pelagic ecosystems and the observed state of the sea surface.

The Laboratory of Physical Oceanography provides teaching support to all subjects of the career. It has a Lab facility, as well as a sieve for analysis of sediment samples (mainly sand). The main equipment it possesses for its operations are: Rosette sampler (A device for water

sampling in deep water), Conductivity temperature and Depth (CTD), Grab sampler, kits for coastal observations (clinometers, compasses, boards), multiparametric probe (Temperature / Conductivity /pH) and GPS (Global Positioning System).

Chemical Oceanography Laboratory

The Chemical Oceanography Lab investigates the geochemical, physical and biological processes that regulate the distribution of trace metals and nutrients in estuarine, coastal and open-ocean environments. The laboratory carries out the tests the state of chemical parameters in seawater, sediment and biota (algae, shellfish, fish). Measurements in sea water samples include pH value, dissolved oxygen content, concentration of dissolved inorganic forms of nutrient (nitrates, ammonia, orthophosphates, silicates) and organic phosphorus and nitrogen. Our field research also involves mapping the distributions of trace metals in different marine environments in order to quantify their sources, sinks, biogeochemical cycling and role in modulating biological productivity. The overarching goal of the Chemical Oceanography Lab is to improve the spatial and temporal resolution of nutrients and trace metal observations in the marine environment. We achieve this through field studies, oceanographic cruises and the development of automated analyzers with potential for in situ deployment.

Biological Oceanography Laboratory

The Laboratory of Biological Oceanography is a specialized infrastructure for the study and analysis of marine organisms; and its relationship with the physical environment. The main equipment it holds for its works are: microscopes, stereomicroscopes, phyto-zooplankton nets and a Niskin water sample bottle.

International Centre for Ocean Governance (ICOG)

International Centre for Ocean Governance (ICOG) is established as a cooperative research center by the joint initiative of Department of Oceanography at the University of Dhaka and School of Law, University of Western Sydney, Australia on 27th March 2017. ICOG is the first research center of its kind in Bangladesh. It can play a crucial role to achieve on the ground change, securing protection for the Bay of Bengal environment and the economic and social sustainability of all actors in the region. It can use its resources to build and enhance resource capacity of the Government of Bangladesh to govern and manage the activities in marine and coastal areas by providing new theoretical knowledge and practical experience on sustainable ocean governance to senior and mid-level career academics and government and non-government officials, researchers and students as well.

Extracurricular Activities

Students of the department actively participate in the departmental and interdepartmental indoor and outdoor events of games, sports and other cultural activities regularly.

Details of the Degree Programme

Title Of the Program: **MS in Oceanography**
Duration of the Program**: 1 Year**

In recent years, Bangladesh Government has taken strategic steps for Blue Economy, a sector which was relatively untapped and underutilized until now, could be an effective tool for substantial future economic growth. The Blue Economy approach could significantly contribute towards eradication of poverty, food security, generation of sustainable and inclusive livelihoods, mitigation & adaptation to climate change. Blue Economy requires a balanced approach between conservation, development and utilization of marine and coastal ecosystems, oceanic resources and services with a view to enhance their value and generate decent employment, secure productive marine economy and healthy marine ecosystems.

The Department of Oceanography at the University of Dhaka, up until now, the only one of its kind in Bangladesh, aims to advance our knowledge of all facets of the ocean environment around Bangladesh. Emphasis will be given to the physical, chemical, biological, geological and atmospheric aspects of the Indian Ocean especially the Bay of Bengal.

Department of Oceanography's goal is to advance marine sciences through observation, experimentation and modeling, and to provide excellent educational and research opportunities for graduate and undergraduate students in Bangladesh with degrees in Oceanography. Through active learning, research and discovery, we prepare students for careers across the public and private sector. The Master of Science in Oceanography degree program fosters a broad understanding of marine systems through an interdisciplinary program of study. The MS program has two tracks:

Thesis Group

The MS thesis group is a research-based program that emphasizes a hands-on approach to learning through the completion of an original thesis project under the direct mentorship of an experienced marine science researcher. The purpose of the thesis group is to give students the opportunity to develop a strong foundation in research methodology. Individualized programs of study ensure that each student has the best possible preparation based on their interests, background, and abilities. MS thesis students take core courses while engaging in an intensive, independent research project. Students work side-by-side with a faculty mentor to discover or synthesize knowledge that contributes to the field of marine science.

