

M.C.E, 1st Year, 2nd Semester Examination, 2025(1st / 2nd Semester / Repeat / Supplementary / Annual / Biannual)**SUBJECT: HAZARDOUS WASTE MANAGEMENT**

(Name in full)

Full Marks: 100

Time: ~~Two hours~~/Three hours/~~Four hours~~/ ~~Six hours~~

(60 marks for this part)

Use a separate Answer-Script for each part

No. of Question	Part-I	Marks
<u>Answer Question-I and any two from the rest</u>		
Q.1) a)	Deduce the expression for determining “Depth of Column (Z)” for an Air Stripping Column.	(8)
b)	Explain with necessary reactions the steps involved in destruction of cyanide by chlorine.	(8)
c)	Explain with the help of appropriate example the process of cometabolism in the context of biodegradation of xenobiotic compounds.	(6)
d)	What do you mean by concentration polarization in the context of ultrafiltration and how is it controlled?	(4)
Q.2) a)	<p>In an industrial zone the groundwater aquifer is found to be contaminated with chloroform. The maximum concentration of chloroform was found to be 1.32 mg/L which is to be reduced to 30µg/L by an appropriately designed air stripping column. The following data are available:</p> <ul style="list-style-type: none"> i) Overall transfer rate constant ($K_{1,a}$)= 0.013/sec ii) Liquid flow rate (Q_w)=6.87lt/sec iii) Temperature=27°C iv) Henry’s Law Constant (H)=6.37×10^{-3}(atm.m³/gm.mol) v) Column Diameter=0.7m vi) Air to Water Ratio (Q_A/Q_W)=21 <p>Determine the following:</p> <ul style="list-style-type: none"> i) Liquid Loading Rate (L) ii) Stripping Factor (R) iii) Height of Transfer Unit (HTU) iv) Number of Transfer Unit (NTU) v) Height of packing in column 	(3+3+4+4+3) = 17

[Turn over

Form A: Paper –Setting Blank

Ref No.: Ex/PG/CIV/PE/T/124A/2025

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Q.3) a)	What are the important considerations to be made while designing for dosage of a chemical oxidant?	6															
b)	A semiconductor effluent contains 86.5Kg of cyanide per day. Determine the stoichiometric amounts of chlorine (Cl ₂) and Caustic Soda (NaOH) required for: i) Oxidation of Cyanide to Cyanate ii) Oxidation of Cyanide to Nitrogen Disregard the NaOH requirement for maintaining a pH of 10.0.	(6+5)															
Q.4) a)	What are the essential components of an improved version of Land Treatment?	(6)															
b)	Grab samples were taken from a test plot of 120ft* 60ft of a land farming site and analyzed for waste oil content on mass basis. The samples were reported to be collected from upper 5 inches of the zone of incorporation (ZOI) and the sampling occurred just over 375 days after initial application. The arithmetic mean value of waste oil content was observed as 12.69%. What are the half life and degradation rate constant for the waste oil? Assume a soil density of 94lb/ft ³ . The date of application and the amount of waste applied to the plot receiving the waste oil are shown below:	(11)															
<table border="1"> <thead> <tr> <th>Time of application (days after initial application)</th> <th>Amount of Waste Oil applied (Tons)</th> <th>Waste Oil concentration of applied waste (%)</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>22.3</td> <td>13.7</td> </tr> <tr> <td>103</td> <td>32.4</td> <td>14.2</td> </tr> <tr> <td>217</td> <td>28.6</td> <td>15.8</td> </tr> <tr> <td>308</td> <td>24.9</td> <td>16.3</td> </tr> </tbody> </table>			Time of application (days after initial application)	Amount of Waste Oil applied (Tons)	Waste Oil concentration of applied waste (%)	0	22.3	13.7	103	32.4	14.2	217	28.6	15.8	308	24.9	16.3
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ME Civil Engineering First Year Second Semester Examination 2025**Hazardous Waste Management**

Time: Three Hours

Full Marks: 100

(60 marks for Part I & 40 marks for Part II)

Use separate Answer-Scripts for each part

Part-IIAnswer **All Questions**. Any relevant data may be assumed, if necessary.

1. Answer following questions very briefly:

- a) When was Hazardous Waste (HW) Rule first implemented in India and under which act was it enacted?
- b) Write the full forms of the following abbreviated terms (i) LD₅₀ and (ii) DWEL
- c) Write hierarchy of priorities in HW management (HWM). d) What is the last step of risk assessment?
- e) "Petrol has a flash point -47°C"-explain. f) What is a reactive waste?
- g) Mention the parameters only to define corrosivity of HW. h) What is TCLP?
- i) What is the significance of lethal concentration (LC)?
- j) Mention the criteria for which USEPA refrained from adding carcinogenicity as a characteristic of HW.
- k) Define phytotoxicity. l) What is the unit of LD₅₀?
- m) What is the difference between reuse and recycle? n) Define 'disposal' as per Indian HW Rule.
- o) What is Basel Convention? p) What is the threshold value of risk difference?
- q) By which Ministry was HW Rules promulgated? r) Why are Bio-concentration Factors needed?
- s) 'Potency factor of chloroform (oral route) is $6.1 \times 10^{-3} \text{ (mg/kg-day)}^{-1}$ '-explain the statement.
- t) What should be the threshold value for a chronic dose-response curve for a carcinogen? **1X20=20**

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Part-II

2. a) "TCLP of Arsenic is 5 mg/L"-explain. Give example of a HW which may not be toxic waste.
- b) A toxicity study on the resistance of mice to a new pesticide has been conducted with the following results: What is LD₅₀ of this pesticide for mouse (20gm)? What may be the LD₅₀ for a standard man?

Dose (mg/kg)	% mortality
0	0
2.5	10
5.0	20
7.5	30
10.0	40
12.5	60
15.0	70
17.5	90
20.0	100

4+6=10

3. a) Compute the DWEL for methylene chloride.
- b) Write a brief note on uncertainty factors to get RfD.
- c) For a person eating locally caught fish, estimate the lifetime cancer risk from fish taken from waters containing a concentration of TCE equal to 150ppb.

3+3+4=10

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Some of the following information may be needed:**i) Table A**

Chemical	PF(oral) (mg/kg-day) ⁻¹	PF(inhalation) (mg/kg-day) ⁻¹	Oral RfD (mg/kg-day)	BCF (L/kg)
Chloroform	6.1x10 ⁻³	8.1x10 ⁻²	0.010	3.75
Trichloroethylene (TCE)	1.1x10 ⁻²	1.3x10 ⁻²	0.0005	10.6
Tetrachloroethylene	5.1x10 ⁻²	1-3.3x10 ⁻³	0.10	31.0
Benzo(a)pyrene (BaP)	11.5	6.11	0.0002	-----
Methylene chloride	7.5x10 ⁻³	1.4x10 ⁻²	0.060	-----

ii) Table B

Exposure pathway	Daily Intake	exposure frequency (days/yr)	exposure Duration (yrs)	body wt. (kg)
Ingestion of potable water	2 L	350	30	70
Inhalation of contaminant	20 m ³	350	30	70
Consumption of fish	54 gm	350	30	70