

**Inndraprastha Institute of Information Technology Delhi**

**ESC 205 A Environment Science**

**End Semester Examination (11/12/2023)**

**Time : 2 hrs.**

**MM 30**

**Name :**

**Roll No.**

**1. a. What do you understand by EIA studies?**

**b. What is an effective EIA system?**

**As an IT engineer , how do you think that air pollution and water pollution can be modelled and which models can be used? ( 0.5 + 1 + 1.5)**

**a. Environmental Impact Assessment studies are the process of identifying, predicting, evaluating and mitigating the bio- physical, social, and other relevant effects of development proposals prior to major decisions being taken and commitments made.**

**b. Adequate institutional arrangement (policy, law understanding & organization).**

**The quality of an environmental impact statement (EIS) and environment management programme/ plan ( EMP).are being implemented optimally –**

**TOR - Terms of Reference i.e., What is to be done for the project being undertaken.**

**SOP – Standard Operating Procedure**

**Detailed review will address-quality of field work ,primary and secondary survey data collection & interpretation and ground validation and**

leading to better Environment Information Programme and Environment Management Plan. Base line studies are carried out to record the existing air, water and soil conditions along with other conditions.

AERMOD modelling is used for air pollution modelling and WASP modelling is used to study the impact of the project being undertaken on the water. The Water Quality Analysis Simulation Program (WASP).

2. a. Describe the names of 4 different air pollution control equipments/ devices.

a. Describe what is FGD? ( 2 +1 )

a. Names :

Gravitational settling chamber

Cyclone separator

Electrostatic precipitators

Fabric filters

b. Flue Gas Desulfurisation – Scrubbing of the flue gases is done with lime solution to remove  $\text{SO}_2$  and  $\text{SO}_3$ .

3. a . What is activated sludge treatment of wastewater.

b .How is the waste sludge disposed of ? ( 2+!)

**a. In this process the primary wastewater mixed with bacteria-rich (activated) sludge and air or oxygen is pumped into the mixture in a tank.**

**Both aerobic and anaerobic bacteria may exist which promotes bacterial growth and decomposition of organic matter present in the wastewater.**

**A part of the activated sludge is recycled while excess of this is wasted for disposal by other treatments.**

**BOD removal is approximately 85%.**

**b. The waste sludge is disposed of through any of the following treatments :**

**Anaerobic digestion**

**Incineration or pyrolysis or gasification**

**Composting or fertilizer**

**Landfills etc.**

**4. a .How can the hazardous waste be treated ?**

**b .How can the biological waste be treated ? (1+1)**

**a. Many hazardous wastes can be recycled safely and effectively, while other wastes will be treated and disposed of in landfills or incinerators.**

**However, improper storage of those materials might cause spills, leaks, fires, and contamination of soil and drinking water. To encourage hazardous waste recycling while protecting health and the environment, EPA developed regulations to ensure recycling would be performed in a safe manner.**

**Treatment Storage and Disposal Facilities (TSDFs) provide temporary storage and final treatment or disposal for hazardous wastes.**

**Since they manage large volumes of waste and conduct activities that may present a higher degree of risk, TSDFs are stringently regulated. The TSDF requirements establish generic facility management standards, specific provisions governing hazardous waste management units and additional precautions designed to protect soil, ground water and air resources.**

**What are the four methods for treating hazardous waste?**

**1. Chemical treatment – e.g., Neutralization, Precipitation, Ion exchange, Reduction or Oxidation**

**2. Thermal treatment – e.g., incineration**  
**Among thermal methods is high-temperature incineration, which not only can detoxify certain organic wastes but also can destroy them.**

**3. Biological treatment – e.g., landfarming; Microbial degradation**

**and.**

**4. Physical treatment – e.g., solidification, flotation, sedimentation, evaporation, or filtration.**

**Finally the hazardous waste is disposed of in the Hazardous Waste landfill sites.**

**b. Biological waste treatment – Biological waste can be treated through careful microwave treatments, autoclaving, chemical disinfection and incineration.**

**5. a What is climate vulnerability ?**

**b What do you understand by the carrying capacity of Delhi ? ((0.5+0.5)**

**a .IPCC definitions of vulnerability. The IPCC Third Assessment Report (TAR) describes vulnerability as. “The degree to which a system is susceptible to, or unable to cope with, adverse effects of. climate change, including climate variability and extremes.**

**b Depending on natural and strategic location the expansion of a city will be bound by some limits, which may be termed the carrying capacity. The concept of "carrying capacity" addresses the question as to how many people can be permitted into any area without the risk of degrading the environment and health of the people and other facilities.**

**6. What are the following effluent, wastewater and waste treatments:**

**a. ZLD**

**Zero Liquid Discharge- No effluent water is discharged from the industry.**

**b. Cradle to grave**

**The EPA's “cradle-to-grave” program aims to ensure that, during the life cycle of hazardous waste, it is safely handled and managed from the time it is created or generated until it is either permanently stored or disposed of.**

**c. Cradle to cradle**

**Cradle to cradle can be defined as the design and production of products of all types in such a way that at the end of their life, they can be truly recycled (upcycled), imitating nature's cycle with everything either recycled or returned to the earth, directly or indirectly through food, as a completely safe, nontoxic ...**

**d. Sloughing ( 1.5)**

**As the biological film continues to grow, the microorganisms near the surface lose their ability to cling to the medium, and a portion of the slime layer falls off the filter. This process is known as sloughing.**

