	examples of various projects. Objectives of EIA implementation and follow up. Tools of EM & performance review. Environmental auditing. Evaluation of EIA effectiveness and performance. **Module 4: EIA of Mining** Potential sites, brief description of the project, identification, nature of mineral, Quality and quantity, resource available, geology, types of mining, carrying capacity, Blasting - Rules and Guidelines, Dust and noise pollution, transportation, Biodiversity assessment, Impact on human settlement, Restoration, reclamation and mitigation measures, hydrology, safety and prevention measures.	10 hours
Pedagogy:	Lectures/assignments/workshops and discussion/presentations.	
References/ Readings	1. Glasson, J., Therivl. R & Chadwick, A. (2005). Introduction to Environmental Impact Assessment. Published by Routledge. Taylor and Francis Group. New York 2. Arts, J., & Morrison-Saunders, A. (Eds.). (2012). *Assessing impact: handbook of EIA and SEA follow-up*. Routledge. Taylor and Francis Group. New York 3. Abaza, H., Bisset, R., Sadler, B., (2004). Environmental Impact Assessment and Strategic Environmental Assessment: towards an Integrated approach. UNEP. 4. Therivel, R., & Wood, G. (Eds.). (2017). *Methods of environmental and social impact assessment*. Routledge. Taylor and Francis Group. New York. 5. Morris, P., & Therivel, R. (Eds.). (2001). *Methods of environmental impact assessment* (Vol. 2). Taylor & Francis. New York	
Learning Outcomes	On completion of the course, the student will be able to apply various methods to assess the impacts of developmental projects on various aspects of environment with special reference to mining.	

Title of the Course: Lab Course in Environmental Science

Course Code: ESO-302 **Number of Credits:** 03

Total Contact Hours: 72 **Effective from AY:** 2022-23

Prerequisites for the course:	Graduates in any discipline with science subjects at the 10+2 level.
Objectives:	1. To introduce students to basic instruments in chemistry lab, significance of calibration of glassware/ use of analytical grade reagents/ general reagents, use of analytical balance, basic laboratory practices, safety in laboratory. 2. To understand the concentration of various pollutants including trace metals

	in the water/soil/air. The analyses of BOD and COD are used to understand the impact organic pollution on water bodies.	
Content:	**Section –I**	
	Module 1 (Any 6 experiments, 3 hours each) 1. Demonstration of instruments (colorimeter, pH meter, conductivity meter, Karl Fischer titrator, 2. Calibration of glass electrode and conductivity meter. 3. Determination of pH and conductivity of surface, ground and sea water 4. Determination of alkalinity and acidity of surface, ground and sea water sample using titrimetric analysis. 5. Estimation of total solids, dissolved solids, suspended solids of river/lake/pond water sample. 6. Estimation of total residual chlorine of water samples. 7. Estimation of sulfate in water samples (tap water) by turbidimetry.	18 hours
	Module 2 (Any 6 experiments, 3 hours each) 1. Determination of pH and conductivity of soil samples. 2. Determination of moisture content of soil samples. 3. Estimation of hardness of water samples by complexometric method 4. Determination of chemical oxygen demand in given water sample 5. Determination of nitrite in water sample using colorimetry. 6. Determination of chromium in water sample by colorimetry. 7. Determination of elements (Fe/Mn/Zn/Pb/Cd etc) in air using high volume sampler	18 hours
	Section –II	
	Module -3: 1. Determination of dissolved oxygen in coastal waters. (4 hrs; Ref.1) 2. Estimation of dissolved oxygen in polluted water (6 hrs. Ref. 2, 3) 3. Determination of biochemical oxygen demand in coastal waters (4 hrs; Ref. 1) 4. Estimation of hydrogen sulfide in coastal waters (4 hrs. Ref. 3)	18 hours
	Module 4: 1. Determination of chemical oxygen demand in coastal waters by $KMnO_4$ method (4 hrs; Ref. 2)	18 hours

