

B.E. Civil Engineering (4th Year, 2nd Semester Examination), 2025(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

No. of Question	Part-I	Marks												
	<u>Answer all questions</u>													
Q.1) a)	Differentiate between 'Recalcitrant' and 'Xenobiotic' compounds. (CO1)	(4)												
b)	What do you mean by 'Flammability' of hazardous waste? (CO1)	(3)												
c)	What do you mean by "Partitioning of Hazardous Contaminants"? What are the different modes of partitioning of hazardous waste to various media? (CO1)	(2+3)												
d)	Determine the lower flammability limit (LFL) and upper flammability limit (UFL) of a gaseous mixture (v/v) of 0.62% Acetone, 0.23% Decane and 0.31% Hexane . Given, the LFL and UFL of individual gaseous constituents as follows: (CO1)	(5)												
	<table border="1"><tr><th>Compound</th><th>LFL (%)</th><th>UFL (%)</th></tr><tr><td>Acetone</td><td>2.6</td><td>12.8</td></tr><tr><td>Decane</td><td>0.8</td><td>9.2</td></tr><tr><td>Hexane</td><td>1.1</td><td>7.5</td></tr></table>	Compound	LFL (%)	UFL (%)	Acetone	2.6	12.8	Decane	0.8	9.2	Hexane	1.1	7.5	
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Acetone	2.6	12.8												
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Q.2) a)	Differentiate between LD ₅₀ and LC ₅₀ . (CO2)	(4)												
b)	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: (CO2)	(8)												
	$ED = 30 \text{ yrs}, BW = 70 \text{ kg}, EF = 365 \frac{\text{days}}{\text{yr}}, CR = 2 \frac{\text{L}}{\text{day}} \text{ for adult}, CR = 1 \frac{\text{L}}{\text{day}} \text{ for child}$													
c)	Determine the ' Threshold Limit Value (TLV) ' of a worker exposed to 42 ppm PCE, 34 ppm TCE, 80 ppm MEK and 37 ppm MIBK in the exhaust air of a solvent recycling operation. What is the TLV of the mixture? (CO2)	(5)												
	<table border="1"><tr><th>Chemical</th><th>TLV (ppm)</th></tr><tr><td>PCE</td><td>50</td></tr><tr><td>TCE</td><td>50</td></tr><tr><td>MEK</td><td>200</td></tr><tr><td>MIBK</td><td>50</td></tr></table>	Chemical	TLV (ppm)	PCE	50	TCE	50	MEK	200	MIBK	50			
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PCE	50													
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Ref No.: Ex/CE/PE/B/T/421G/2025

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(50 marks for this part)

Use a separate Answer-Script for each part

No. of Question	Part-I	Marks
Q.4) a)	What are the salient features of Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016. (CO3)	(8)
b)	What do you mean by 'Other Wastes' in the context of Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016. (CO3)	(3)
c)	State the essential features of any TSDF system for management of Hazardous waste. (CO3)	(5)

B.E. CIVIL ENGINEERING FOURTH YEAR SECOND SEMESTER – 2025**SUBJECT: HAZARDOUS WASTE AND ITS DISPOSAL (CE/PE/B/T/421G)****Time: 3 hours****Full Marks: 50****Instructions: Use Separate Answer scripts for each part.****Part - II**

Sl. No.	Question	CO	Marks
1	Answer any five	[CO4]	[5 x 10 = 50]
1. A	a) Describe with the help of a neat sketch the fundamentals of air stripping process involving air stripping tower. b) State the differences between different 'pressure membrane process' from the view point of applied pressure and size of the particles removed.	[CO4]	[5+5]
1. B	a) Describe with the help of a neat sketch the operation of a reverse osmosis process. b) Discuss on the role of ozone as chemical oxidant in hazardous waste treatment.	[CO4]	[5+5]
1. C	A w/w stream at 25°C temp is to be treated by as R.O. system. The w/w has a flow rate of 50 gallon/min. A concentration of 5000 mg/ltr of NaCl. A R.O. vendor has recommended a membrane with the following characteristics: i. Coefficient of water permeation, $\omega_p = 1.9 \times 10^{-6} \text{ gm - mole/cm}^2 - \text{sec} - \text{atm}$ ii. Area of bundle of membrane = 300 ft ² iii. Recovery rate per pass = 50% iv. Rejection rate of the salt = 95% v. Desired recovery rate = 75% vi. Optional pressure difference across the membrane = 500 psi vii. Osmotic pressure coefficient, $\varphi_c = 0.92$ Determine: a. Osmotic pressure of the solution b. Waterflow through the membrane c. No of bundles required per unit d. Final Product water quantity and quality	[CO4]	[5+5]
1. D	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 $\left(\frac{C.D.}{N}\right) = 5700 \text{ amp/m}^2/\text{gm-eqv/ltr}$ 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]
1. E	Discuss how xenobiotic compounds are treated in context of hazardous waste management.	[CO4]	[10]
1. F	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 $\mu\text{g/ltr}$ by an air stripping column given the following data: i) $k_1 a = 0.016 / \text{sec}$ ii) Liquid flow rate = 7 ltr/sec	[CO4]	[2+2+2+2+2=10]

	iii) <i>temparature</i> (t) = 20°C iv) Henry's constant = $6.5 \times 10^{-3} \text{ atm.m}^3/\text{gm.mol}$ v) Column dia = 0.65 m vi) <i>Air to water ratio</i> , $\frac{Q_a}{Q_w} = 19$ Determine the liquid loading rate, stripping factor, HTU, NTU and height of packing in column.		
1. G	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]	[5+5]
1. H	a. What is the essence of “two-film theory” in the context of air stripping process? b. Write a short note on Ultrafiltration process in connection with hazardous waste treatment.	[CO4]	[5+5]