Project Group

The project group provides students with a broad-based, in-depth knowledge of physical, geological, chemical, and ecological processes in the ocean coupled with the technical skills necessary to contribute to the exploration of the marine environment and the management of its living resources. Because the project group is designed primarily for students seeking careers in applied resource management, this program emphasizes the practical skills and the analytical expertise required to monitor and manage the global ocean system.

PROGRAM OBJECTIVES

Students who successfully complete the Master of Science in Oceanography will:

1. Demonstrate an interdisciplinary knowledge of marine systems.
2. Demonstrate the ability to plan and implement observational, theoretical, and experimental studies.
3. Interpret and critique professional scientific literature.
4. Demonstrate an advanced ability to apply and integrate scientific principles and research data to address complex questions in marine systems.
5. Demonstrate competence in scientific communication through technical and scientific reports, publications and oral presentations.
6. Demonstrate professionalism and scientific ethics.
7. Have the competence to gain employment in advanced resource management positions or entrance to a doctoral program in related fields.

Masters in Oceanography will be offered and the degree will be in two streams which are as follows:
Masters by project work - **Project Group (A)**
Masters by research work - **Thesis Group (B)**
All courses are compulsory. Course No. OCN-501 to OCN-507 are compulsory for both project and thesis groups. Course No. OCN-508 to OCN-510 are for Project Group and Course No. OCN-511 & OCN-512 are for Thesis Group.

The Programme

The MS programme shall be of 30 credits and divided into 2 semesters. Each semester shall be of 19 weeks, of which 15 weeks will be for class teaching, 1 week break for preparation and 3 weeks for holding the semester final examinations

For a 3 or 4 credit theory courses there shall be three lecture classes per week i.e., a total of 45 lecture classes of 1 hour duration and for 2 credit course there shall be a two lecture classes per week i.e., a total of 30 lecture classes of 1 hour duration.

Note: Curriculum of courses and other rules (Credit and distribution of courses over the Semester, Evaluation and Grading, Degree Requirements, Credit Transfer, Improvement of Grades, Re-admission) are same as BS syllabus.

Credit and distribution of courses over the Semester

Theory:

2 credit = 30 classes (1 hour duration) = 50 marks

3 credit = 45 classes (1 hour duration) = 100 marks

Practical/Lab:

1 credit = 10 classes (3 hours duration) = 25 marks

2 credit = 20 classes (3 hours duration) = 50 marks

Field Trip:

1 credit = 1~2 full working days of field work = 25 marks

2 credit = 3~4 full working days of field work = 50 marks

Viva-voce: 1 credit/2 credit = 50 marks

The course and credit over eight semesters are illustrated below:

Class Year	**Number of Courses**		**Total Course**	**Credit Distribution**		**Total Credit**
	First Semester	Second Semester		First Semester	Second Semester	
First Year	6	4	10	18	12	30
Total			10			30

Assessment and Evaluation of Learning Achievement

Assessment System

i. Theory courses

Type of Assessment	Marks
FORMATIVE	
In-Course/Midterm Exam	25%
Attendance	5%
SUMMATIVE	
Course final examination	Subjective: 70%

ii. Practical course

In-course assessment + class attendances	40%+10%
Course final examination	50%

iii. Marks of attendances

Attendance %	Marks%
90 and above	05
85 to 89	04
80 to 84	03
75 to 79	02
70 to 74	01
Less than 74	00

iv. In-course Assessment for Theory Courses

(a) In-course Assessment may be done by taking class test and/or by giving assignments.

(b) The course teacher will announce the dates of in-course examinations at the beginning of the course. The in-course assessment will be of one hour duration and the teacher concerned will be responsible to assess the students sitting in his/her course. There will be 2 tests for each course.

(c) Maximum duration of in-course test will be one class hour.

v. Course Final Examination (Theory and practical Courses)

(a) Student having 75% or more attendance on average (collegiate) are eligible to appear in the final examination.

