

**Department of Oceanography
University of Dhaka**

Curriculum of Courses
for
M.Phil/Ph.D in Oceanography

December 2013

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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 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's goal is to advance marine sciences through observation, experimentation and modeling, and to provide excellent educational and research opportunities for graduate students (M.Phil./Ph.D.) in Bangladesh with degrees in Oceanography. Through discovery and active learning we prepare students for careers across the public and private sector.

Graduate studies (i.e., M.Phil./Ph.D.) in Oceanography will be offered. Students have to take the following courses:

Course No.	Course Title	Credit Hours
OCN 601	Fundamentals of Oceanography	3
OCN 602	Advanced Oceanography	3
OCN 603	Viva-voce	3
OCN 604	Thesis	6
Total		15*

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

* However, common rules, regulations and practices for the M.Phil/Ph.D. degree of the University of Dhaka would be applicable.

Introduction to Geological oceanography: development in the recent past.

Origin of the Earth and Ocean: The age of the Earth and the geological time, scale; structure of the Earth's interior and its composition; features of the Ocean; Continental drift and sea floor spreading; Plate tectonics-the types of plate boundaries-rifting and subduction zones; the trenches.

The sea floor and continental margins: the ocean basins- origin and morphology; identification of components of the ocean margin; ridges and rises; processes responsible for creating the ocean margin features; the shelf, slope and abyssal plain. Active and passive continental margin.

Introduction to marine sediments: sediment sources and pattern of sediment deposition from the self to the deep ocean; sediment size and accumulation; sampling of sediments; dominant transportation processes; sea bed resources.

The marine environments: general conditions, distribution of life form in the oceans; divisions of the marine environment- pelagic and benthic environments, Basic marine life styles.

Sea level changes: Geological evidence and consequences: Eustatic vs. relative sea level changes: effects of sea level change on marginal marine environments.

Physical Oceanography: Introduction. Definition, Scope, Multidisciplinary investigation application for Bangladesh.

Relief of the Ocean: Physical feature of the ocean floor, ocean floor topography, trenches, oceanic ridges, submarine canyon, passive and active continental margin, continental shelves & slope, ocean floor of the Atlantic, Pacific and Indian Ocean.

Ocean Sediments: Source of sediments, types, characteristics, depositional environments.

Ocean temperature: Temperature change, causes, vertical and horizontal distribution and Implication.

Ocean Salinity: Salinity change, causes, distribution and implication.

Ocean Currents: Causes, types, mean current in Atlantic, Pacific and Indian Ocean.

Ocean Tide: Causes and effects. Global distribution, Implication.

Waves: causes, characteristics of wave actions, wave energy.

Storm surges and cyclones, characteristics, environmental consequences and management.

Sea-level change: Definition, causes, past, present and future trends of S. L. changes. Consequences of S. L. changes.

Marine Environment: Marine climatic Zone, EL-Nino. La-Nina, Man-Ocean relation.

Books Recommended:

Duxury, A.B. R Duxubury A.C (1999): Fundamentals of Oceanography (3rd Ed.), WCB/MC Graw-Hill.

Thurman, H.V. (1994): Introductory Oceanography (7th Ed.), Macmillan Pube. Comp.

Seibold, E. & Berger, W. H: The sea Floor- An Introduction to Marine Geology (3rd Ed.).

Erickson & Timothy (2002): Marine Geology.

The Ocean Basins: Their Structure and Evolution (second edition). Open University. ISBN 0750639830

The Sea Floor ---An Introduction to Marine Geology (third edition). E. Seibold and W.H. Berger. ISBN 3540601910

Rhatt, J.J., Oceanography, 13. Van Nostrand Company, New York.

King, C.A.M., Oceanography for Geographers, Edwin Arnold Publishers Ltd. London

Sharma, R-C. and Vatal, M. Oceanography for Geographers, Chaitanya Publishing House, Allahabad, India.

Carson, R.J., The Sea Around, Staples Press Ltd. London.

Engel, L., The Sea, Time Incorporated, London.

Islam. M.S. Sea-Level Changes in Bangladesh 2001

OCN- 602

Advanced Oceanography

Credit: 4

Introduction, Background:

Introduction, the composition of seawater, what is salinity? The properties of water and seawater, the global hydrologic cycle, general oceanic circulation, 'meridional overturning circulation', global salinity distribution, density and vertical density profiles.

Intro to Earth Processes; Seawater and Salt, Salinity and Chemical Transformations. Gas Solubility and Air-Sea exchange. Elemental composition of seawater. Conservative and non-conservative behaviour. Salinity, its measurement and applications.

Steady vs non-steady state of ocean composition. Mean oceanic residence times, the thermocline and the 2-box model of ocean chemistry; thermohaline circulation. Estuaries, Evaporites, Primary productivity and particle fluxes.

Geochemical Cycling through the Oceans:

Compositions and Residence Times. Major ions and salinity, box models, mass balances, river input, weathering, cyclic salts, hydrothermal systems and sediments, speciation of major ions. Tools for studying geochemistry.

