Ref No.: Ex/CE/PE/B/T/421G/2024

B.E. Civil Engineering (4th Year, 2nd Semester Examination), 2024

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

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

Full Marks: 100

Time: Two hours/Three hours/Four hours/Six hours (50 marks for this part)

Use a separate Answer-Script for each part

Part-I

Answer all questions:

Sl. No.	Question	CO	Marks
1	**a)** What are the **key issues** likely to be addressed in connection with effective hazardous waste management in our country?	[CO1]	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) Differentiate between **'Recalcitrant'** and **'Xenobiotic'** compounds.		4
	d) What do you mean by **'Corrosivity'** of hazardous waste?		3
2	a) Determine the **chronic daily intake (CDI)** of a non-carcinogenic chemical in water, given that the concentration is **5.75 mg/L**. Compare the CDI for an adult and child (both carcinogenic and non-carcinogenic risks involved). Given the following parameters: $ED = 30\,yrs, BW = 70\,kg, EF = 365\frac{days}{yr}, CR = 2\frac{L}{day} for\ adult, CR = 1\frac{L}{D} for\ child$	[CO2]	9
	b) Determine the **'Threshold Limit Value (TLV)'** of a worker exposed to **42 ppm PCE, 36 ppm TCE, 82 ppm MEK** and **39 ppm MIBK** in the exhaust air of a solvent recycling operation. What is the **TLV** of the mixture?		8
3	a) Define **'Hazardous Wastes'** as per **Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016.**	[CO3]	5
	b) What are the criteria set for reuse of **'Used Oil'** and **'Waste Oil'** in the context of **Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016.**		6
	c) State the essential features of any **TSDF system** for management of Hazardous waste.		5

Chemical	TLV (ppm)
PCE	50
TCE	50
MEK	200
MIBK	50

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B.E. CIVIL ENGINEERING FOURTH YEAR SECOND SEMESTER – 2024

SUBJECT: HAZARDOUS WASTE AND ITS DISPOSAL (CE/PE/B/T/421G)

Time: 3 hours **Full Marks: 100**

Instructions: Use Separate Answer scripts for each part.

CO4: Employ domain knowledge in designing different treatment units, storage and disposal options for hazardous waste.

Part - II (50 Marks)

Sl. No.	Question	CO	Marks
1. A)	Derive the design equation for stripping towers and stripping columns.	[CO4]	[12]
1. B)	What is the essence of "two-film theory" in the context of air stripping process?	[CO4]	[4]
1. C)	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) $k_l a = 0.017\ /sec$ ii) $Liquid\ flow\ rate = 7.5\ ltr/sec$ iii) $temparature\ (t) = 20℃$ iv) Henry's constant $= 6.4 \times 10^{-3}\ atm.m^3/gm.mol$ v) Column dia $= 0.61\ m$ vi) $Air\ to\ water\ ratio, \frac{Q_a}{Q_w} = 20$ Determine the liquid loading rate, stripping factor, HTU, NTU and height of packing in column.	[CO4]	[12]
1. D)	A waste stream contains 120 kg of cyanide daily. Determine the stoichiometric amount of chlorine and caustic soda required to oxidize: i) Cyanide to Cyanet, ii) Complete oxidation of cyanide to nitrogen. Ignore the amount of caustic soda required for maintaining pH of 10	[CO4]	[12]
1. E)	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 = 85 % iii.Maximum $\left(\frac{C.D.}{N}\right)$ = 5700 amp/m^2/gm-eqv/ltr iv.Membrane area = 1 m^2 Provide a preliminary design of the system to produce 95% removal of nickel. Determine the number of membrane, power required for the system.	[CO4]	[10]