(b) Student having 60-74% attendance are considered to be non-collegiate and will be eligible to sit for the final examination on payment on fine Tk. 1,000/= (One thousand).

(c) Student having attendance less than 60% will not be allowed to sit for the final examination but may ask seek readmission in the program.

(d) The duration of theoretical course final examinations will be as follows:

Credit	**Duration of Examination**
3 credit courses	3 hours
2 credit courses	2 hours

(e) Duration of practical examinations will be between 3-5 hours irrespective of credit hours.

The Class Test (s) for first In-course Assessment will be taken usually after covering 40% of the course topics and second In-course Assessment will be taken usually after covering 80% of the course topics. The Course Final Examination will be taken upon completion of the entire course. In Final Examination, each theory course will be evaluated by two teachers of the Department. If a single teacher teaches a course, then the semester final test scripts must also be evaluated by two teachers, one of whom must be the course teacher, and another, a suitable second examiner who may be either from DU or outside DU. In the semester final examination if the difference of marks in any course is more than 20%, the script will be evaluated by a third examiner. The final marks obtained will be averaged of the nearest two marks, or third examiners marks if the difference between his/her marks and the two other examiner's marks are the same.

The total marks in a course will be converted into letter grade as under:

Numerical Marks	Letter Grade	Grade Point
80 above	A+	4.00
75 -79	A	3.75
70 – 74	A-	3.5
65 -69	B+	3.25
60 – 64	B	3.00
55 -59	B-	2.75
50 – 54	C+	2.50
45 -49	C	2.25
40 – 44	D	2.00
Below 40	F	0.00

Promotion

For promotion from one class year to next class year, a student is required to obtain a minimum CGPA (Cumulative Grade Point Average) or GPA (only for 1st Semester) as under:

Class Year	**Minimum CGPA**
From First Semester to Second Semester	2.00
From Second Semester to complete MS degree	2.50

The minimum CGPA of a student, as mentioned above, is calculated taking into consideration the grade points obtained in courses of all previous class years. Besides, a

student failing to clear up university or departmental dues shall not be promoted to the next class year.

Degree Requirements

For the M.S. Honors degree, each student is required to:

i) Complete 30 credit hours without a F grade in any course
ii) Earn a minimum CGPA of 2.50: and
iii) Complete the program in maximum six consecutive academic years including the year of first admission into the program.

For appearing at each semester final examination, every student is to fill in examination entry form supplied by the Controller of Examination on payment of dues.

Credit Transfer

No credit transfer from any other programs or institutions is allowed for the MS degree.

Improvement of Grades

A student earning F grade in a course in any year must improve the grade with any of the following two batches. A student is allowed to seat for improvement examinations in a course not more than one times. No improvement is allowed for marks in mid-term examination and viva voce, as well as in course(s) in which a student did not attend classes. Students obtaining less than C+ grade in any course may also choose to improve the grade by appearing at the semester final examination with the following batch only. In such cases, the best one of the two examinations will be considered for improving the result. Students willing to improve the grade in a course should apply to the Chairman of the Department at least four weeks before the start of the semester final examination.

Re-admission

A student failing to get the requisite grade points for promotion to the next year may seek re-admission with the following batches. For re-admission a student should apply within one month after the publication of result of the concerned year. On re-admission, grades obtained earlier by a student in the class year of re-admission shall be canceled and the student shall have to retake all the courses and examinations. Re-admission in a class-year shall be allowed only once in a class and a student shall not be allowed re-admission in more than twice during the entire program.

