Department of Applied Chemistry
B.I.T. Mesra, Ranchi
Environmental Science (CH-2203)

Module I: Introduction to Environmental Pollution **(5)**

Introduction to Environmental Pollution: Environmental Awareness, Concept of an ecosystem, structure and function of an ecosystem, energy and nutrient flow, biogeochemical cycles, sources, pathways and fate of environmental pollutants.

Module II: Atmosphere & Air Pollution **(5)**

Air pollution- Introduction, Segments of environment, Layers of atmosphere and their significance; Mechanism, Causative factors, Consequences and Preventive measures – Ozone depletion, Green house effect and Global warming; Earth's radiation budget, Classification of air pollutants, Indoor air pollution, Smog-photochemical and sulphurous, Acid rain, Air Quality Standards, Human health effects-Bhopal gas tragedy.

Module III: Air Pollution Monitoring & Control **(5)**

Pollution Sources: Stationary & Mobile emission Sources, Monitoring & Control of air pollutants using high volume sampler, cyclone separators, wet scrubbers, electrostatic precipitators, etc. automobile emission control.

Module-IV: Water Pollution **(5)**

Water Resource; Water Pollution : Definition, Classification , Sources of Contamination, Pollutants & their Detrimental Effects; Water Quality: Portability limit – WHO and PHED Specification; Water Quality Monitoring, Municipal Water Treatment: Slow and Rapid Sand Filter, Disinfection – Methods, Advantages & Disadvantages, Sterilization

Module V Industrial & Waste Water Treatment **(5)**

Industrial Water: Specification of boiler feed water, internal and external treatment, ion exchange process, electro-dialysis, and reverse osmosis. Sewage Treatment: composition, aerobic and anaerobic treatment, chemical and biological oxygen demand

Module VI: Soil and Noise pollution **(5)**

Lithosphere and Soil profile, Soil contamination, sources of soil contamination,Important environmental properties of soil contaminants, Ecological & Health effects, Exposure & Risk Assessment. Noise pollution: Brief introduction to noise pollution, source, measurement and prevention of noise pollution

Module VII: Radioactive Pollution & Solid Waste Management **(5)**

Radioactive pollutant: units of radiation and instruments for their measurements, types of radioactive pollutants and risk factor associated with these radiations Radioactive waste and their disposal, accidental leakage of radiation from nuclear reactors (discuss Chernobyl and Fukushima). Solid waste management- different types of solid waste, composting, biological methods of detoxification of hazardous waste Onsite handling and composting, integrated solid waste management,

Books Recommended:

1. Miller, T. G. Jr., Environmental Science, Wadsworth Publishing House, USA
2. De. A. K., Environmental Chemistry: New Age International (P) Ltd. Publishers.
3. Masters, G.M, Introduction to Environmental Engineering.
4. Connell, D. W., Basic Concepts of Environmental Chemistry

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Module I: Introduction to Environmental Pollution (5)

Introduction to Environmental Pollution: Environmental Awareness, Concept of an ecosystem, structure and function of an ecosystem, energy and nutrient flow, biogeochemical cycles, sources, pathways and fate of environmental pollutants.

Questions

1. Discuss the multidisciplinary nature of environmental science?
2. What according to you are the basic issues of environmental science?
3. What is an 'eco-system'? Discuss the biotic and abiotic components of an ecosystem.
4. Provide the characteristic features, structure and functions of the following types of ecosystem: forest; grassland; desert; aquatic.
5. Discuss ecosystem energetics. Describe the energy flow in a typical ecosystem.
6. What are ecological pyramids? Explain the types of pyramids.
7. Explain as to how the energy flow differs from the nutrient flow?
8. a.What is a bio-geochemical cycle? Describe any one briefly.
   b.How does carbon cycle operate in the environment?
   c. Describe the flow of phosphorus and sulphur in the environment.
9. What is nitrogen fixation? Explain its significance with the help of nitrogen cycle.
10. a. What are environmental pollutants? Discuss their classification.
    b. Discuss the various sources, pathways and fate of environmental pollutants.
    c. Discuss the biological and non-biological methods of transformation of pollutants with the help of examples.

Module II: Atmosphere & Air Pollution (5)

Air pollution- Introduction, Segments of environment, Layers of atmosphere and their significance; Mechanism, Causative factors, Consequences and Preventive measures – Ozone depletion, Green house effect and Global warming; Earth's radiation budget, Classification of air pollutants, Indoor air pollution, Smog-photochemical and sulphurous, Acid rain, Air Quality Standards, Human health effects-Bhopal gas tragedy.

