P P SAVANI UNIVERSITY

Fourth Semester of B. Tech. Examination

December 2021

SEME2060 Fluid Mechanics

10.12.2021, Friday **Time: 12:30 p.m. To 3:00 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	Attempt Any Five.	**[05]**
(i)	What do you mean by the term 'Viscosity'?	
(ii)	What is the difference between cohesion and adhesion?	
(iii)	Define the following terms: (i) Total pressure, and (ii) Centre of pressure.	
(iv)	Define and explain Metacentre.	
(v)	Write a Bernoulli's equation for real fluid.	
(vi)	Sketch the velocity distribution for uniform irrotational flow.	
(vii)	What do you understand by rotational and irrotational flow?	
Q - 2 (a)	State and prove the Pascal's law.	**[05]**
Q - 2 (b)	A U-tube manometer is used to measure the pressure of oil of specific gravity 0.85 flowing in a pipe line. Its left end is connected to the pipe and the right-limb is open to the atmosphere. The centre of the pipe is 100 mm below the level of mercury (specific gravity = 13.6) in the right limb. If the difference of mercury level in the two limbs is 160 mm, determine the absolute pressure of the oil in the pipe.	**[05]**

OR

Q - 2 (a)	Derive an expression for calculating time of rolling of a floating body.	**[05]**
Q - 2 (b)	A solid cylinder 2m in diameter and 2m high is floating in water with its axis vertical. If the specific gravity of the material of cylinder is 0.65 find its metacentric height. State also whether the equilibrium is stable or unstable.	**[05]**
Q - 3 (a)	Derive the Continuity Equation in cartesian coordinates.	**[05]**
Q - 3 (b)	If u = x – 4y and v = - y – 4x, show that velocity potential function exists and find stream function.	**[05]**

OR

Q - 3 (a)	Show that the stream lines and equipotential lines form a net of mutually perpendicular lines.	**[05]**
Q - 3 (b)	Prove that the discharge through an orifice meter is given by $$Q = C_d \frac{a_0 a_1}{\sqrt{a_1^2 - a_0^2}} \sqrt{2gh}$$	**[05]**
Q - 4	Attempt any one	**[05]**
(i)	Derive Euler's equation of motion with assumptions.	
(ii)	Why is co-efficient of discharge of an orifice meter much smaller than that of venturi meter?	

SECTION – II

Q - 1	Attempt Any Five.	[05]
(i)	Explain the term dimensional homogeneity.	
(ii)	What are repeating variables? How are these selected by dimensional analysis?	
(iii)	How is vena contracta defined?	
(iv)	Define Hydraulic Gradient Line and Total energy line?	
(v)	Define the terms : Major energy losses and minor energy losses in pipe.	
(vi)	What is an equivalent pipe?	
(vii)	What is the physical significance of displacement thickness of boundary layer?	
Q - 2 (a)	What are the various methods of dimensional analysis to obtain a functional relationship between various parameters influencing a physical phenomenon.	[05]
Q - 2 (b)	Using the method of dimensional analysis obtain an expression for the discharge Q over a rectangular weir. The discharge depends on the head H over the weir, acceleration due to gravity g, length of weir crest L, height of the weir crest over the channel bottom Z and the kinematic viscosity v of the liquid.	[05]
	OR	
Q - 2 (a)	Enumerate different laws on which models are designed for dynamic similarity. Where are they used?	[05]
Q - 2 (b)	A model of submarine is scaled down to 1/20 of the prototype and is to be tested in a wind tunnel where free stream pressure is 2.0 MPa absolute and temperature is 50°C. The speed of the prototype is 7.72 m/s. Determine the free stream velocity of air and the ratio of the drags between model and prototype. Assume kinematic viscosity of sea water as 1.4 $\times 10^{-6}$ m²/s and viscosity of air as 0.0184 cP.	[05]
Q - 3 (a)	At a sudden enlargement of a water main from 240 mm to 480 mm diameter, the hydraulic gradient rises by 10 mm. Calculate the rate of flow.	[05]
Q - 3 (b)	Find an expression for the discharge over a triangular notch or weir in terms of head of water over the crest of the notch or weir.	[05]
	OR	
Q - 3 (a)	Three pipes of length 800 m, 600 m and 300 m and of diameters 400 mm, 300 mm and 200 mm respectively are connected in series. The ends of the compound pipe is connected to two tanks, whose water surface level are maintained at a difference of 15 m. Determine the rate of flow of water through the pipes if f = 0.005. What will be the diameter of a single pipe of length 1700 m and f = 0.005, which replaces the three pipes? Neglect Minor losses.	[05]
Q - 3 (b)	Derive Hagen-Poiseuille equation and state the assumptions made.	[05]
Q - 4	Attempt any one	[05]
(i)	Obtain an expression for the boundary shear stress in terms of momentum thickness.	
(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.	

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