	2. Pre-concentration of sea water by solvent extraction method for analysis of trace metals by AAS (6 hrs; Ref 5,6,7) 3. Estimation of Cu & Pb in coastal waters by AAS method (8 hrs; Ref 5, 6, 7).	
Pedagogy:	Pre-lab and post-lab assignments or a combination of some of these. Sessions shall be interactive in nature to enable peer group learning.	
References/ Readings	**Section – I** 1. Sawyer, C. N., McCarty, P. L., & Parkin, G. F. (2002). *Chemistry for environmental engineering and science* (5th ed). McGraw-Hill Education. 2. Dey, A. K. (2018). *Environmental Chemistry* (9th ed). New Age International Publishers. 3. Jeffery, G. H., Bassett, J., Mendham, J., & Denney, R. C. (1989). *Vogel's Textbook of quantitative chemical analysis.* (5th ed). Longman Scientific and Technical, U.K. 4. Moore, J. W., & Moore, F. A. (2012). *Environmental Chemistry:* (1st ed). Academic Press. 5. Lakshmi, G. S. (2010). *Environmental Science: A practical manual*. (1st ed). BS publications 6. Rattan, S. (2011). *Experimental in Applied Chemistry*. (3rd ed). S.K Kataria & Sons. 7. Mitra, S., Patnaik, P., & Kebbekus, B. (2019). *Environmental chemical analysis: Laboratory Experiments in Environmental Chemistry* (2nd ed). CRC Press. 8. Henrie, S. A. (2015). *Green Chemistry: Laboratory manual for General Chemistry* (1st ed). CRC Press Taylor & Francis Group. **Section – II** 1. Martin, D. F. (1972). *Marine chemistry, 1*. Academic Press. 2. Standard methods for the examination of water and waste water analysis. 22nd Edition. 3. Rice, E. W., & Bridgewater, L. (2012). American Public Health Association. 4. Grasskhoff, E. K. M., & Krembling, K. (1983). *Methods of Seawater analysis*. Verlag Chemie, Weinneim. 5. Strickland, J. D. H., & Parsons, T. R. (1972). *A practical hand book of seawater analysis* [Fisheries Board of Canada bulletin] (2nd ed). 6. Riley, J. P., & Skirrow, G. (1975). Analytical chemistry of seawater. In *Chemical oceanography, 3*. Academic	

	Press. 7. Allen, S. E., Grimshaw, H. M., Parkinson, J. A., Quarmby, C., & Roberts, J. D. (1976). (eds) Chapman S. B, Chapter 8. Chemical analysis. In *Methods in plant Ecology*. Blackwell Scientific Publications.	
Learning Outcomes	1. Students will be in a position to know the basic environmental chemical processes. 2. Students will be able to explain the origin and harmful effects of toxic chemicals in the environment. 3. Student will be in position to use different techniques for qualitative and quantitative estimation of environmental samples. 4. The results of analyses of different pollutants in sea water can be used to set the limits of their discharge. 5. These concentrations will be compared with the daily intake of, or exposure to a pollutant by organism/man and it can lead to acceptable concentration of pollutant in organism. 6. These studies would help to regulate the release of a particular pollutant in the marine environment.	

Title of the Course: Marine Pollution
Course Code: ESO-303 **Number of Credits:** 03
Total Contact Hours: 36 **Effective from AY:** 2022-23

Prerequisites for the course:	Graduates in any discipline with science subjects at 10+2 level	
Objectives:	1. To identify the type of materials added to the sea and their sources. 2. What effect these additions to the sea and animal living there. 3. What implications these effects have for human health and 4. What is being done to reduce the undesirable effects.	
Content:	**Module 1: Introduction** Introduction to Environment, Objectives of environment, Marine pollution definition, Some questions, Categories of additions, Nature of inputs, and Sources of inputs. Gross chemical composition of seawater, Sources of dissolved and particulate matter in the sea, Geochemical balance and residence times of elements in seawater **Module 2: Organic wastes** Biochemical oxygen demand, the dilution factor, Settlement, Oxygen budget, Consequences of organic discharges into Thames and Mersey estuaries. Decomposition of organic matter in oxic	06 hours 10 hours