



GUJARAT TECHNOLOGICAL UNIVERSITY
Integrated Master of Science (Biotechnology)
Semester: 8
Subject Name: Marine Pollution & Toxicology
Subject Code: 1380411

Prerequisite:

Basic knowledge of environmental science, chemistry, and marine biology is required. Understanding pollution sources, ecological impacts, and toxicological principles will help students explore marine contaminants, bioaccumulation, and the effects of pollutants on marine organisms and ecosystems.

Rationale:

This course focuses on marine pollution sources, toxicological effects, and remediation strategies. It equips students with knowledge of pollutant fate, bioaccumulation, environmental monitoring, and regulatory policies, enabling them to develop sustainable solutions for marine pollution control and ecosystem conservation.

Course Scheme:

Teaching Scheme			Total Credits	Assessment Pattern and Marks				Total Marks
L	T	PR		C	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 Marine Pollution & Toxicology Definition of Marine Pollution – Classification, types, and sources; Role of GESAMP – (Group of Experts on the Scientific Aspects of Marine Environmental Protection); Major Pollutants – Sources, transport pathways, and dynamics; Toxicology in Marine Systems – Lethal vs. sub-lethal effects on marine organisms; Processes of Contaminant Transfer – Bioconcentration, bioaccumulation, and biomagnification; Methods of Toxicity Testing – Acute and chronic toxicity assays; Factors Influencing Toxicity – Synergistic and antagonistic effects, role of microcosms and mesocosms.	12	20
2	Pollution from Urban and Industrial Sources Sewage Pollution – Industrial, agricultural, and domestic wastewater impacts on marine environments; Wastewater Treatment Methods – Physical, chemical, and biological treatment; Detergent Pollution – Composition, ecological significance, and eutrophication effects; Plastics and Marine Litter – Sources, microplastics, and environmental impacts; Case Studies – Urban coastal pollution and mitigation strategies.	12	20



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3	Heavy Metals & Pesticide Pollution Heavy Metal Pollution – Sources (natural and anthropogenic); Distribution, transport, and fate in marine ecosystems; Analytical methods for detection. Pesticide Pollution – Classification and chemical properties; Sources and distribution in the marine environment; Ecological impacts on marine fishes, birds, and mammals.	12	20
4	Oil, Thermal, and Radioactive Pollution Oil Pollution – Composition and sources of crude oil and petroleum hydrocarbons; Biological impacts on marine organisms (fishes, birds, and mammals); Treatment and remediation techniques. Thermal Pollution – Sources of thermal discharge. Effects of waste heat on aquatic ecosystems; Role of biocides and chlorine. Radioactive Pollution – Natural and artificial sources; Biological effects of radiation on marine organisms.	12	20
5	Environmental Monitoring & Analytical Techniques Marine Pollution Monitoring – Objectives, methods, and limitations; Biological Indicators – Bioaccumulation in mussels (Mussel Watch programs), Water quality assessments and biological response indicators; Analytical Approaches for Marine Contaminants – Atomic Absorption Spectroscopy (AAS), Inductively Coupled Plasma Spectroscopy (ICP), Gas-Liquid Chromatography (GLC), Spectrofluorometry for petroleum hydrocarbons, pesticides, and heavy metals.	12	20
Total Hours:		60	100

Textbook:

1. Clark R.B 1992. Marine pollution 3rd edition Clavendron, Press Oxford.
2. Williams 1996. Introduction to Marine Pollution Control. John Wiley.
3. Michael J. Kennish 1994. Practical Handbook on Estuarine and Marine Pollution.

Reference Books:

1. Johnston, R. (ed), 1976. Marine Pollution, Academic Press, London.
2. Goldberg, E. D. 1974. The Health of the oceans, UNESCO Press. Paris.
3. Park, P .K, Kester D.R., J.W. Deudall and B.H Ketchum, 1983. Wastes in the Ocean. Vols. 1 to 3 Wiley Interscience Publishers, New York.