Semester-wise Distribution of Courses

Distribution of Courses

First Semester

Course No.	Course Title	Credit Hours
OCN-501	Advanced Satellite Oceanography	3 Credits
OCN-502	Ocean Dynamics and Climate Change	3 Credits
OCN-503	Coastal and Marine Resources: Management and Policy	3 Credits
OCN-504	Geopolitics of Indian Ocean Region	3 Credits
OCN-505	Coastal Ecology and Management	3 Credits
OCN-506	Numerical Models and Global Ocean Data Analysis	3 Credits
Sub-total		**18 Credits**

Second Semester

Course No.	Course Title	Credit Hours
Project Group (A)		
OCN-507	Seminar in Oceanography	2 Credits
OCN-508	Lab. and Field Work	4 Credits
OCN-509	Project Report (Report-2; Presentation-2)	4 Credits
OCN-510	Viva-voce	2 Credits
Sub-total (A) =		**12 Credits**
Thesis Group (B)		
OCN-507	Seminar in Oceanography	2 Credits
OCN-511	Thesis (Thesis-6; Thesis Presentation-2)	8 Credits
OCN-512	Viva-voce	2 Credits
Sub-total (B) =		**12 Credits**
Grand total (A+B) =		**(18+12=30 Credits)**

First Semester

Course Number and Title: OCN 501: Advanced Satellite Oceanography
Credit hours: 3

Course Content:

SL.	Topics	No. of Lectures
1.	Advanced Concept of Geo-information Science: Time Series Analysis, Network Analysis, Terrain Analysis, Process Modeling, Data Quality and Accuracy Assessment, Concept and Application of Geo-health, Customization, Scripting and programming, Geo-database, spatial database, Metadata, Model builder.	5
2.	GIS based Analysis: Spatial Analysis and Modeling (knowledge driven and data driven methods); Geo-statistical Analysis; 3-D Analysis; Interpolation; Topographic Analysis using TIN; DEM and Surfacing;	5
	MIDTERM EXAMINATION – I	
3.	GIS Mapping: Elements and types of Map, Basics of Mapping, Concepts of mapping using RS and GIS;	5
4.	Advanced Concepts and Principles of Remote Sensing: Air- and Space-borne	5
	Multispectral and Hyperspectral remote sensing concepts: Sensors; Information Extraction Techniques, Pre-processing, Classification Approaches, Special Techniques used for Hyperspectral Imagery;	5
	MIDTERM EXAMINATION – II	
5.	Radar and Lidar remote sensing: Concepts, Sensors; Information Extraction Techniques, Pre-processing, Classification Approaches, Special Techniques used for Radar imagery, Interferometry and Lidar & Radar Data Analysis;	5
6.	Satellite born SAR (Synthetic Aperture Radar)**:** Application of SAR, Radar Scatterometer and Radar Precipitation Sensors Onboard Satellites and their Applications.	5
	MIDTERM EXAMINATION – II	
7.	Advanced Image Classification: Support Vector Machine, Super Resolution, Mapping, Markov Random Field, Sub-Pixel Analysis of Optical Imagery, Object-based image classification, Radar Image Analysis: Interferometry & Polarimetry,	5
8.	Advanced Image Classification: Support Vector Machine, Super Resolution,	5

	Mapping, Markov Random Field, Sub-Pixel Analysis of Optical Imagery, Object-based image classification, Radar Image Analysis: Interferometry & Polarimetry,	
		Total = 45

Instructional Strategies: Lecture, Discussion, Question-Answer, Class Performance

Assesment:

Type of Assessment	Marks
FORMATIVE	
In-Course Exam	25
Attendance	5
SUMMATIVE	
Final Examination (Subjective)	70

Reading Materials:

1. John Stillwell, Graham Clarke - Applied GIS and Spatial Analysis
2. Jeremy W. Crampton (auth.), John Paul Jones (eds.) Mapping: A Critical Introduction to Cartography and GIS
3. John A. Richards, Xiuping Jia - Remote Sensing Digital Image Analysis: An Introduction
4. James B. Campbell PhD, Randolph H. Wynne - Introduction to Remote Sensing
5. Joe Breman, Charles Convis coordinator ESRI's Conservation Program - Marine geography- GIS for the oceans and seas

Course Number and Title: OCN 502: Ocean Dynamics and Climate Change
Credit Hours: 3

Course Content:

