Ref. No. Ex/CE/PC/H/T/416/2025

BACHELOR OF ENGINEERING IN CIVIL ENGINEERING EXAMINATION 2025

(Fourth Year, First Semester)

Water Resources Engineering III (Honors)

[WRE III (H)]

Time: Three Hours | Full Marks 100

Q No		Attempt any Two GROUPS		Marks
		Assume suitable values for the parameters if not supplied.		
		GROUP A		
1	(a)	Define 'Hydraulic Jump. What are the different depths in 'Hydraulic Jump'? What is the application of 'hydraulic jump'? What is called dead storage of a Reservoir?	CO1	1+2+1+1=5
	(b)	What are the assumptions made in the momentum formula for 'Hydraulic Jump'? Discuss the effect of inclined bed, on the depth estimating equation of 'Hydraulic Jump', derived for horizontal bed. What would be the type of hydraulic jump in case of critical flow?	CO3	3+3+1=7
	(c)	Derive the expression of 'Initial Depth' of 'Hydraulic Jump', using momentum formula for horizontal bed.	CO4	13
2	(a)	Write down the 'Laplacian equation' related to two dimensional seepage flow, through pervious soil. Also explain the notation. What are the assumptions made in the 'Laplacian equation'? Define 'Isotropic Soil'. Derive the expression for seepage discharge through isotropic soil; also write down the expression for the same through 'Anisotropic Soil'.	CO4	1+1+3+1+5 +1= 12
	(b)	What is 'Phreatic Line'? What it indicates? Determine the phreatic line for the earth dam (details given below) with a horizontal filter of length equal to 25m provided inward from the downstream toe of the dam, also determine the discharge passing through the dam. The earth dam made of homogeneous material has the following details: Coefficient of permeability of dam material = 5×10^{-4} cm/sec Level of top of dam = 200.0 m Level of deepest river bed = 180.0 m H.F. L. of reservoir = 197.0 m Width of the top of dam = 4.5 m U/s Slope = 3H:1V D/s Slope = 2H:1V	CO2	1+2+8+2= 13
		GROUP B		
3	(a)	What are the factors, which affect the design of spillway? What are the factors that affect the value of Coefficient of discharge? Explain briefly.	CO1	3+4=7
	(b)	What are the major components of spillway? Make a list of different types of spillway.	CO1	1+4=5
	(c)	An overflow ogee spillway of height 13m is discharging water with a head of 2 m over the crest. A reverse curvature of radius 4.5 m, subtending an angle of 60° at the centre, is provided at the spillway bottom. Assuming the discharge coefficient for the spillway as 2.2, determine the magnitude and direction of the dynamic force on the reversed curved portion of the spillway.	CO3	13
4	(a)	What is canal fall structure? Derive the expression for discharge through a trapezoidal notch. Establish the correlation between 'half supply depth' and 'full supply depth'.	CO4	2+4+3= 9
	(b)	Design and draw a neat sketch for a siphon well drop using the following data: Fall = 4.0m; General ground level=+160.36m RL; Full supply depth= 75 cm; Bed level at u/s=+159.83m RL; Discharge=1.2 cumecs; Bed width= 2.4m; Given that, Darcy's coefficient of friction= 0.012 and Length of the pipe=12m.	CO2	16
		GROUP C		
5	(a)	Define 'Freeboard' for Hydraulic Structures. Also define 'Fetch' and 'Effective Fetch'. How do you estimate 'Effective Fetch'? Explain Briefly. What is the pre-condition of "Hydraulic Jump"?	CO1 CO3	2+3+4+1= 10
	(b)	Compute 'Freeboard and the top elevation of the dam for the following details: Full reservoir level = 335.00m; Maximum water level = 337.20m Effective fetch: For normal freeboard = 3.66km & minimum freeboard = 4.00km Wind velocity over land for normal freeboard = 160km/hr Average depth of reservoir: For normal freeboard = 29.0m & minimum freeboard = 31.2m Embankment slope = 2.25(H):1(V) along with the following coefficients: • The upstream face surface roughness = 0.75 • The ratio of wind velocity over water surface to the wind velocity over land surface for effective fetch 2 and 4 as 1.16 and 1.24 respectively • Variation of the Relative Run-up (R/H_0) against Embankment Slope is as follows:	CO2	15

Embankment slope	0.1	0.2	0.3	0.4	0.5	0.6
Relative Run-up, R/H_0	0.368	0.752	1.200	1.600	1.968	2.272

[Turn over

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(Fourth Year, First Semester)

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[WRE III (H)]

Time: Three Hours | Full Marks 100

Q No		***Attempt any Two GROUPS***			Marks
6	(a)	Design an aqueduct flumed section for a cross drainage work for the following given data: **Canal Data**: Discharge = 30.0 Cumecs Bed width = 20.0 m Depth of Water = 1.5 m Full Supply Level (FSL) = 251.50 m RL **Drainage Data**: High Flood Discharge = 250.0 Cumecs High Flood Level = 252.5 m RL High Flood Depth = 2.5 m General Ground Level = 250.0 m	**CO2**	**18**
	(b)	Draw (on a graph sheet) the flumed section in plan and show the profile of Total Energy Level (TEL), Water Surface and Bed Level in elevation.	**CO4**	**7**