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

Common to Industrial, Manufacturing and Mining Engineering
Third Semester
CE23C02 FLUID MECHANICS AND MACHINERY
(Regulation 2023)

Time: 3hrs

Max.Marks: 100

PART- A

(10 x 2 = 20 Marks)

Q. No	Questions	Marks	CO	BL
1	Kinematic viscosity and specific gravity of a fluid is 5.58×10^{-4} m^2/s and 2.0 respectively. Compute the dynamic viscosity and density of the fluid.	2	1	1
2	What is center of pressure and total pressure on a vertical rectangular plate of size 5m width X 4m depth. Top surface of the plate is touching the water surface?	2	1	2
3	Draw the boundary layer normal thickness for a uniform flow over a in plate.	2	2	1
4	Differentiate between pipes connected in parallel and connected in series	2	2	2
5	State Buckingham π theorem.	2	3	2
6	Model of a river is constructed to a horizontal scale 1 : 800 (H) and the vertical scale 1 : 40 (V). Determine the scale ratio for the discharge in the river. (Froude model Law)	2	3	1
7	Mention about the type of inward radial flow reaction turbine.	2	4	2
8	Write the equation for the specific speed of a turbine.	2	4	3
9	What is priming and its necessary in a centrifugal pump?	2	5	2
10	Write the equation for percentage slip in reciprocating pump.	2	5	3

PART- B

(5 x 13 = 65 Marks)

Q. no		Questions	Marks	CO	BL
11	a. (i)	A rectangular plate of size 250 mm X 500 mm and weighing 250 N slides down a 30 degree inclined surface at a uniform velocity of 2.0 m/s. If the uniform 2 mm gap between the plate and the inclined surface is filled with oil, compute the dynamic viscosity of oil.	6	1	3
	(ii)	A square disc of side 1 m is immersed vertically in water so that an edge of the square makes an angle of 35 degree with horizontal. If the highest corner of the disc is at a depth of 1.5 m below the free surface, find the total pressure on one face of the disc.	7	1	3
		(OR)			
11	b)	Derive from basic principle the Euler equation of motion and deduce to obtain Bernoulli's equation. State assumption made in deriving Bernoulli's equation.	13	1	3

12	a)	The velocity distribution in a laminar boundary layer is given by $\frac{u}{U} = 3\frac{y}{\delta} - 2\left(\frac{y}{\delta}\right)^2$ in which u is velocity at distance y and U is free stream velocity at distance δ the thickness of the boundary layer. Determine the value of displacement thickness when δ=24 mm.	**13**	2	4
		(OR)			
12	b)(i)	A compound piping system consists of 1800 m long with 0.5 m diameter, 1200 m length with 0.4 m diameter and 600 m length with 0.3 m diameter made of new cast iron pipes are connected in parallel. Convert the system to an equivalent length of 0.50 m diameter pipe.	**5**	2	4
12	b)(ii)	Two sharp ended pipes of diameters 50 mm and 100 mm respectively, each of length 100 m are connected in parallel between two reservoirs which have a difference of level of 10 m. If the friction factor is 0.032, compute the rate of flow for each pipe considering all losses in the system. (entrance, friction and exit losses)	**8**	2	4
13	a)	An airfoil subjected to drag force F with flow velocity U, chord dimension D, density ρ, dynamic viscosity μ, Bulk Modulus of Elasticity E respectively. Prove that the functional relationship through Buckingham π method. $F = \rho U^2 D^2 \phi[\frac{\mu}{\rho UD}, U\sqrt{\frac{\rho}{E}}]$	**13**	3	4
		(OR)			
13	b)	1 m width of artificial water drainage model of geometric scale 1/50. Prototype width 15m and its depth 1.5m. Determine the width of the model and model depth. If the discharge in the model is 0.015 m^3/s, minimum pressure head is 250 mm, find out the discharge and minimum pressure head in the prototype?	**13**	3	4
14	a)(i)	Prove that the hydraulic efficiency of a Pelton wheel will be maximum when the velocity of the wheel is half the velocity of the jet of water at inlet.	**9**	4	5
	a(ii)	A water jet of 50 mm diameter strikes a stationary curved plate at the center with a constant jet velocity 20 m/s. If the water jet is deflected through an angle of 120 degree at the outlet of the curved plate. Determine the force exerted by the water jet in the direction of the jet	**4**	4	5
		(OR)			

14	b)	A Francis turbine has to be designed to develop 367.5 kW under a head of 70 m while running at 750 rpm. Ratio of width of runner to diameter of runner is 1/10, inner diameter is 1/2 of the outer diameter. Flow ratio is 0.15, hydraulic efficiency is 95 %, mechanical efficiency is 84 %, four percentage of the circumferential area of runner to be occupied by the thickness of the vanes, velocity of flow is constant and discharge is radial at exit of the runner. Determine the diameter of the runner wheel, discharge through the turbine and guide vane angle at inlet and runner vane angles at inlet and outlet of the turbine.	**13**	4	5
15	a)	Centrifugal pump discharges 0.170m^3/s under a head of 25 m. The speed of the blade is 1400 rpm, hydraulic efficiency 0.55, head loss in the impeller is 0.01 V^2. Where V is outlet absolute velocity from the pump. The area of flow at outlet is 1.2 D^2. m^2. Where D is Diameter of the outlet. The flow enters without whirl and loss. Determine (i) Diameter of the blade (ii) The blade angle at outlet of the impeller.	**13**	5	5
		OR			
15	b)	A single acting reciprocating pump has a cylinder 0.2 m in diameter and a stroke of 0.4 m. The delivery pipe is 0.075 m in diameter and 40 m long. Taking friction coefficient 0.01. Find the power saved by fitting an air vessel to the delivery pipe. The pump runs at 60 rpm. The air vessel is fitted 2m away from the cylinder.	**13**	5	5

PART- C

(1 x 15 = 15 Marks)

Q. No		Questions	Marks	CO	BL
16.(a)		Derive the Darcy-Weisbach equation for loss of head due to friction in turbulent flow through pipe.	**8**	2	5
	(b)	A pump operates at a maximum efficiency of 82% and delivers 2.25 m^3/s under a head of 18 m while running at 3600 rpm speed. Compute the specific speed of the pump. Also determine the discharge, head and power input to pump at a shaft speed of 2400 rpm. Assume the efficiency remains constant at all the speeds.	**7**	5	5

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