

Indraprastha Institute of Information Technology Delhi

Course: ESC 205 A – Environmental Science End Semester Examination

Time: 2 hrs

Max. Marks: 30

Section 1: Short Answer Questions

(3 Marks)

1a. Describe how solar cells can be recycled.

Recycling involves the recovery of aluminium, glass, silver, copper, lead, etc., from end-of-life solar cells. These processes typically involve crushing, shredding, and milling, usually after the removal of the frame and junction box. In these processes, glass, aluminum, tin, and copper may be recovered. Techniques such as chemical leaching, pyrolysis, incineration, etc., may be used. In the European Union, solar cell waste is regarded as electronic industry waste.

1b. What are 5 disadvantages of solar energy?

1. The high initial costs of installing panels.
2. Solar energy storage is expensive.
3. Solar doesn't work for every roof type.
4. Solar panels are dependent on sunlight.
5. Production of panels and batteries can be harmful to the environment.

1c. Describe the 3 processes by which the power generated by photovoltaic cells be stored?

1. Lithium-ion batteries.
2. Water pump storage.
3. Hydrogen production.
4. Thermal storage through phase change materials or water.

Section 2: Definitions & Processes

(3 Marks)

2a. What is the cradle to grave story?

'Cradle-to-grave' assessment considers impacts at each stage of a product's life-cycle, from the time natural resources are extracted from the ground and processed through each subsequent stage of manufacturing, transportation, product use, and ultimately, disposal.

2b. What is CAPA? What are the 7 steps of the CAPA process?

Corrective and Preventive Action (CAPA) consists of improvements to an organization's processes taken to eliminate causes of non-conformities or other undesirable situations.

- **The 7 Steps:** 1. Identification, 2. Evaluation, 3. Investigation, 4. Analysis, 5. Action Planning, 6. Implementation, 7. Verification.

2c. What are the typical PLF numbers for RE projects (solar, wind, and solar-wind hybrid)?

The typical PLF (Plant Load Factor) numbers for RE projects are **20-25%** for solar, **30-38%** for wind, and **40-45%** for solar-wind hybrid projects.

Section 3: Fill in the Blanks

(10 Marks)

- a. Windrose/wind rose diagrams show a **graphical representation of the direction, intensity & duration** which act on offshore structures over time of wind.
- b. Environment load refers to the various types of forces such as **Winds, currents and waves** that act on offshore structures over time.
- c. Backwater is water that is **stagnant and out of the current**.
- d. PAN in air pollution stands for **Peroxyacetyl nitrates**.
- e. India has **4%** of the total global water and **18%** (17–18% acceptable) of world population.
- f. TSDF stands for **Treatment Storage and Disposal Facility** in hazardous waste management.
- g. Liners in landfills are used to **Stop or prevent** leachates.
- h. RCA stands for **Root Cause Analysis**.
- i. PDCA stands for **Plan Do Check Act**.
- j. HIRA in hazardous waste management modeling stands for **HAZARD IDENTIFICATION & RISK ASSESSMENT**.
- k. ALOHA in the hazard modeling stands for **Areal Locations of Hazardous Atmospheres**.
- l. In India almost **36-40%** people live in cities.
- m. PFAS are **Per- and polyfluoroalkyl** substances.
- n. Greenwashing is an advertising or marketing spin that **deceptively / negatively** uses green PR and green marketing to persuade the public that an organization's products, goals, or policies are environmentally friendly.
- o. Hayli Gubbi volcano erupts in Ethiopia after 12,000 years and its **hazardous and nonhazardous emissions** (hazardous gas/ash acceptable) reached India and China.
- p. CDW stands for **Construction and demolition waste**.
- q. Cement kilns can be used to incinerate **hazardous wastes / plastics / hazardous gas / ash**.
- r. Compressed biogas consists of mainly **methane**.
- s. Brown coal is also called **lignite (brown gold acceptable)** in some countries.
- t. The full form of KRA is **Key Result Area or Key Responsibility Area**.

Section 4: True or False

(9 Marks)

- i. Indoor pollution can be controlled through use of belfams. **[False]**
- ii. Solar concentrators are used in the filtration of sun light. **[False]**
- iii. Carbon black is a super pollutant. **[True]**
- iv. Solar wind is prevalent in coastal areas. **[False]**
- v. LNG stands for liquefied nitrogen gas. **[False]**
- vi. Line source of air pollution is a pollution generated from roadways. **[True]**

- vii. CO is a secondary pollutant. **[False]**
- viii. Life cycle assessment is a widely used tool to quantify the potential output of products. **[False]**
- ix. Acid rain has no effect on marble. **[False]**
- x. Thermocol is a domestic hazardous waste. **[False]**
- xi. Cradle to grave concept involves final disposal of the waste. **[True]**
- xii. PEC shows the Predicted effluent concentration at which there would be great effects on organisms in the compartment. **[False]**
- xiii. ISO 14010 is mandatory. **[False]**
- xiv. Environment audit is conducted periodically. **[True]**
- xv. ISO 14031 gives the guidelines for Environmental Performance Index. **[False]**
- xvi. National Environment Policy was the first initiative in 2010. **[False]**
- xvii. BEE is a Board of Energy Efficiency. **[False]**
- xviii. UNFCCC stands for United Nations Framework for Climate Conference. **[False]**

Section 5: Numericals

(1 Mark Each)

5. In a wastewater settling tank the length of the tank is 4 meters, width is 3 meters, and the depth is 5 meters. The flow rate is $1.2 \text{ m}^3/\text{min}$. Calculate the terminal velocity $v(t)$ of the critical particle.

Solution:

$$v(t) = \frac{Q}{L \times W} = \frac{1.2}{3 \times 4} = 0.1 \text{ m/min}$$

6. Calculate the Sludge Volume Index (SVI) when the sludge volume after settling for 30 min (ml/litre) is 25 and MLSS concentration is 125 mg/litre. Calculate the Maximum Return Sludge Concentration also.

Solution:

- SVI Calculation:

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

- Return Sludge Concentration:

$$\text{Conc.} = \frac{10^6}{SVI} = \frac{10^6}{200} = 5000 \text{ mg/l}$$

7. Calculate the calorific value of Municipal waste having the following analysis: Hazardous waste = 14% (21 MJ/kg), Medical Waste = 19% (42 MJ/kg), Plastics = 39% (35 MJ/kg), Inert material = 28%.

Solution:

$$\text{Total CV} = (21 \times 0.14) + (42 \times 0.19) + (35 \times 0.39) = 25.57 \text{ MJ/kg}$$

8. Estimate the tons of carbon in the atmosphere corresponding to a concentration of 380 ppm of CO_2 .

(Assumption: $1 \text{ ppm CO}_2 = 2.13 \text{ GtC}$)

Solution:

$$\text{Carbon mass} = 380 \times 2.13 = 810 \text{ GtC}$$

9. Comparison of Carbon Emissions (Coal vs. Gas Water Heaters).

Solution:

- Coal Emissions (33% efficient):

$$3 \times 25.2 \times 10^6 = 75.6 \times 10^6 \text{ ton C}$$

- Gas Emissions (75% efficient):

$$\text{Input} = \frac{1}{0.75} = 1.33 \text{ quad} \implies 1.33 \times 14.5 \times 10^6 = 19.28 \times 10^6 \text{ ton C}$$

- Reduction:

$$75.6 - 19.28 = 56.32 \quad (\approx 74.49\% \text{ reduction})$$