SL.	Topics	No. of Lectures
1.	Overview of climate system	2
2.	Climate variation during the postglacial period and to assess for future decades	3
3.	Current understanding of key climate issues such as the working of the climate system	3
4.	Natural causes of climate change and anthropogenic effects on climate	2
	MIDTERM EXAMINATION - I	
5.	Impact of climate change on estuarine, coastal and marine water	3
6.	Physical, Chemical and Biological changes on ocean temperature, salinity, density, MLD, Co_2, oxygen, ocean circulation, currents, waves, tides, nutrients, flora and fauna etc.	6
7.	Impact of Climate change on ocean Biogeochemistry	3
8.	Ecosystem and ecological response to climate change	3
	MIDTERM EXAMINATION - II	
9.	Implication of climate change on estuarine, coastal and marine fisheries. Sea level rise and salinity intrusion Cyclone and storm surges	5
10.	International Participations: Agenda-20, UNFCC, IPCC, Kyoto Protocol, COP, CDM, Carbon Trade.	5
	MIDTERM EXAMINATION - III	
11.	Policy, laws, international conventions and country program.	4

12.	Global awareness and IPCC interpretations Kyoto protocol and other international conventions Responses to climate change: global, national and local National Climate change strategies and activities Institutional arrangements of climate change	6
		Total = 45

Instructional Strategies: Lecture, Discussion, Question-Answer, Class Performance

Assesment:

Type of Assessment	**Marks**
FORMATIVE	
In-Course Exam	25
Attendance	5
SUMMATIVE	
Final Examination (Subjective)	70

Reading Materials:

1. J.T. Houghton, G.J. Jekins and J.J.Ephraums (1990) Climate Change, Cambridge University Press
2. S. Huq, Z. Karim M. Asaduzzaman and F. Mahtab (1999) Vulnerability Adaptation to Climate Changes for Bangladesh, Kluwerr Academic Pub.
3. S.B.Smith (eds.) 1996 Adapting to Climate Change: Assessment and Issues, Springer.
4. Asian Development Bank, (1994) Climate Change in Asia: Bangladesh Country Report; Published by ADB.
5. Hug. S *et al* (1999) Vulnerability and Adaptation to Climate Change for Bangladesh, Kluwer Academic Publishers.
6. Washington W.M. and Parkinson C.L. (1986) An Introduction to Three Dimensional Climate Modelling, USA.
7. Lockwood, J. G. -World Climatology: A Environmental Approach. Edulard Arnold.

Climate change in Asia: Bangladesh - Asian Development Bank.

Course Number and Title: OCN 503: Coastal and Marine Resources: Management and Policy
Credit: 3

Course Content:

SL.	Topics	No. of Lectures
1.	**Coastal and Marine Resources Management**	2
2.	Introduction to Natural Resources, History of Natural Resources and Civilization, Types of Natural Resources, Demand and Use of Natural Resources, Natural Resources Exploration, Economics of Natural Resources, Sustainable Development of Natural Resources. Environmental Impact of Natural Resources Extractions.	8
	MIDTERM EXAMINATION – I	
4.	Global Overview of Natural Resources: Occurrences, Extractions and Uses, Legal Aspects and Policy of Natural Resources Management	5
5.	Coastal and Marine Resources Management: Flora and Fauna, Coral Reef, Mineral Resources, Offshore hydrocarbon exploration and exploitation, Offshore mineral resources exploration and exploitation, Marine renewable energy resources.	5
6.	Economics, Policy and Management of Natural Resources of Bangladesh: i) Energy Resources ii) Coastal and Marine Resources iii) Mineral/Other Resources iv) Fisheries Resources	5
	MIDTERM EXAMINATION - II	
8.	**Coastal and Marine Policy**	2
9.	Coastal Zone Management: Concept, Policies, ICZM, Land Reclamation, Coastal Zoning, Protection and Defense, Management techniques, Community Participation, Coastal Conservation	4
	Bay of Bengal with emphasis on EEZ of Bangladesh and estuaries: Resource Utilization, Govt. policy on Bay of Bengal.	4
	MIDTERM EXAMINATION - III	
10.	Marine and coastal community-based management Marine and coastal ecosystem-based management Marine protected areas Marine debris Maritime safety	5

	Maritime security	
	Management of maritime cultural assets, Marine socioeconomics Ocean Policy, Marine Fisheries Policy Maritime Zones Act MPA, ECA, ABNJ	5
		Total = 45

Instructional Strategies: Lecture, Discussion, Question-Answer, Class Performance.