Questions

1. Describe the various layers of atmosphere explaining the significance of each layer.
2. Give graphical representation of the change in temperature (lapse rate) with altitude. How would you explain these variations in the lapse rate? What is temperature inversion?
3. How does the earth manage its heat radiation balance so as to maintain an average temperature of 15 ^{0}C?

4. What are the major greenhouse gases? Explain the phenomenon of green house effect.
5. Discuss global warming, causative factors and its imperative consequences.
6. Write short notes on (a) albedo (b) *El Nino* and *La Nina* (c) *aurora borealis* and *aurora australis.*
7. What is ozone depletion? Discuss briefly the likely sources and effects of ozone depletion.
8. How are chlorofluoro carbons (CFC's) responsible for the depletion of ozone layer? Illustrate it by reactions.
9. Discuss the pollutants and sources that contaminate indoor air?
10. Discuss the units used to report the concentration of air pollutants. Mention the significance of average residence time of the pollutant in air?
11. What are primary and secondary air quality standards? What is the basis of pollutant standard index (PSI)? What do you mean by ambient air quality standards?
12. What are secondary air pollutants? Discuss the reactions that lead to the generation of these pollutants? What are their toxic effects?
13. Differentiate between sulfurous and photochemical smog? Enumerate the conditions necessary for their formation and their toxic effects.
14. What is Acid Rain? Discuss causes and mechanism of formation of acid rain (give reactions). Discuss its harmful effects and preventive measures for its control.
15. Write notes on: (a) Enhanced green house effect (b) Global climatic change (c) Biodiversity (d) Sustainable development (e) Bhopal gas tragedy (f) NAAQs

Module III: Air Pollution Monitoring & Control (5)

Pollution Sources: Stationary & Mobile emission Sources, Monitoring & Control of air pollutants using high volume sampler, cyclone separators, wet scrubbers, electrostatic precipitators, etc. automobile emission control.

Questions

1. Discuss the role of NO_x in the generation of secondary pollutants. Mention the chief sources of NO_x. Why is it difficult to control the emission of NO_x?
2. Suggest measures for the control of CO from mobile and stationary emission sources.
3. Describe methods applied for control of emissions from a coal-fired thermal power plant.
4. What are the major sources of vehicular emissions? How can they be controlled?
5. Discuss the benefits using catalytic converters and multipoint fuel injection system.
6. In a petrol run internal combustion engine what are the major pollutant emitted if (i) lean fuel-air mixture is taken (ii) if rich fuel air mixture is taken? How can we control these emissions?
7. Explain electrostatic precipitator with the help of labeled diagram and state its

merits and demerits.

8. Discuss in detail the principle and application of the techniques used for control of industrial emissions giving examples of the industries where the following are used (a) cyclone separator (b) electrostatic precipitator.
9. Write short notes on:
   (a) Bag house filter (b) Dry and Wet Scrubbers
   (c) Catalytic converters.
10. What will happen if the electrostatic precipitator of a thermal power plant stops functioning. Discuss its environmental implications?
11. Describe giving an example as to how you will measure ambient air quality of a place. On what basis the variations may be observed?

Module-IV: Water Pollution **(5)**

Water Resource; Water Pollution : Definition, Classification , Sources of Contamination, Pollutants & their Detrimental Effects; Water Quality: Portability limit – WHO and PHED Specification; Water Quality Monitoring, Municipal Water Treatment: Slow and Rapid Sand Filter, Disinfection – Methods, Advantages & Disadvantages, Sterilization

Questions

1. Describe the Hydrologic cycle.
2. What is Renewable water?
3. Differentiate between Consumptive and Non-consumptive water.
4. Discuss the thermal stratification of water.
5. How does the dissolve oxygen level of water vary with depth of a water body (like a lake) and why?
6. Differentiate between Eutrophic and Oligotropic lake.
7. Enlist various water pollutants indicating their detrimental effects.
8. Describe the process of Hg pollution in human body.
9. Write short note on acid mine drainage.
10. give examples of three pesticides with chemical formula.
11. What do you mean by potability limit? Give PHED and WHO specifications for municipal water supply.
12. Give a brief description of various units of a water treatment plant for municipal supply
13. What is disinfection of water? What is the difference between disinfection and sterilization? Mention the common reagents for disinfection of water. Discuss their actions.
14. What is break point chlorination- Explain by an experimental graph.