Introduction to stable isotopes. Introduction to radiochemistry, chart of the nuclides, Applications. eg. Carbon-14 dating, particle scavenging rates, air-sea gas exchange, quantification. The Global Journey - inputs to and outputs from the ocean. Rivers and estuaries, weathering, hydrothermal processes, gas exchange across the air-sea interface, atmospheric deposition, sediments.

Inorganic Carbon Chemistry 1: The oceanic chemistry of dissolved inorganic carbon, pH, the alkalinity of seawater, ion activity products.

Biogeochemical Cycling within the Water Column:

Life Processes in the Ocean, Redfield ratios, nutrients, nutrient limitation, photosynthesis, respiration, particles and scavenging in the water column, transport and removal of particles, ²³⁴Th methods, controls of primary productivity, nutrient distributions. trace element distributions, trace elements and phytoplankton, quantifying fluxes and rates.

Biogeochemical Cycling in the Sediments:

Sediment Chemistry, The importance of oxygen, redox geochemistry, early diagenesis, sequence of terminal electron acceptors, organic matter preservation, global distribution of sediments.

Inorganic Carbon Chemistry II: Preservation of carbonate sediments, alkalinity budgets, paleo-oceanographic implications of ocean carbonate chemistry.

Global Biogeochemical Cycles:

The Carbon Cycle - long term cycles, weathering, preservation in sediments, anthropogenic impacts. The Nitrogen Cycle - denitrification, nitrogen fixation, annamox, paleo-oceanographic applications.

The biolimiting elements: P, N and Si. Biological cycling of other elements. CaCO₃ biogeochemistry and changing pH of oceans. Dissolved oxygen and anoxia. Scavenged elements. Geochemistry of ocean sediments.

Oxygen, Organic Matter, Nutrients and Biolimiting Elements, Trace Metals, Diagenesis. Nitrogen and Phosphorus Cycles, Production of DOM, Silica and Evaporites, Inorganic Chemistry of Seawater, Marine Carbon Cycle and Global Climate Change.

Introduction, basic terms, zonation of the oceans, history, physical & chemical properties of seawater, water masses, density, pressure, salinity.

Light, temperature, ocean heat budget, physics of waves & currents, major current systems, Upwelling.

Nitrogen, phosphorus, silicate, biogeochemical cycles, carbon cycle and the marine carbonate system.

Photosynthesis, primary production, phytoplankton systematics, zooplankton systematic, ecology of zooplankton, secondary production and zooplankton activity, food chains, food webs and the "microbial loop".

Nutrient uptake and competition, zonation of the benthos, seafloor, macroalgae. seagrass, benthic animals, ecology of benthic communities and mangroves, coral reefs.

Fisheries oceanography, marine mammal ecology, deep-sea ecology and hydrothermal vents, alien species and harmful algal blooms, human impacts on the oceans.

Books Recommended:

Emerson, S.R and Hedges, J.I. *Chemical Oceanography and the Marine Carbon Cycle*. Cambridge University Press, Cambridge, UK, 2008.

Pilson, M.E.Q. *An Introduction to the Chemistry of the Sea*. Prentice Hall, New Jersey, USA, 1998.

Sarmiento, J. and Gruber, N. *Ocean Biogeochemical Dynamics*. Princeton University Press, Princeton, N.J, USA, 2006.

Berner. Elizabeth Kay and Robert A. Berner. *Global Environment: Water, Air, and Geochemical Cycles*. Prentice Hall, New Jersey, 1996.

Broecker, Wallace and Peng, Tsung-hung, *Tracers in the Sea*, Palisades, N.Y. LamontDoherty Geological Observatory, Columbia University. 1982.

Burdige David, *Geochemistry of Marine Sediments*. Princeton University Press, 2006.
Morel, Francois M. M. and Janet G. Hering. *Principles and Applications of Aquatic Chemistry*. Wiley-Interscience, New York, 1993.

Millero, Frank J. *Chemical Oceanography*, Third Edition. CRC Press, New York, 2006.

Marine Biogeochemical Cycles, 2nd Edition by Rachel James. The Open University, ISBN: 0750667931

Seawater: Its Composition, Properties and Behavior, 2nd Edition by The Open University, ISBN: 0750637153

Marine Biogeochemical Cycles (second edition). Open University. ISBN075066791

Marine Geochemistry. H.D. Schulz and M. Zabel (eds.). ISBN 354066453X

Carol M Lalli & Timothy Parsons (1997) *Biological Oceanography: An Introduction*, 2nd edition. Butterworth-Heinemann Publishers. ISBN 0750633840.

J. Levinton (2009) *Marine Biology: Function, Biodiversity, Ecology*. (3rd edition, Oxford University Press).

Sumich, James, L. & Morrissey, John, F. (2008) *Introduction to the Biology of Marine Life, 9th edition*. Jones & Bartlett Publishers. ISBN: 0-7637-3313-X.

M. Takahashi, B. Hargrave & T. R. Parsons (2005) *Biological Oceanographic Processes*, 344 pages, 3rd Edition. Pergamon Press.

Jumars, P. A. (1993) *Concepts in Biological Oceanography: An Interdisciplinary Primer*. Oxford University Press, New York. 348 p. ISBN 0- 19-506732-0.