Assesment:

Type of Assessment	**Marks**
FORMATIVE	
In-Course Exam	25
Attendance	5
SUMMATIVE	
Final Examination (Subjective)	70

Reading Materials:

1. D. Raffaelli and S. (1997) Hawkins Intertidal Ecology
2. J. Pathick A. (1986) Introduction to Coastal Geomorphology
3. E.C. Birds (1993) Submerging Coast
4. S.C. Snedakar and J.G. Snedakar (1984) The Mangrove ecosystem
5. MS Islam (2001) Sea-Level Changes of Bangladesh: Last Ten Thousand Years
6. Mitchell, Bruce, Geography and Resource Analysis, London & New York: Longman
7. Simons, Ian,, The Ecology of Natural Resources
8. Plerce, J.T., The Flood Resource
9. Islam, M.A., Environment, Landuse and Natural Hazards in Bangladesh
10. Kabir, M.H. and Amin, S.M.N. (2007) Tanguar *Haor*: *A Diversified Freshwater Wetland*,
11. Academic Press and Publishers Library, Dhaka.
12. Warrick and Ahmad (eds.) The Implications of Climate and Sea Level for Bangladesh

Course Number and Name: OCN 504: Geopolitics of Indian Ocean region
Credit Hours: 3

Course Content:

SL.	Topics	No. of Lectures
1.	Geo-politics, Political Oceanography, Geo-economics and Geo-strategy: Conceptual Considerations	4
2.	Geo-politics of Bangladesh: Studies in Locational Significance	2
3.	Bangladesh in Asia: Relationship of Bangladesh with SAARC, ASEAN, China, India, USA, Europe and Middle-East/OIC Countries.	4
	MIDTERM EXAMINATION – I	
4.	Geo-political Strengths and Weakness of Bangladesh Indo-Bangladesh Relations: Geo-political, Geo-strategical and Geo-economic Considerations	7
5.	Geo-political and Geo-strategical Aspects of Indo-Bangladesh Connectivity: Transit-Transshipment Problems, Asian Highway and Asian Railway, Port Facilities for Neighbouring Countries and Security of Bangladesh; Sub-Regional Groupings.	8
	MIDTERM EXAMINATION – II	
8.	Hydro-Politics of Bangladesh: History, Farakka Problems, Transboundary River Disputes, Tipaimukh Dam and Interest of Lower Riparian Bangladesh, Teesta and Other Water-Sharing Problems of the Region.	5
9.	Disputes of Bangladesh with Neighbouring Countries: Disputes Related to Demarcation of Boundary, South Talpatti Island and Demarcation of Maritime Boundary, Bangladesh-Myanmar Geo-political Problems (Maritime Boundary).	5
	MIDTERM EXAMINATION – II	
10.	Security and Defense of Bangladesh: Classification of Security Strategies; Regional and International Cooperation; Environmental Politics and Security of Bangladesh; Maritime security; NGOs and Interference in National Security Issues.	5
11.	Connectivity and Regional Trade, FTA agreement, ASEAN, BCIM, BIMSTEC, RECP UNCLOS Area Beyond National Jurisdiction (BBNJ, ABNJ) Indian Ocean Rim Association (IORA) One Belt One Road (OBOR) and Maritime Silk Route	5

		Total = 45

Instructional Strategies: Lecture, Discussion, Question-Answer, Class Performance

Assesment:

Type of Assessment	Marks
FORMATIVE	
In-Course Exam	25
Assignment/Group Project/Class Performance	5
Attendance	
SUMMATIVE	
Final Examination (Subjective)	70

Reading Materials:

