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[5352]-506

S.E. (Civil Engineering) (Second Semester)

EXAMINATION, 2018

FLUID MECHANICS—I

(2015 PATTERN)

Time : Two Hours

Maximum Marks : 50

**N.B.** :— (i) Answer any *six* questions from Q. No, 1 or 2, Q. No. 3 or 4, Q. No. 5 or 6, Q. No. 7 or 8, Q. No. 9 or 10, Q. No. 11 or 12.

(ii) Neat diagrams must be drawn wherever necessary.

(iii) Figures to the right indicate full marks.

(iv) Use of calculator is allowed.

(v) Assume suitable data, if necessary.

1. (a) Explain in brief phenomenon of cavitation. [2]

(b) Define Specific weight, dynamic viscosity and capillarity. [3]

Or

2. (a) Derive an expression for a pressure inside a liquid jet of radius R and surface tension  $\sigma$ . [3]

(b) State and explain Newton's law of viscosity. [2]

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3. (a) Define 'Metacentre and Metacentric Height'. How are they important in case of floating body ? [3]
- (b) Discuss conditions of stability of a submerged body in short. [2]

*Or*

4. (a) Distinguish between simple manometer and differential manometer. [2]
- (b) Define gauge pressure, vacuum pressure and absolute pressure. [3]
5. (a) Distinguish between irrotational and rotational flow. [2]
- (b) Define path line and streak line, stream tube and give the example of each. [3]

*Or*

6. (a) What is velocity potential and stream function ? [2]
- (b) Define : [3]
- (1) Steady and unsteady flow
- (2) Uniform and non-uniform flow.
7. (a) What is an orifice ? What is meant by 'Large orifice' ? How does it differ from a small orifice ? [2]
- (b) Define coefficient of contraction, coefficient of discharge and coefficient of velocity. [3]

Or

8. (a) Explain how Bernoulli's theorem, applied to two points in flow, is modified to account for : [3]
- (i) Loss of head,
  - (ii) Installation of pump,
  - (iii) Non-uniform velocity variation in pipe.
- (b) What do you understand by dynamics of fluid flow ? How does it differ from kinematics of fluid flow ? [2]
9. (a) What is laminar sublayer ? How is its existence established ? [4]
- (b) Starting from first principles, derive Hagen-Poiseuille equation for steady laminar flow in pipes. [5]
- (c) A plate  $3\text{m} \times 1.5\text{m}$  is held horizontally in water moving at  $1.25\text{ m/s}$  parallel to its length. If the flow in the boundary layer is laminar at the leading edge of the plate : [6]
- (i) Find the distance from the leading edge where the boundary layer flow changes from laminar to turbulent,
  - (ii) Find the thickness of the boundary layer at this section
  - (iii) Find the frictional drag on this plate consisting both its sides. Assume negligible thickness of the plate. Take the dynamic viscosity of water as  $0.01\text{ P}$  and assume that the laminar boundary layer exists up to  $\text{Re} = 5 \times 10^5$ .

Or

10. (a) Define displacement thickness and derive an expression for the same. [5]
- (b) Explain different methods for controlling the boundary layer. [5]
- (c) An oil of mass density  $950 \text{ kg/m}^3$  and dynamic viscosity  $1.5$  poise is pumped through a  $100 \text{ mm}$  diameter and  $600 \text{ m}$  long pipe at a rate of  $0.01 \text{ m}^3/\text{s}$ .

Find :

- (i) Reynolds' number,
- (ii) Calculate the pressure required at the pump, if outlet, which is free to atmosphere is  $25\text{m}$  above pump level,
- (iii) What would be the power input if the overall efficiency of pump is to be  $75\%$  ? [5]
11. (a) A horizontal pipe of  $0.075 \text{ m}$  diameter delivers a discharge of  $0.01 \text{ m}^3/\text{sec}$ . This pipe has sudden expansion of  $0.10 \text{ m}$  diameter at a section. If the pressure at just upstream of sudden expansion is  $25 \text{ kN/m}^2$ , determine pressure at just downstream. Take specific weight of water as  $9.79 \text{ kN/m}^3$ . [5]
- (b) Define turbulent flow, Instantaneous velocity and temporal mean velocity. Write all the characteristics of turbulent flow. [5]
- (c) Write a short note on Prandtl's mixing length theory. [5]

*Or*

12. (a) A 60 cm diameter pipe carries water. The velocity at 4 cm from the pipe wall is 3 m/s and the velocity gradient at the same point is  $11.25 \text{ s}^{-1}$ .

Determine :

- (i) the mean velocity of the flow,
  - (ii) friction factor,
  - (iii) average shear stress at the wall,
  - (iv) average height of roughness protrusions.
- (b) Enlist all the minor losses and write their expressions. [4]
- (c) Derive the expression for major loss of head in pipe. [5]