Ref No.: Ex/CE/PE/B/T/421G/2022

B.E. Civil Engineering (4th Year, 2nd Semester Examination), 2022

(1st / 2nd Semester / ~~Repeat~~ / ~~Supplementary~~ / ~~Annual~~ / ~~Biannual~~)

SUBJECT: HAZARDOUS WASTE AND ITS DISPOSAL (Elective-G)

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

Full Marks: 70

(35 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)	What are the **key issues** likely to be addressed in connection with effective hazardous waste management in our country?	(5)
b)	What do you mean by **"Partitioning of Hazardous Contaminants"**? What are the different modes of partitioning of hazardous waste to various media?	(2+3)
c)	Write short notes on **i) LD_{50} ii) Bioconcentration Factor (BCF)**	(3+2)
Q.2) a)	Determine the **lower flammability limit (LFL)** and **upper flammability limit (UFL)** of a gaseous mixture (v/v) of **0.63% Acetone, 0.22% Decane** and **0.37% Hexane**. Given, the LFL and UFL of individual gaseous constituents as follows:	(5)
b)	Determine the **Henry's Law constant** of toluene at 20°C. Vapour pressure is given to be 22 mm Hg and solubility is 512 mg/L.	(5)
Q.3)	Determine the chronic daily intake (CDI) of a non-carcinogenic chemical in water, given that the concentration is 5.5 mg/L. Compare the CDI for an adult and child (both carcinogenic and non-carcinogenic risks involved). Given the following parameters: $ED = 30\ yrs, BW = 70\ kg, EF = 365\frac{days}{yr}, CR = 2\frac{L}{day}\ for\ adult, CR = 1\frac{L}{D}\ for\ child$	(10)
Q.4) a)	What are the points to be specifically examined during an exposure pathway assessment?	4
b)	What do you mean by **"Threshold Limit Value (TLV)"**? Study in mice showed a **NoAEL of 6 mg/kg** for a certain contaminant. What do you think the Acceptable Daily Intake (ADI) and Reference Dose (RfD) would be?	(2+2+2)

Compound	LFL (%)	UFL (%)
Acetone	2.6	12.8
Decane	0.8	9.2
Hexane	1.1	7.5

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B.E. CIVIL ENGINEERING FOURTH YEAR SECOND SEMESTER EXAM 2022

SUB: HAZARDOUS WASTE AND ITS DISPOSAL

Time: 4 hours | Full Marks: 70

Use separate answer scripts for each part

Part-II

[Answer Question No.1 and any two from the rest]

Full Marks: 35

1) A groundwater supply has been contaminated with ethyl benzene whose maximum level in the groundwater is 1 mg/ltr. This level is to be reduced to 35 μg/ltr by an air stripping column given the following data:
   i) $k_l a = 0.015\ /sec$
   ii) $Liquid\ flow\ rate = 7.5\ ltr/sec$
   iii) $temparature\ (t) = 20°C$
   iv) Henry's constant $= 6.44 \times 10^{-3}\ atm.m^3/gm.mol$
   v) Column dia $= 0.6\ m$
   vi) $Air\ to\ water\ ratio, \frac{Q_a}{Q_w} = 20$

   Determine the liquid loading rate, stripping factor, height of the transfer unit, number of the transfer unit and height of packing in column. [2+2+2+2+3=11]

2) Waste stream contains 90 kg of cyanide (CN^-) daily. Determine the stoichiometric amount of chlorine and caustic soda required to oxidize:
   i) Oxidation of Cyanide to Cyanet
   ii) Complete oxidation of cyanide to nitrogen.

   Ignore the amount of caustic soda required for maintaining pH of 10. [6+6=12]

3) An electroplating plant generates 1600 m^3/day of nickel bearing wastes having average Ni Concentration of 15000 mg/ltr as $NiSO_4$. Assume the following characteristic of the system:

i. Resistance through the unit = 10.5 Ω.

ii. Current efficiency = 90%

iii. Maximum $\left(\frac{C.D.}{N}\right)$ = 5800 amp/m²/gm-eqv/ltr

iv. Membrane area = 0.95 m²

Provide a preliminary design of the system to produce 93% removal of nickel. Determine the number of membrane, power required for the system. [12]

4. A) Describe with the help of a neat sketch the fundamentals of air stripping process involving air stripping tower.

B) Describe with the help of a neat sketch the operation of a reverse osmosis process.

[6+6 =12]

5. A) Discuss on the role of ozone as chemical oxidant in hazardous waste treatment.

B) State the differences between different 'pressure membrane process' from the view point of applied pressure and size of the particles removed.

C) What is the essence of "two-film theory" in the context of air stripping process?

[5+4+3=12]