**7. Answer True or False**

- a. BAP stands for Benzo- $\alpha$ - pyrrolidone **False**
- b. Anthropogenic pollution is natural pollution.  
**False**
- c. Fugitive emissions can be mitigated by Sonochemical treatments. **False**
- d. Plants can be used for controlling indoor air pollution. **True**
- e. Dioxins are xenobiotic pollutants. **True**
- f. Cyclone separators cannot remove PM 10 particles  
**False**
- g. Chimney area can be calculated as  $A = Q / v$  (3), where  $v$  is the volume of flue gases and  $Q$  is the quantity of particles. **False**
- h. Sewage can be subjected to aerobic fermentation to yield biogas. **False**
- i. Thermal pollution raises the DO levels of water bodies.
- j. Facultative anaerobes survive with or without oxygen. **Trues**
- k. Sloughing is involved in the activated sludge treatment process. **Ealse**
- l. TSDF is the transport and storage and degradation Facility of hazardous wastes.  
**False**
- m. Incineration refers to the crushing and plasma treatment of solid wastes . **False**

- n. The total amount of water for which all the people, plants and animals on Earth compete is 12 % of the total global water.  
**False**
- o. TSDF stands for Treatment Storage and Distillation Facilities. **False**
- p. Methyl chlorate had leaked from the industry during Bhopal Tragedy. **False**
- q. Liners in landfills are used to stop leachates.  
**True**
- r. RCA stands for Risk Cause Analysis.  
**False**
- s. PDCA stands for Plan Do Check Act.  
**True**
- t. CMAQ stands for Community Multisectoral Air Quality Model. **False**

### **Numericals..**

**8.** In a wastewater settling tank the length of the tank is 1.5 meters , width is 4.5 meters and the depth is 5 meters, and the flow rate is  $1.3 \text{ m}^3 / \text{min}$ . Calculate the terminal velocity  $v(t)$  of the critical particle.

**(0.5)**

**Solution :  $v(t) = Q/L \times W = 1.3/1.5 \times 4.5 = 0.192 \text{ m/min}$ .**



**9. Calculate the sludge volume index (SVI) when the sludge volume after settling for 30 min., (ml/litre) is 25 and MLSS ( Mixed Liquor Suspended Solids) concentration is 125 mg/litre.**

**Calculate the Maximum Return Sludge Concentration also. (1.5)**

**Solution**

$$\text{SVI} = \text{SV} / \text{MLSS} \times 1000 = 25 / 125 = 1/5 \times 1000 = 200 \text{ ml/g.}$$

$$\text{Return Sludge Concentration} = 10^6 / \text{SVI} = 10^6 / 200 = 5000 \text{ g/ml.}$$

10. Estimate the tons of carbon in the atmosphere corresponding to a concentration of 390 ppm of  $\text{CO}_2$ . Assume the total mass of air equals

$5.1 \times 10^{18}$  kg. The density of air at the standard temperature and pressure ( STP, 0 degree C and 1 atm. ) is  $1.29 \text{ kg/m}^3$ . (2)

0.10 1g-mole of  $\text{CO}_2$  contains 44g [12+2x16] and each mole at STP occupies vol. of  $22.4 \times 10^{-3} \text{ m}^3$ . At 390ppm, the conc (by weight at STP) is given by,

$$C_{\text{O}_2} = \frac{390 \text{ m}^3 \text{ CO}_2}{1 \times 10^6 \text{ m}^3 \text{ air}} \times \frac{\text{mol}}{22.4 \times 10^{-3} \text{ m}^3 \text{ CO}_2} \times \frac{44 \text{ g}}{\text{mol}}$$

$$C_{\text{O}_2} = 0.766 \text{ g/m}^3$$

Since, 44g of  $\text{CO}_2$  contains 12g of C, total amount of Carbon in the atmosphere is

$$C = \frac{0.766 \text{ g CO}_2}{\text{m}^3 \text{ air}} \times \frac{12 \text{ g C}}{44 \text{ g of CO}_2} \times \frac{5.1 \times 10^{18} \text{ kg air}}{1.29 \text{ kg/m}^3}$$

$$C = 8.259 \times 10^{17} \text{ g} \quad \text{--- (A)}$$

which, at  $10^6 \text{ g/ton}$ , is equivalent of so

$$\boxed{825 \times 10^9 \text{ tons}} \quad \text{or} \quad \boxed{825 \text{ giga tons}}$$

(B) (C)

11. If the utilities generate electricity using 33 % efficient coal fired power plant. As a carbon reducing measure if electric water heater that convert heat into electricity at 100 % efficiency are replaced with a gas water heaters with a 76 % conversion efficiency. By what fraction the ( and percentage) carbon emission would be reduced.

Emission factor for coal is  $25.2 \times 10^6$  ton. C/ quad

Emission factor for gas is  $14.5 \times 10^6$  tons/quad.  
You may Assume 1 quad of electricity is being  
delivered to electric heaters. (2)

Q.11 Coal Emissions =  $3 \text{ quad} \times 25.2 \times 10^6 \text{ ton C/quad}$   
 $= 75.6 \times 10^6 \text{ ton C}$

To get 1 quad of heat using 76-percent efficient  
gas-fired water heaters would require  
Heat input =  $1 \text{ quad} / 0.76$   
 $= 1.31 \text{ quad}$

Corresponding Carbon emissions would be  
Gas emission =  $1.31 \text{ quad} \times 14.5 \times 10^6 \text{ ton C/quad}$   
 $= 20.7 \times 10^6 \text{ ton C}$

Reduction =  $75.6 \times 10^6 - 20.7 \times 10^6 \text{ ton C}$   
 $= 54.9 \times 10^6 \text{ ton C} - \text{A}$

which is  $74.5\% \text{ approx}$  reduction in  
Carbon Emissions by using gas instead of Coal.