11/12/24 (FN)

Roll No. | | | | | | | | | | |

ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)
B.E. (Full Time) - END SEMESTER EXAMINATIONS, NOV / DEC 2024

CIVIL ENGINEERING
CE5403 APPLIED HYDRAULIC ENGINEERING
(Regulation 2019)

Time: 3hrs Max. Marks: 100

CO1	Describe the basics of open channel flows, its classifications and analysis of uniform flow in steady state conditions with specific energy concept and its application
CO2	Analyse steady gradually varied flow, water surface profiles and its length calculation using direct and standard step methods with change in water surface profiles due to change in grades.
CO3	Derive the relationship among the sequent depths of steady rapidly varied flow and estimating energy loss in hydraulic jump with exposure to positive and negative surges.
CO4	Design turbines and explain the working principle
CO5	Differentiate pumps and explain the working principle with characteristic curves and design centrifugal and reciprocating pumps.

BL – Bloom's Taxonomy Levels
(L1-Remembering, L2-Understanding, L3-Applying, L4-Analysing, L5-Evaluating, L6-Creating)

PART- A (10x2 = 20Marks)
(Answer all Questions)

Q. No.	Questions	Marks	CO	BL
1	Define open channel flow with examples.	2	1	1
2	What are the conditions for a best rectangular channel?	2	1	2
3	List the assumptions involved in deriving the dynamic equation of the GVF.	2	2	1
4	Under which circumstances M_2 and S_2 Profile will occur in open channels?	2	2	1
5	A 4 m wide rectangular channel conveys 10 m^3/s of water with a velocity of 4 m/s. Is there a condition for hydraulic jump to occur?	2	3	3
6	What is meant by surge and what are the types?	2	3	1
7	Differentiate impulse and reaction turbine. Give examples.	2	4	1
8	What is meant by Net Positive Suction Head?	2	4	2
9	How a single acting reciprocating pump is different from double acting reciprocating pump?	2	5	2
10	Define the term cavitation?	2	5	1

PART- B (5x 13= 65 Marks)

Q.No.	Questions	Marks	CO	BL
11 (a)	A hydraulically efficient trapezoidal channel has side slopes of 1:1. It is required to discharge 14m^3/s with a gradient (channel slope) of 1 in 1000. If unlined, the value of Chezy's C is 45. If lined with concrete, the value is 70. If the least cost per m^3 of excavation is three times the cost m^2 of lining, will the lined or unlined channel be cheaper.	13	1	3
	OR			
11 (b)	Derive the conditions for most economical trapezoidal section	13	1	3
12 (a)	Derive the dynamic equation of the Gradually Varied Flow	13	2	4
	OR			
12 (b)	Explain in detail, the classification and the characteristics of surface profiles in open channels	13	2	4

13 (a)	Derive an expression for estimation of sequent depths of a hydraulic jump and also list the applications of hydraulic jump	**13**	3	4
	OR			
13 (b)	A horizontal rectangular channel of 3m width and 2m water depth conveys water at 20 m^3/s. If the flow rate is suddenly reduced to 2/3 of its original value, compute the magnitude and speed of the upstream surge. Assume that the front of the surge is rectangular and friction in the channel is neglected.	**13**	3	4
14 (a)	The following data is given for a Francis Turbine. Net head H= 60m; speed =700 rpm; shaft power = 293 kw; η_o=84%; flow ratio =0.20; breadth ratio n=0.1; outer diameter of the runner = 2 x inner diameter of the runner. The thickness of vanes occupies 5% of circumferential area of the runner, velocity of flow is constant at inlet and outlet and discharge is radial at outlet. Determine Guide blade angle, diameters of runner at inlet and outlet, runner vane angle at inlet and outlet and width of the wheel at inlet.	**13**	4	4
	OR			
14 (b)	Derive an expression for minimum speed for starting a centrifugal pump	**13**	4	4
15 (a)	Determine the maximum speed at which a double acting reciprocating pump can be operated under the following conditions (a) no air vessel on the suction side (b) very large air vessel on the suction side close to the pump. The suction lift is 4m, length of suction pipe 6.5 m, diameter of suction pipe 100 mm, diameter of piston 150mm and length of stroke is 0.45m. Assume SHM, separation would occur at 2.6 m of water absolute. Take Darcy's f =0.024.	**13**	5	4
	OR			
15 (b)	Derive an expression for the acceleration head in a single acting reciprocating pump and how it is shown in the indicator diagram	**13**	5	4

PART- C(1x 15=15Marks)

(Q.No.16 is compulsory)

Q. No.	Questions	Marks	CO	BL
16.	Show that the head loss in a hydraulic jump formed in a rectangular channel may be expressed as $E = (V_1-V_2)^3 / 2g (V_1+V_2)$	**15**	1	5