P P SAVANI UNIVERSITY

Fourth-Semester of B. Tech. Examination

November 2022

SEME2060 Fluid Mechanics

28.11.2022, Monday **Time: 1:00 p.m. To 3:30 p.m.** **Maximum Marks: 60**

Instructions:

1. The question paper comprises of two sections.
2. Section I and II must be attempted in separate answer sheets.
3. Make suitable assumptions and draw neat figures wherever required.
4. Use of scientific calculator is allowed.

SECTION – I

Q - 1	**Answer the Following.**	**[05]**	**CO**	**BTL**
(i)	Define the concept of Vapour Pressure, Cavitation and Surface Tension.		**1**	**1**
Q - 2 (a)	Prove that Intensity of pressure at a point in static fluid is equal in all directions.	**[05]**	**1**	**3**
Q - 2 (b)	A single U-tube manometer is used to measure water pressure in pipe line. The left limb of manometer is connected to the pipe and the right lime is open to atmosphere. The mercury level in the left limb is 80 mm below the center of the pipe and the right limb is 220mm above the center of the pipe. Calculate the pressure of water in meter and also in KN/m².	**[05]**	**2**	**5**
	OR			
Q - 2 (a)	Derive an expression for total pressure and position of pressure when vertical surface immersed inside the liquid.	**[05]**	**2**	**4**
Q - 2 (b)	A rectangular plate 1 m wide and 1.5 m deep is held vertically in water so that the upper horizontal edge is 1.5 m below the free surface. Find the total pressure on one face of the plate and also calculate the centre of pressure.	**[05]**	**2**	**5**
Q - 3 (a)	Write a statement of continuity equation and derive the expression for three dimensional cartesian coordinates.	**[05]**	**5**	**3**
Q - 3 (b)	If u = x – 4y and v = - y – 4x, show that velocity potential function exists and find stream function.	**[05]**	**5**	**5**
	OR			
Q - 3 (a)	Discuss the analytical method to obtain metacentric height.	**[05]**	**2**	**4**
Q - 3 (b)	A solid cylinder of diameter 4 m has a height of 4 m. Find the metacentric height of cylinder if the specific gravity of cylinder material is 0.6 and it is floating in water with its axis vertical. State wheatear the equilibrium is stable or unstable.	**[05]**	**4**	**5**
Q - 4	**Attempt any one.**	**[05]**		
(i)	Derive Bernoulli's equation from Euler's equation. Also state assumptions and practical applications of it.		**1**	**4**
(ii)	Prove that the discharge from orificemeter is given by $$Q = \frac{C_d a_1 a_2}{\sqrt{a_1^2 - a_2^2}} \sqrt{2gh}$$		**1**	**4**

SECTION – II

Q - 1	**Answer the Following: (Any five)**	**[05]**		
(i)	Define Weber Number.		4	1
(ii)	Differentiate Model and Prototype.		4	1
(iii)	Define Coefficient of Discharge.		4	1
(iv)	Total energy line - Hydraulic Gradient Line = _____		2	1
(v)	Head loss in the case of hot water is _____ compared to cold water. Equal b) More c) Less d) Can't Say		3	1
(vi)	What is Syphon? Give its applications.		4	1
Q - 2 (a)	Explain Dimensionless Numbers and its significance.	**[05]**	4	2
Q - 2 (b)	The ratio of length of submarine and its model is 30:1. The speed of sub-marine (Prototype) is 10 m/s, The model is to be tested in a wind tunnel. Find the speed of air in the wind tunnel. Also determine the ration of drag (Resistance) between model and prototype. Take the value of kinematic viscosity for sea water and air is 0.012 stoke and 0.016 stoke respectively. The density of sea water and air is given as 1030 kg/m³ and 1.24 kg/m³ respectively.	**[05]**	4	5
	OR			
Q - 2	The pressure difference Δp in the pipe of diameter D and length L due to turbulent flow depends upon velocity V, viscosity μ, density ρ of fluid and acceleration due to gravity (g). Find the expression for the force using dimensional analysis.	**[10]**	4	5
Q - 3 (a)	Derive Hagen-Poiseuille equation and state the assumptions made.	**[05]**	3	4
Q - 3 (b)	Find an expression for the discharge over a trapezoidal notch in terms of head of water over the crest of the notch.	**[0]**	3	4
	OR			
Q - 3 (a)	Derive Darcy – Weisbach 's equation for loss due to friction for flow through pipe.	**[05]**	5	4
Q - 3 (b)	The pipeline of length 2100 m is used to transmitting 103 kW. The pressure at the inlet of pipe is 392.4 N/cm². If the efficiency of transmission is 80 %, calculate the diameter of pipe. Take f = 0.005.	**[05]**	3	5
Q - 4	**Attempt any one**	**[05]**		
(i)	Obtain an expression for the boundary shear stress in terms of momentum thickness.		5	4
(ii)	Air is flowing over a smooth flat plate with a velocity of 12 m/s. The velocity profile is in the form: $$\frac{u}{U} = 2\left(\frac{y}{\delta}\right) - \left(\frac{y}{\delta}\right)^2$$ The length of the plate is 1.1 m and width 0.9 m. If laminar boundary layer exists upto a value of Re = 2×10^5 and kinematic viscosity of air is 0.15 stoke, find: (i) The maximum distance from the leading edge upto which laminar boundary layer exists, and (ii) The maximum thickness of boundary layer.		1	5

****

CO : Course Outcome Number BTL : Blooms Taxonomy Level

Level of Bloom's Revised Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create