Code No: **20CE4T03** **R20**

II B. TECH II SEMESTER REGULAR EXAMINATIONS, JUNE - 2022
HYDRAULICS AND HYDRAULIC MACHINERY
(CIVIL ENGINEERING)

Time: 3 hours Max. Marks: 70

Note: Answer **ONE** question from each unit **(5 × 14 = 70 Marks)**

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UNIT-I

1.	a)	What is critical velocity? Given the average flow velocity and the flow depth, explain how you would determine if the flow in open channels is tranquil, critical, or rapid.	[7M]
	b)	Determine the most economical section of rectangular channel carrying water at a rate of 0.5 m3/s when bed slope is 1 in 2000 and Chezy's constant is 50.	[7M]
		(OR)	
2.	a)	Water flows at a steady and uniform depth of 2 m in an open channel of rectangular cross section having base width equal to 5 m and laid at a slope of 1 in 1000. It is desired to obtain critical flow in the channel by providing a hump in the bed. Calculate the height of the hump. Consider the value of Manning's rugosity coefficient as 0 .02 for the channel surface.	[7M]
	b)	What do you mean by specific energy? Also explain a specific energy curve.	[7M]

UNIT-II

3.	a)	In your own words, summarize the steps of the boundary layer formation.	[7M]
	b)	The velocity distribution in the boundary layer is given u/U = y/δ. Where u is the velocity at distance y from the plate, δ is boundary layer thickness and u = U at y = δ, Determine (i) displacement thickness (ii) momentum thickness.	[7M]
		(OR)	
4.	a)	It is required to determine the frictional drag of a submarine. The length of the hull is 75 m and its surface area is 3000 m^2. The submarine is travelling at a constant speed of 5 m/s. Critical Reynolds number at which the flow in the boundary layer changes from laminar to turbulent is 5 × 105. Assuming that the boundary layer at the leading edge is laminar, obtain the frictional drag and the power required to propel the submarine at 5 m/s. Take υ = 1 × 10^{-6} m^2/s (0.01 cm2/s) and ρ = 1000 kg/m^3.	[7M]
	b)	Explain the boundary layer separation with neat sketches.	[7M]

UNIT-III

5.		A propeller of diameter D rotates at angular velocity v in a liquid of density r and viscosity m. The required torque T is determined to be a function of D, v, r, and m. Using dimensional analysis, generate a dimensionless relationship. Identify any established nondimensional parameters that appear in your result. Hint: For consistency (and whenever possible), it is wise to choose a length, a density, and a velocity (or angular velocity) as repeating variables.	[14M]
		(OR)	
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6. a) List the three primary purposes of dimensional analysis. List and describe the three necessary conditions for complete similarity between a model and a prototype. [7M]

   b) A wind tunnel is used to test 5: 1 scale model of a car. The velocity with prototype is 60 km/hr and for the dynamic similar conditions, the model drag is 240 N. If air is used with model as well as the prototype, then determine the drag and the power required for the prototype. [7M]

UNIT-IV

7. a) A Pelton wheel develops 2.5 MW of power while operating at 260 rpm and working under a head of 250 m. The diameter of the nozzle is 15 cm and the coefficient of velocity is 0.98. The blade outlet angle is 15° and the speed ratio is 0.46. Determine (i) the turbine efficiency, (ii) wheel diameter at the pitch circle of the blades and (iii) hydraulic efficiency. [7M]

   b) An outward flow reaction turbine is running at 275 rpm. The internal and external diameters of the turbine are 2 m and 2.75 m, respectively. The width of the runner is constant at the inlet and outlet and it is equal to 275 mm. The head on the turbine is 180 m and the rate of flow through the turbine is 6 m^3/s. If the discharge at the outlet is radial, then determine (i) the velocity of flow at the inlet and outlet of the runner and (ii) vane angles. [7M]

(OR)

8. a) A hydraulic turbine generates 0.13 MW at 230 rpm while operating under a head of 16 m. Calculate the scale ratio and the speed of a similar turbine which will develop 0.65 MW when operating under a head of 25 m. [7M]

   b) Discuss the various efficiency of hydraulic turbines. [7M]

UNIT-V

9. a) A centrifugal pump is required to deliver 0.03 m3/s of water to a height of 25 m through a 12 cm diameter pipe and 110 m long. Determine the power required to drive the pump if its overall efficiency is 72%. Take coefficient of friction f = 0.01 for the pipeline [7M]

   b) Define indicator diagram. Show that work done by the reciprocating pump is proportional to the area of the indicator diagram [7M]

(OR)

10. a) A single acting reciprocating pump delivers 9 litres per second of water against a suction head of 4 m and a delivery head of 16 m while running at a speed of 60 rpm. The diameter and stroke of the piston are 200 mm and 300 mm, respectively. Determine (i) the theoretical discharge, (ii) coefficient of discharge, (iii) slip, (iv) percentage slip and (v) power required to drive the pump. [7M]

    b) Define specific speed of a centrifugal pump and derive its expression. [7M]

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