1. Graham P. Chapman - Geopolitics of South Asia
2. Marie Lall (Ed.) - The Geopolitics of Energy in South Asia
3. The China Pakistan Axis – Asia's New Geopolitics
4. Belt and Road -A Chinese World Order - Bruno Maçães
5. Bertil Lintner - The Costliest Pearl: China's Struggle for India's Ocean
6. Harsh V. Pant and Kriti M. Shah - South Asia's changing geopolitical landscape
7. Asanga Abeyagoonasekera - Geopolitics and Security: The view from South Asia
8. Abbas. B.M. The *Ganges* Water Dispute
9. Ahmad. M. (ed.) (1989) Flood in Bangladesh
10. Ahmed. Q.K. et al (eds.) (1994) Converting Water into Wealth
11. Gleick P.H. (ed.) (1993) Water in Crisis
12. Haggart K. (ed.) (1994) Rivers of Life
13. ICID (1994) Management of International River Basins and Environmental Challenges
14. Ohisson, L. (1995) Hydropolitics
15. Deniel, P. The Geography of Settlement
16. Jones, E. and Eyles, J. An Introduction to Social Geography, Oxford University Press, London.

Course Number and Title: OCN 505: Coastal Ecology and Management

Credit hours: 3

Course Content:

SL.	Topics	No. of Lectures
1.	The Chemical and Physical Environment: Measures of physiological performance; Temperature; Salinity; Oxygen; Light	3
2.	Ecological and Evolutionary Principles of Marine Biology: Ecological interactions; Interactions on the scale of individuals; The population level; The community level: structure and interspecies interactions; The ecosystem level	7
	MIDTERM EXAMINATION – I	
4.	Foraging; Predator-Prey and Trophic Interactions; Reproduction and Early Life History Patterns; Life History Traits and Social Behavior;	4
5.	Distributions, Guilds, Habitat Utilization and Community Structure; Fish Communities in Estuarine and Marine Systems, Biology of reef fishes; Conservation and management	6
6.	Reproduction, Dispersal, and Migration: Ecological and evolutionary factors in sex; Reproduction, demography, and life cycles; Migration; Larval dispersal at different scales	5
	MIDTERM EXAMINATION - II	
8.	Physical Setting: Biology of reef invertebrates; Coral life history & reproduction; Coral reef trophic interactions	4
9.	Reef Formation, zonation, biogeography, types, coral reef trophic system, Diversity and Distribution of Reef Organisms, Coral origins, evolution and speciation; Coral Reproduction, Larval Ecology, Coral diseases	6
	MIDTERM EXAMINATION - III	
	Coral polyp; Symbiosis with zooxanthellae and calcification; Coral growth and reproduction; Factors limiting the growth; Distribution of coral reefs; Coral reef development and types;	3
	Mangroves, sea grasses, sea weeds and algae	2
	Zonation; Biological interactions in coral reef ecosystem; Bioerosion and corallivory. Bioerosion, competition, threats to coral reefs; Fieldtrip preparation and discussion of write-up; Fieldtrip to coastal areas of Bay of Bengal	5

		Total = 45

Instructional Strategies: Lecture, Discussion, Question-Answer, Class Performance

Assesment:

Type of Assessment	Marks
FORMATIVE	
In-Course Exam	25
Attendance	5
SUMMATIVE	
Final Examination (Subjective)	70

Reading Materials:

1. Walker, P. & Wood, E. (2005) The Coral Reef (Life in the Sea). ISBN 081605703
2. Wolanski, E. (2000) Oceanographic Processes of Coral Reefs: Physical and Biological
3. Links in the Great Barrier Reef (1st Edition). ISBN 084930833
4. Sorokin, Y. I. (1993): Coral Reef Ecology (1st Edition). ISBN 9783540605324
5. Bowen J. (2015) The Coral Reef Era: From Discovery to Decline: A history of scientific investigation from 1600 to the Anthropocene Epoch (1st Edition). ISBN 9783319074788
6. Wootton, R. J. (1992) Fish Ecology (1st Edition). Springer Netherlands. ISBN 9780751403060
7. Gerking, S. D. (1994) Feeding Ecology of Fish (1st Edition). Academic Press. ISBN 9780122807800
8. Pitcher, T.J., Morato, T., Hart, P. J. B., Clark, M. R., Haggan, N., Santos, R. S. (2007)
9. Seamounts Ecology Fisheries and Conservation. Blackwell. ISBN 1405133430
10. Ueda, H., Tsukamoto, K. (2013) Physiology and Ecology of Fish Migration (1st edition). CRC Press. ISBN 9781466595132