Module V Industrial & Waste Water Treatment **(5)**

Industrial Water: Specification of boiler feed water, internal and external treatment, ion exchange process, electro-dialysis, and reverse osmosis. Sewage Treatment: composition, aerobic and anaerobic treatment, chemical and biological oxygen demand

Questions

1. What are the common problems in boilers? Discuss their causes and effects. Identify the specifications meant for the water to be used in boilers.
2. (a). Explain the terms: priming, foaming and carry over in boilers. (b) Suggest ways of minimizing or removing such problems.
3. Discuss the mechanism of scale formation. What are its ill effects? Explain as to how this can be prevented by the use of phosphate conditioning.
4. Calgon conditioning is better than Phosphate conditioning. Why?
5. Discuss the principle behind lime-soda treatment of water. What are the advantages of hot lime-soda process over the cold one?
6. Explain as to why the water treated with lime-soda process cannot be used in the high pressure boilers.
7. What are zeolites? Discuss the mechanism of cation exchange process (zeolite process) for the treatment of water. Why is the water softened using zeolite process is unsuitable for boilers?
8. Explain the chemical reactions involved in the treatment of water by ion-exchange method.
9. Write brief notes on: (a) pH control in boiler feed water (b) caustic embrittlement (c) sludge formation (d) corrosion in boilers (e) Calgon conditioning. (f) Reverse osmosis (g) electro-dialysis (f) water quality speciation for construction applications.
10. What is leaching? What parameters of water quality need to be assessed for use in agricultural applications?
11. What is the composition of municipal sewage? Give a schematic diagram for the primary and secondary treatment of waste water.
12. What is B.O.D.? Compare and contrast B.O.D. and C.O.D.
13. Discuss the importance of dissolved oxygen in water. Outline the principles behind the determination of D.O. present in water by Winkler's method.
14. How does one remove nutrients in waste water.
15. Describe the method for the estimation of (a) BOD, (b) COD, and also comment on the sampling , preservation and treatment method for each.
16. Write notes on: (a) activated sludge process (b) RBC (c) trickling filters.
17. Compare aerobic treatment process with anaerobic treatment process.
18. What is the purpose of the return sludge step in the activated sludge process.
19. What are the advantages of physical-chemical treatment of municipal wastewater over biological treatment system.
20. Why is BOD called the 5-day test? Discuss the procedure for BOD determination?

Module VI: Soil and Noise pollution **(5)**

Lithosphere and Soil profile, Soil contamination, sources of soil contamination,Important environmental properties of soil contaminants, Ecological & Health effects, Exposure & Risk Assessment. Noise pollution: Brief introduction to noise pollution, source, measurement and prevention of noise pollution

Questions:

Q1: What is lithosphere? What are the common components of soil?

Q2: What are the major sources of soil pollution? How does soil pollution affect the soil productivity and suggest some measures to check soil pollution.

Q3: Discuss the distribution of soil contaminants in soil ecosystem?

Q4: Enumerate the important environmental properties of soil Contaminants? What is the significance of organic matter in soil?

Q5: What are the major ecological & health effects caused due to soil contamination ?

Q6: Discuss the control measures for noise pollution both at source and at receiver's end?

Q7: Describe briefly the sources and impact of noise pollution?

Q8: What is the unit of measurement of noise? What is sound intensity level and Impulse noise?

Module VII: Radioactive Pollution & Solid Waste Management (5)

Radioactive pollutant: units of radiation and instruments for their measurements, types of radioactive pollutants and risk factor associated with these radiations Radioactive waste and their disposal, accidental leakage of radiation from nuclear reactors (discuss Chernobyl and Fukushima). Solid waste management- different types of solid waste, composting, biological methods of detoxification of hazardous waste Onsite handling and composting, integrated solid waste management,

Q1: What is solid waste?Discuss integrated solid waste management? Classify them according to their sources

Q2: What are the adverse effects caused due to solid waste?

Q3: Explain the different methods used for the proper management of solid wastes.

Q4: Describe the major components of sanitary landfill. Write down the advantage and disadvantage of dealing with solid and hazardous waste by burning in sanitary incerations.

Q5: Write short notes on- (a) Composting (b) bio- and phytoremediation (c) sanitary landfill (d) acid base reactions in soil

Q6: What is radioactive pollution? What are the various units and instruments for the measurement of radiation?

Q7: Classify the radioactive pollutants depending on the source and nature with examples.

Q8: Discuss in brief the methods and necessary precautions used for safe disposal of radioactive waste.

Q9: What are the ionizing radiations? What are the major risks associated with the ionizing radiations.

Q10: Write short notes on- (a) Chernobyl disaster (b) impact of bombardment on Hiroshima and Nagasaki during world war-II (c) Fukushima disaster

Q11: Propose five methods for the disposal of high level radioactive waste.

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