Course Outcomes:

No.	Course Outcomes	RBT Level*
1	Describe the sources, types, and pathways of pollutants in marine environments.	RM, UN



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2	Explain the principles of toxicology, including bioaccumulation, biomagnification, and pollutant interactions with marine organisms.	UN, AP
3	Analyze the physiological and ecological effects of marine pollutants on biodiversity and ecosystem health.	AN, EL
4	Evaluate environmental monitoring techniques, pollution control measures, and regulatory frameworks for marine pollution management.	EL, CR
5	Apply toxicological assessment methods to develop sustainable remediation strategies for marine ecosystem protection.	AP, CR

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

Suggested Course Practical List:

1. Case Study of a Polluted Marine Area – Site visit, documentation of pollution sources, and assessment of ecological impact.
2. Collection & Analysis of Environmental Parameters – Sampling of seawater and sediment for pollution indicators (pH, temperature, salinity, DO, BOD, COD).
3. Toxicity Evaluation of Heavy Metals on Marine Organisms – Bioassay techniques to assess LC50 (lethal concentration) and EC50 (effective concentration).
4. Toxicity Assessment of Pesticides, PCBs, and Oil on Marine Species – Testing sub-lethal effects on selected fish or invertebrates.
5. Analysis of Heavy Metals in Marine Water & Sediments – Using Atomic Absorption Spectroscopy (AAS) or Inductively Coupled Plasma Spectroscopy (ICP).
6. Gas Chromatography (GC) for Pesticide & PCB Detection – Demonstration of sample preparation, extraction, and analysis.
7. Spectrofluorometric Analysis of Petroleum Hydrocarbons – Detection and quantification of oil residues in marine samples.
8. Toxicity Testing Methods – Static and dynamic bioassay experiments on selected marine organisms.
9. Demonstration of Analytical Instruments – Hands-on training in AAS, ICP, GC, and Spectrofluorometry for marine pollution studies.
10. Preparation & Submission of Pollution Assessment Report – Compilation of findings from case studies, toxicity assessments, and laboratory analysis.

List of Laboratory/Learning Resources Required

1. Field Sampling Equipment

- Water Sampling Bottles – Niskin bottles, Van Dorn samplers
- Sediment Samplers – Van Veen grab, corers
- Multiparameter Water Quality Meter – For measuring pH, salinity, temperature, DO, BOD, COD
- Filtration Units & Membrane Filters – For sample preparation
- GPS Device – For site location tracking in field studies

2. Analytical Instruments for Pollution Assessment

- Atomic Absorption Spectroscopy (AAS) – For heavy metal detection
- Inductively Coupled Plasma Spectroscopy (ICP-MS) – For trace metal analysis



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- Gas Chromatography (GC) – For pesticide, PCB, and hydrocarbon analysis
 - Spectrofluorometer – For petroleum hydrocarbon detection
 - UV-Vis Spectrophotometer – For general water quality assessments
 - Flame Photometer – For sodium and potassium analysis in water samples
3. Toxicity Testing & Bioassay Equipment
- Aquatic Bioassay Chambers – For toxicity evaluation
 - Standard Test Organisms (Fish, Algae, Crustaceans) – For LC50 and EC50 studies
 - Micropipettes & Analytical Balances – For chemical handling
 - Incubators & Water Baths – For controlled exposure studies
4. Sample Preparation & Chemical Reagents
- Reagents for Heavy Metal Analysis – Nitric acid, perchloric acid, calibration standards
 - Solvents for Pesticide Extraction – Hexane, acetone, dichloromethane
 - Microbial Culture Media – For testing pollution impact on microbial diversity
 - Glassware – Beakers, conical flasks, centrifuge tubes, volumetric flasks
5. Learning & Reference Materials
- Marine Pollution Monitoring Manuals – GESAMP reports, WHO guidelines
 - Standard Methods for the Examination of Water and Wastewater (APHA, AWWA, WEF)
 - Case Studies & Research Papers – On oil spills, microplastics, eutrophication, and bioaccumulation

