



GUJARAT TECHNOLOGICAL UNIVERSITY

Integrated Master of Science (Biotechnology)

Semester: 7

Subject Name: Oceanography and Marine Bio resources

Subject Code: 1370411

Prerequisite:

Basic knowledge of biology, chemistry, and environmental science is required. Familiarity with ecosystem dynamics, hydrology, and marine biodiversity will help students understand oceanographic processes, marine resource distribution, and their ecological significance for sustainable exploration and conservation.

Rationale:

This course explores physical, chemical, biological, and geological oceanography, focusing on marine bio-resources, ecosystem interactions, and sustainable management. It equips students with the knowledge to analyze oceanographic processes, assess marine resource potential, and implement conservation strategies for maintaining marine biodiversity and ecosystem health.

Course Scheme:

Teaching Scheme			Total Credits	Assessment Pattern and Marks				Total Marks
L	T	PR		Theory		Practical		
			ESE (E)	PA(M)	ESE (V)	PA (I)		
4	0	8	8	70	30	30	20	150

Course Content:

Unit No.	Content	No. of Hours	Weightage (%)
1	Introduction to Oceanography - history of oceanography-expeditions, marine biological Institutions, origin of oceans-bottom topography, abyssal hills-plains: submarine canyons-ocean trenches. Physical Properties of Seawater- density, viscosity, surface tension, conductivity and their relationship, temperature distribution in the sea-heat budget, UV radiation, acoustics. Dynamics of the ocean-general surface circulation - wind and thermohaline circulation. Forces causing currents, boundary currents, Langmuir circulation, Geotropic currents, turbidity currents, monsoon and trade winds, Upwelling.	10	16
2	Waves, Currents and Tides theories of waves-tidal waves-formation of swells internal and standing waves- storm surges tsunami - tide generating forces- tidal currents- tidal effects in coastal areas tide and wave energy. Estuaries -origin and classification estuarine circulations-estuarine zonation- lagoons. Sedimentation- origin and physical properties of sediments (lithogenous, biogenous and	10	16



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	cosmogenous), distribution and transport of sediments, determination of age of sediments.		
3	<p>Introduction to marine chemistry- ocean as a chemical system - origin of sea salts properties of water molecules differences between fresh and seawater.</p> <p>Chemical composition of seawater- ionic, major and minor constituents, constancy- ionic compositions and factors affecting constancy- major and minor elements, trace elements-their importance, distribution. Chemistry of seawater constituents- concept of chlorinity and salinity - methods of measurements.</p> <p>Radio nuclides in the sea- origin, distribution and use as tracers of water masses. Dissolved Gases- carbon dioxide- origin, importance and distribution. Oxygen origin and factors governing the distribution- BOD and COD. Other Gases nitrogen, hydrogen sulphide, methane.</p>	10	16
4	<p>Nutrients- Inorganic, origin, distribution and important role in the fertility of the sea. Nitrogen, Phosphorous and Silicon in the sea- distribution, cycling, regeneration concept new and regenerated production, N: P ratio. Mineral wealth of the sea- salts, glauconite, petroleum, phospharite, manganese nodules- potential, economy of extraction. Desalination - recovery of chemicals.</p> <p>Organic matter- dissolved, particulate and colloidal species, sources, classification, composition, distribution, seasonal variation- ecological significance- growth promoting and growth inhibiting effects biogeochemical cycle.</p>	10	16
5	<p>Sea as a Biological Environment: Plankton Classification- Based on size, mode of life, and habitat. Types of Plankton- Phytoplankton and Zooplankton. Plankton Collection Methods- Sampling techniques for qualitative and quantitative assessment. Standing Crop Estimation- Wet and dry weight estimation, plankton volume settling, and displacement methods. Organic Matter Analysis- Oxidation as carbon in marine ecosystems.</p> <p>Plankton Adaptation and Ecological Interactions: Structural Adaptations- Weight, surface area, flotation mechanisms. Physiological Adaptations- Specific gravity, water content, fat content, ion balance (mono- & divalent), gas vacuoles. Ecological Interactions- Phytoplankton and Zooplankton interrelationships, microbial loop. Red Tide Phenomenon- Causes, impacts, and ecological consequences.</p>	10	16
6	<p>Organic Production and Marine Productivity: Primary & Secondary Production- Concepts and estimation methods. Factors Influencing Primary Production- Environmental,</p>	10	16



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	<p>geographical, and seasonal variations. Regional Variability-Differences in primary and secondary productivity across marine ecosystems.</p> <p>Marine Vegetation and Resource Management: Seaweeds-Occurrence, distribution, and economic importance. Seagrasses-Morphological and anatomical adaptations, ecological role. Mangroves-Distribution, adaptations, conservation, and ecological significance. Salt Marsh and Sand Dune Vegetation-Adaptations, ecological roles, and conservation. Biological Resource Assessment-Role of remote sensing and Geographic Information Systems (GIS) in marine ecosystem monitoring and management.</p>		
	Total Hours:	60	100

Textbook:

1. Grant Gross, M., 1993 Oceanography: A view of the earth (sixth edition). Prentice Hall Inc. New Jersey.
2. Thurman, Harold., 2001 Introduction to Oceanography, Prentice Hall Inc. New Jersey.
3. Steve Neshya, 1987. Oceanography perspective on a fluid earth. John Wiley & Sons, New Jersey.
4. Qasim, S.Z. 1999. The Indian Ocean, Images and realities. Oxford and IBH.
5. Pilson, M.E.Q., 1998. An Introduction to the Chemistry of the Sea Prentice Hall New Jersey.
6. Millero F. J 2002. Chemical Oceanography CRC press.
7. Grasshoff, Klaus 1999. Methods of Sea water Analysis. Wiley VCH New York
8. Sumich, J. L., 1999. Introduction to the biology of Marine Life 7th Edition. The Mc Graw Hill Companies Inc.
9. Nybakken, J. W 2001. Marine Biology an Ecological Approach 4th edition. Addison Wesley Edu. Pub. Inc
10. Peter McRoy, C. and G. Helfferich, 1977, Seagrass Ecosystems. A scientific Perspective. Marcel Dekker Inc., New York.

