Form A: Paper –Setting Blank **Ref No.:** Ex/PG/CE/T/1210C/2024

M.E. CIVIL ENGINEERING/ M.TECH. FOOD TECHNOLOGY AND BIO-CHEMICAL ENGINEERING 1st YEAR 2nd SEMESTER EXAMINATION, 2024

(~~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
	Answer Question-1 and any *two* from the rest	
Q.1) a)	Deduce the expression for determining **"Depth of Column (Z)"** for an **Air Stripping Column.**	(7)
b)	Explain with necessary reactions the steps involved in **destruction of cyanide by chlorine.**	(7)
c)	Explain with the help of appropriate example the process of **cometabolism** in the context of **biodegradation of xenobiotic compounds.**	(7)
d)	Deduce the necessary expression for estimating the bulk feed concentration **(C_f)** for **"Ultrafiltration"** process operating under **batch mode.**	(7)
Q.2) a)	In an industrial zone the groundwater aquifer is found to be contaminated with chloroform. The maximum concentration of chloroform was found to be **1.34mg/L** which is to be reduced to **30µg/L** by an appropriately designed air stripping column. The following data are available: i) Overall transfer rate constant (K_La)= **0.0128/sec** ii) Liquid flow rate (Q_w)=**6.83 lt/sec** iii) Temperature=**26°C** iv) Henry's Law Constant (H)=**$6.37*10^{-3}$(atm.m^3/gm.mol)** v) Column Diameter=**0.7m** vi) Air to Water Ratio (Q_A/Q_W)=**21** **Determine the following:** 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	**(4+4+4+4)**

[Turn over

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No. of Question	Part-I	Marks
Q.3) a)	What are the important considerations to be made while designing for dosage of a chemical oxidant?	(5)
b)	A semiconductor effluent contains **82.9Kg** 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.	(5+6)
Q.4) a)	What are the essential components of an improved version of Land Treatment?	(5)
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 **372 days** after initial application. The arithmetic mean value of waste oil content was observed as **12.55%.** What are the half life and degradation rate constant for the waste oil? Assume a soil density of **92.5 lb/ft^3** and an oil density of **1995 lb/T.** The date of application and the amount of waste applied to the plot receiving the waste oil are shown below:	(11)

Time of application (days after initial application)	Amount of Waste Oil applied (Tons)	Waste Oil concentration of applied waste (%)
0	21.7	13.3
102	31.7	14.7
237	28.2	15.1
303	24.9	16.8

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ME Civil Engineering First Year Second Semester Examination 2024

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-II

Answer Question No. 1 and any Two from the rest. Any relevant data may be assumed, if necessary.

1. Answer following questions very briefly:

a) Name the current Indian Hazardous Waste (HW) Management Rule.

b) What is the most preferred option in Hazardous Waste Management Hierarchy?

c) Give an example to show the difference between risk and hazard?

d) What should be the first step of risk assessment?

e) What is the basic difference between flash point and fire point?

f) Why is steel corrosion considered as a primary indicator of a HW?

g) Mention the parameters to define reactive HW. h) How is toxicity and TCLP correlated?

i) What is the limitation of lethal dose (LD) tests?

j) Why is carcinogenicity not considered as a characteristic in defining HW?

k) 'LC50 of a chemical is 50gm/kg' – explain the statement.

l) Mention four criteria used by the USEPA to define toxicity of a HW.

m) Which one should be preferred among reuse, recovery, release & recycle of HW?

n) Define 'storage' as per Indian HW Rule.

o) Why is 'Basel Convention' so named? p) What is the threshold value of risk ratio?

q) By which Ministry was HW Rules promulgated? r) Explain significance of Bio-concentration Factor.

s) Why is 'potency factor' also called 'slope factor'?

t) Draw a sketch to show threshold value of a chronic dose-response curve for a carcinogen?

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Hazardous Waste Management

Time: Three Hours | Full Marks: 100

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Use separate Answer-Scripts for each part

Part-II

2. a) When a substance which is not a liquid may be called 'ignitable'?

   b) When a waste may be termed as 'corrosive'?

   c) *"TCLP of Arsenic is 5 mg/L"*.....explain.

   d) Name two nephrotoxic metals. Why is benzene a hematotoxin?

   e) How to get LD50 of a chemical through toxicological study. 2 x 5 =**10**

3. a) Write a brief note on 'DWEL'.

   b) Compute the DWEL for methylene chloride.

   c) An evaluation of records for employees of a vinyl chloride manufacturing plant finds that out of 400 workers, 35 developed liver cancer. A control group consisting of individuals with smoking histories similar to the exposed workers and who were unlikely to have encounter vinyl chloride , had 27 with liver cancers and 505 who did not develop liver cancer. Find the relative risk and attributable risk. Comment on the results.

   2+4+4=10

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Hazardous Waste Management

Time: Three Hours Full Marks: 100

4. Write short note about any **four** of the followings:

(i) RfD for non-carcinogenic effects (ii) mutagenesis (iii) contaminant degradation (iv) exposure pathway (v) hazardous air pollutants (vi) risk characterization (vii)Transboundary movement of HW

2.5x4 = **10**

Some of the following information may be needed:

i) **Table A**

Chemical	PF(oral) $(mg/kg\text{-}day)^{-1}$	PF(inhalation) $(mg/kg\text{-}day)^{-1}$	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	$5.1x10^{-2}$	$1\text{-}3.3x10^{-3}$	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