P P SAVANI UNIVERSITY

Fourth Semester of B. Tech. Examination

May 2019

SEME2060 Fluid Mechanics

17.05.2019, Friday **Time: 09:30 a.m. To 11:00 a.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]**
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) Define Weber Number.

(ii) Differentiate Model and Prototype.

(iii) Define Coefficient of Discharge.

(iv) Total energy line - Hydraulic Gradient Line = _____

(v) Head loss in the case of hot water is _____ compared to cold water.

Equal b) More c) Less d) Can't Say

(vi) What is Syphon? Give its applications.

(vii) What is the physical significance of displacement thickness of boundary layer?

Q - 2 (a) Explain Dimensionless Numbers and its significance. **[05]**

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]**

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]**

Q - 3 (a) Derive Hagen-Poiseuille equation and state the assumptions made. **[05]**

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]**

OR

Q - 3 (a) Derive Darcy – Weisbach 's equation for loss due to friction for flow through pipe. **[05]**

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]**

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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