Reference Books:

1. Sverdrup, H.U., M.W. Johnson and R.H. Fleming, 1958. The Oceans- their Physics, Chemistry and General Biology, Prentice- Hall Inc. New Jersey.
2. Pickard, G.L. and W.J. Emery 1995. Descriptive Physical Oceanography. Pergamon Press, London.
3. David A. Ross, 1977. Introduction of Oceanography. Prentice Hall Inc. New Jersey.
4. Riley, J.P. and Skirrow, 1975-1984. Chemical Oceanography Vols. 1 to 8. Academic Press, London.
5. Hill, M.N. 1963. The Sea Vols. 1 to3. Inter science Publishers, New York.
6. Strickland J.D.H and T.R Parson 1972. A Practical handbooks of seawater analysis. Fisheries Research Board of Canada, Ottawa, Bulletin 167.
7. Tomas, Carmelo, R. 1997. Identifying Marine Phytoplankton. Academic Press
8. Chapman, V.J. 1978. Coastal vegetation. Pergamon Press, Oxford.



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9. Parsons, T.R., M. Takahashi and B. Hargrave (II Ed.), 1977. Biological Oceanography Processes. Pergamon Press Oxford.
10. Naskar, K and R. Mandal, 1999 Ecology and Biodiversity of Indian Mangroves Vol. I & II Daya Publishing House.

Course Outcomes:

No.	Course Outcomes	RBT Level*
1	Explain the fundamental concepts of oceanography, including physical, chemical, biological, and geological processes in marine environments.	RM, UN
2	Describe the classification, distribution, and ecological significance of marine bio-resources.	UN, AP
3	Analyze the interactions between oceanographic processes and marine biodiversity, including resource availability and ecosystem stability.	AN, EL
4	Evaluate the impact of climate change, pollution, and human activities on ocean systems and marine bio-resources.	EL, CR
5	Apply oceanographic principles for sustainable marine resource management, conservation, and biotechnological applications.	AP, CR

*RM: Remember, UN: Understand, AP: Apply, AN: Analyze, EL: Evaluate, CR: Create

Suggested Course Practical List:

1. Measuring Devices-I Secchi Disc, Lux meter, Turbidity meter, Under water photometer.
2. Measuring Devices- II Current meter, Echo Sounder, Hygrometer.
3. Water and Sediment sampling devices: Nansen, Mayers, Van Dorn, Niskin and Bacteriological water samplers, Van -Veen grab - Petersen grab, Vertical gravity corer.
4. Estimation of Salinity.
5. Estimation of Dissolved Oxygen.
6. Determination of Nitrite, Nitrate and Ammonia.
7. Determination of Reactive Phosphate and Total phosphorous.
8. Determination of Silicate.
9. Identification of Phytoplankton- Diatoms, Dinoflagellates, Blue green algae and Coccolithophores.
10. Identification of Zooplankton- Copepods, Hydromedusae, Pteropods, Chaetognatha, Thaliaceae and planktonic Larvae.
11. Identification of locally available Seaweeds, Seagrasses and Mangrove plants.
12. Extraction and Estimation of Chlorophyll a, Primary productivity.

List of Laboratory/Learning Resources Required:

1. Equipment & Instruments
 - Secchi Disc, Lux Meter, Turbidity Meter, Underwater Photometer
 - Current Meter, Echo Sounder, Hygrometer
 - Water Samplers (Nansen, Mayers, Van Dorn, Niskin, Bacteriological samplers)
 - Sediment Samplers (Van-Veen Grab, Petersen Grab, Vertical Gravity Corer)



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- Refractometer for salinity estimation
- Spectrophotometer for nutrient and chlorophyll analysis
- Microscope for phytoplankton and zooplankton identification
- Colorimeter for chemical analysis

2. Chemicals & Reagents

- Standard solutions for Nitrite, Nitrate, Ammonia, Phosphate, Silicate
- Winkler's reagents for dissolved oxygen estimation
- Acetone or ethanol for chlorophyll extraction
- Lugol's iodine solution for plankton preservation
- pH buffers and calibration solutions

3. Glassware & Consumables

- Burettes, pipettes, measuring cylinders, and volumetric flasks
- Filtration apparatus and filter papers
- Sample bottles for water and sediment collection
- Light-dark bottles for primary productivity measurement

4. Field & Laboratory Facilities

- Access to marine/coastal field sites for sample collection
- Laboratory with microscopy, spectrophotometry, and chemical analysis facilities
- GIS and Remote Sensing tools for biological resource assessment

5. Reference Manuals & Learning Resources

- Parsons, Maita & Lalli (1984) – A Manual of Chemical & Biological Methods for Seawater Analysis
- Strickland & Parsons (1972) – A Practical Handbook of Seawater Analysis
- UNESCO (1983) – Chemical Methods for Use in Marine Environmental Monitoring
- APHA (2017) – Standard Methods for the Examination of Water and Wastewater
- Trivedy & Goel (1986) – Chemical & Biological Methods for Water Pollution Studies
- Tomas, C. R. (1997) – Identifying Marine Phytoplankton
- Omori & Ikeda (1984) – Methods in Marine Zooplankton Ecology