Course Number and Title: OCN 506: Numerical Models and Global Ocean Data Analysis
Credit hours: 3

Course Contents:

SL.	Topics	No. of Lectures
1.	Introduction to ocean modeling: Model analysis and optimization, filtering approximations. History and methodology of modeling the circulation of the world ocean.	5
2.	The steady problem. A numerical approach to equatorial oceanic wave-mean flow interactions. Advective diffusion equation and turbulence	5
	MIDTERM EXAMINATION - I	
4.	Small scale parameterization in large-scale ocean models. Finite difference technique, finite difference formulation of a world ocean model	5
5.	One dimensional advective-diffusion models. Two dimensional models Three dimensional circulation models, GFD Modular Ocean Model (MOM), S-coordinate models (SPEM/SCRUM), POM, ROMS, Miami Isopycnic Model. Worldwide ocean tide modeling	10
	MIDTERM EXAMINATION - I	
6.	Open boundary conditions in numerical ocean models. Data and data processing, data analysis methods, Data assimilation. Mesoscale dynamics and dynamical forecasting	7
7.	Scientific visualization: Using MATLAB to present scientific data	3
	MIDTERM EXAMINATION - III	
8.	Students will access oceanographic data from local and global depositories: satellites, floats, and gliders. Students will manipulate, graph, and visualize data of increasing complexity while coding to visualize oceanographic events.	2
	Introduction to instrument prototyping and measurements in environmental science. Hands-on with data collection: programming microcontrollers, interfacing hardware and software, wireless sensor networks. Data analysis in Python. Problem solving with Matlab and C in the weekly computer laboratory.	8
		Total = 45

Instructional Strategies: Lecture, Discussion, Question-Answer, Class Performance

Assesment:

Type of Assessment	Marks
FORMATIVE	
In-Course Exam	25
Attendance	5
SUMMATIVE	
Final Examination (Subjective)	70

Reading Materials:

1. David M. Glover, William J. Jenkins, Scott C. Doney. Modeling methods for marine science.

2. Lakshmi H. Kantha, Carol Anne Clayson. Numerical models of ocean and oceanic processes

3. Advanced physical oceanographic numerical modeling,

4. James J. O'Brien, Henk A. Dijkstra. Dynamical Oceanography

5. Malek Madani. Physical Oceanography

6. Alfred R. Osborne. Nonlinear ocean waves

7. Richard E. Thomson, William J. Emery. Data analysis methods in physical oceanography

Second Semester
Group A

Course Number and Title: OCN 507: Seminar in Oceanography
Credit: 2

Course Content:
Each student has to appear for two seminar presentations on current research in various fields of oceanography, selected by the department/course teacher, related to his/her MS thesis/project

Instructional Strategies: Lecture, Discussion, Presentation, Question-Answer, Class Performance

Assesment:

Type of Assessment	**Marks**
FORMATIVE	
In-Course Exam	12.5
Attendance	2.5
SUMMATIVE	
Final Examination	35

Course Number and Title: OCN 508: Lab. and Field Work
Credit hours: **4**

Course Content:

Students will go for field work either in estuarine or coastal areas or in a cruise on ocean going vessel (ORV) in the offshore and deep sea area.

Assesment:

Type of Assessment	**Marks**
FORMATIVE	
In-Course Exam	25
Attendance	5
SUMMATIVE	
Final Examination	70

Second Semester
Group B

Course Number and Title: OCN 507: Seminar in Oceanography
Credit: 2

Course Content:
Each student has to appear for two seminar presentations on current research in various fields of oceanography, selected by the department/course teacher, related to his/her MS thesis/project

Instructional Strategies: Lecture, Discussion, Presentation, Question-Answer, Class Performance

Assesment:

Type of Assessment	Marks
FORMATIVE	
In-Course Exam	12.5
Attendance	2.5
SUMMATIVE	
Final Examination	35

Course Number and Title: OCN-511 Thesis
Credit: 8
Thesis-6;
Thesis Presentation-2