GENERIC ELECTIVE

CREDIT DISTRIBUTION, ELIGIBILITY, AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
INDUSTRIAL POLLUTION-IMPACTS& REMIDIES	**4**	**2**	**0**	**2**	**12th Class: Physics, Chemistry, Mathematics**	**-**

Course Objectives

- To understand the sources, types, and impacts of industrial and environmental pollutants.
- Study remediation techniques and sustainable practices for pollution control.
- Develop hands-on skills for pollutant analysis using non-sophisticated methods.
- Analyze case studies of environmental disasters and policy responses.

Learning Outcomes

By the end of the course, students will be able to:

- Classify major pollutants (air, water, soil) and describe their environmental pathways.
- Explain the chemistry behind pollution effects (e.g., acid rain, bio-magnification).
- Perform basic pollutant detection and remediation experiments.
- Evaluate Indian and global environmental regulations (CPCB, NGT, Paris Agreement).
- Propose sustainable solutions using green chemistry principles.

THEORY COMPONENT

Unit 1: Fundamentals of Pollution Types (8 Hours)

- **Types of Pollution**: Air, water, soil, noise, thermal - definitions, key features, and examples from urban and industrial settings.
- **Pollutant Classification**: Organic pollutants (e.g., volatile organic compounds, pesticides, PAHs), inorganic pollutants (e.g., heavy metals, acids, ammonia), and particulate matter (PM2.5, PM10).
- **Sources of Pollution**: Natural vs. anthropogenic; emissions from chemical industries, fossil fuel combustion, mining operations, fertilizer and pesticide use, and urban waste.
- **Environmental Pathways**: Introduction to pollutant transport and fate — atmospheric deposition, leaching into groundwater, surface runoff, bioaccumulation, and biomagnification in food chains.

Unit 2: Impacts and Monitoring **(7 Hours)**

- **Health Effects of Pollutants**: Acute and chronic impacts — respiratory diseases, carcinogenicity (benzene, dioxins), neurotoxicity (lead, mercury), endocrine disruption.
- **Ecosystem Damage**: Eutrophication of water bodies, degradation of soil fertility, deforestation, and loss of biodiversity.
- **Climate Linkages**: Role of CO_2, CH_4, and N_2O in global warming; CFCs and ozone layer depletion; interconnections between local pollution and global environmental change.
- **Case Studies**:
  Bhopal Gas Tragedy (1984): Methyl isocyanate release and its aftermath
  Minamata Disease (Japan): Industrial mercury poisoning

Unit 3: Environmental Laws & Policies **(7 Hours)**

- **Indian Regulations**:
  Water (Prevention and Control of Pollution) Act, 1974
  Air (Prevention and Control of Pollution) Act, 1981
  Environment Protection Act (EPA), 1986
  Role of the National Green Tribunal (NGT) in enforcement
- **Global Frameworks**:
  Kyoto Protocol: Binding targets for developed nations
  Paris Agreement: Global commitment to climate mitigation
- **Monitoring Techniques**:
  Air: *AQI metrics, stack emission sampling, ambient air samplers*
  Water: *Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), heavy metal testing, TDS*
  Soil: *pH, electrical conductivity, nutrient levels, contaminant profiling (e.g., lead, arsenic)*

Unit 4: Remediation & Sustainability **(8 Hours)**

- **Remediation Techniques**:
  Physical Methods: Filtration, adsorption using activated charcoal, sedimentation
  Chemical Methods: Precipitation of heavy metals, neutralization of acid/alkali wastes, oxidation-reduction methods
  Biological Methods: Bioremediation (microbial degradation), phytoremediation (use of plants like *Brassica*, *Eichhornia*)
- **Green Chemistry Approaches**: 12 principles of green chemistry, pollution prevention at the source, eco-friendly solvents, catalysis, energy-efficient synthesis
- **Circular Economy Concepts**: Resource reuse, closed-loop systems, industrial symbiosis, cradle-to-cradle design
- **Corporate Environmental Responsibility**:
  CSR initiatives in environmental conservation
  Zero-liquid discharge (ZLD) in process industries
  Extended Producer Responsibility (EPR) in plastic and electronics sectors

PRACTICAL COMPONENT **(60 hours)**

1. pH and acidity testing of effluents (comparison of household and industrial acids)
2. Test for coagulation-flocculation (alum treatment of turbid water)
3. Qualitative detection of heavy metals (lead/iron) using sodium sulfide

4. Dissolved oxygen estimation using Winkler's method
5. Soil salinity test using conductivity meter
6. Colorimetric adsorption study (methylene blue on charcoal or silica)
7. Noise pollution mapping using smartphone dB meters in campus zones
8. Airborne particulate capture using sticky tapes and microscopic analysis
9. Neutralization experiments with acidic waste (lime, baking soda titration)
10. Oil–water separation using charcoal/cotton filters.

RECOMMENDED/ESSENTIAL TEXTBOOKS AND REFERENCES

Textbooks:

De, A. K., *Environmental Chemistry* – New Age International.
Manivasakam, N., *Industrial Pollution Control* – SS Publishers.
Anastas, P. T., & Warner, J. C., *Green Chemistry: Theory and Practice* – Oxford University Press.
Pepper, I. L., Gerba, C. P., & Brusseau, M. L., *Pollution Science* – Academic Press.
Walker, P., & Wood, E., *Environmental Science Experiments* – Facts on File.
Thomas, W. J., *Adsorption Technology & Design* – Butterworth-Heinemann.
Smith, K. A., & Mullins, C. E., *Soil and Environmental Analysis* – CRC Press.
Skoog, D. A., West, D. M., Holler, F. J., & Crouch, S. R., *Fundamentals of Analytical Chemistry* (9th Edition) – Cengage Learning.
Vogel, A. I., Svehla, G., Jeffery, G. H., & Mendham, J., *Vogel's Qualitative Inorganic Analysis* (7th Edition) – Pearson.
Vowles, P. D., & Connell, D. W., *Experiments in Environmental Chemistry* – Elsevier.
Boyd, C. E., *Water Quality: An Introduction* – Springer.

Reports & Guidelines:

- CPCB (Central Pollution Control Board) publications.
- UNEP (United Nations Environment Programme) reports.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

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