Ref No: EX/PG/CE/T/1210C/2019

M.TECH. FOOD TECHNOLOGY AND BIO CHEMICAL

1st Year 2nd semester Examination 2019

Time: Three Hours

Hazardous Waste Management

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) Rule.

b) What is the significance of sustainable 'r's in HW management (HWM)?

c) What is the main objective of risk characterization? d) What is the final step of risk assessment?

e) Which is 'flash point'? f) Which other criteria than pH is used to identify corrosive waste?

g) Correlate bioaccumulation and bio-magnification. h) What is the objective of exposure assessment?

i) Define phyto-toxicity.

j) Mention the four criteria used to define toxicity of a waste. k) How is reactivity of a waste defined?

l) 'Oral LD_{50} value of hydrogen cyanide is 3.7 mg/kg'-explain.

m) Define Hazardous Waste as per relevant Indian HW rule.

n) Define Transboundary movement as per relevant Indian HW rule.

o) Define 'Facility' as per relevant Indian HW rule. p) What is the threshold value of relative risk?

q) Write full form of IRIS & NOAEL r) What is intra-species uncertainty factor?

s) 'Potency factor of chloroform (oral route) is 6.1×10^{-3} $(mg/kg\text{-}day)^{-1}$'-explain the statement.

t) 'Bioconcentration factor of TCE is 10.6L/kg' – explain the statement. 1X20=**20**

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Part-II

2. a) What is TCLP test? How are TCLP tests used in classifying a toxic waste as hazardous?

   b) Compare Lethal Concentration tests with Lethal Dose tests.

   c) Find the number of rat poison (LD50=320 mg/kg) pills needed to reach the lethal dose for a standard healthy man. Each pill has 1.5 gm of poison. Assume any data relevantly, if needed. 3+2+5=**10**

3. a) 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

   b) Compute the DWEL for methylene chloride.

   c) If the DWEL of a contaminant is 15 ppb, what potency would produce this value? 4+3+3=**10**

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4. a) A drinking water supply is found to contain 0.1 mg/L of acetone and 0.1 mg/L of chloroform. A 70-kg adult drinks 2 L per day of this water for 10 years. What would be the hazard index and the carcinogenic risk from drinking this water? Comment on the results.

b) 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.

5+5=**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	6.1×10^{-3}	8.1×10^{-2}	0.010	3.75
Trichloroethylene (TCE)	1.1×10^{-2}	1.3×10^{-2}	0.0005	10.6
Tetrachloroethylene	5.1×10^{-2}	$1\text{-}3.3\times10^{-3}$	0.10	31.0
Benzo(a)pyrene (BaP)	11.5	6.11	0.0002	------
Methylene chloride	7.5×10^{-3}	1.4×10^{-2}	0.060	------
Acetone			0.10	

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

Form A: Paper –Setting Blank

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M.E. CIVIL ENGINEERING 1st YEAR 2nd SEMESTER EXAMINATION. 2019

1st / 2nd Semester /

SUBJECT: HAZARDOUS WASTE MANAGEMENT

(Name in full)

Time: Three hours/

Full Marks: 100

(60 marks for this part)

Use a separate Answer-Script for each part

No. of Question	Part-II	Marks
	Answer Question-1 and any *two* from the rest	
Q.1) a)	State the **Faraday's Laws** of Electrolysis. Deduce the expression for **number of cells** between the electrodes of an Electrodialysis unit.	(3+3)
b)	Deduce the necessary expression for estimating the bulk feed concentration (C_f) for **"Ultrafiltration"** process operating under **semi-batch mode.**	(6)
c)	Discuss with the help of pertinent reactions on the chemical oxidation of the following compounds by ozone. **i) Sodium Cyanide ii) Acetaldehyde iii) Alcohols**	(2+2+2)
d)	Differentiate between **"Recalcitrance"** and **"Persistence".**	(5)
e)	What do you mean by concentration polarization in the context of ultrafiltration and how is it controlled?	(5)
Q.2) a)	An industrial effluent stream is to be treated by a reverse osmosis system. The effluent has a flow rate of **46 gal/min (1 gal= 3.79L)** and a concentration of **4785 mg/L** of **NaCl**. The characteristics feature of the membrane is as follows: i. Coefficient of Water Permeation (W_P)= $1.86*10^{-6}$ gm.mol/cm².sec.atm. ii. Area of the bundle=269 sq.ft iii. Recovery rate per pass = 50% iv. Optimal pressure differential across the membrane= 500 psi v. Osmotic pressure coefficient (Φc)= 0.92 vi. Rejection rate of the salt= 94% vii. Recovery rate required= 82% Determine the following: **i. Osmotic pressure of the solution** **ii. Water flow through the membrane** **iii. Number of unit required for 80% and 50% recovery** **iv. The final product water quality and quantity.**	**3+3+5+5**

Form A: Paper –Setting Blank Ref No.: Ex/PG/CE/T/1210C/2019

M.E. CIVIL ENGINEERING 1st YEAR 2nd SEMESTER EXAMINATION, 2019

(1st / 2nd Semester /

SUBJECT: HAZARDOUS WASTE MANAGEMENT

(Name in full)

Full Marks: 100

Time: Three hours/ (60 marks for this part)

Use a separate Answer-Script for each part

No. of Question	Part-II	Marks
Q.3) a)	An electrodialysis unit is to be designed to treat electroplating waste having the following characteristics. i. Nickel concentration = 2.13% as $NiSO_4$ ii) Resistance through the unit= 10.4 ohm iii) Flow rate = 1877 m^3/day iv) Current efficiency = 92% v. Maximum CD/N ratio = 5781(A/m^2) (gm-equivalent/L) vi. Membrane Area= 1.23 m^2 vii. Maximum permissible effluent Nickel concentration = 500mg/L Determine the followings: **i) number of membrane required** **ii) power required in KW**	(8+8)
Q.4) a)	What are the major drawbacks of Land Treatment process?	4
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 **12.55%**. What are the half life and degradation rate constant for the waste oil? Assume a soil density of **93lb/ft^3**. The date of application and the amount of waste applied to the plot receiving the waste oil are shown below:	(6+6)

Time of application (days after initial application)	Amount of Waste Oil applied (Tons)	Waste Oil concentration of applied waste (%)
0	22.5	13.8
102	31.3	14.1
209	29.2	15.6
311	25.1	16.4