Total No. of Questions—12]

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Seat No.

[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 σ . [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] |
| (<i>b</i>) | Discuss conditions of stability of a submerged body in short. [2] |
| | Or |
| 4. (a) | Distinguish between simple manometer and differential manometer. |
| | |
| (<i>b</i>) | Define gauge pressure, vacuum pressure and absolute pressure. |
| | |
| | |
| 5. (a) | Distinguish between irrotational and rotational flow. [2] |
| (<i>b</i>) | Define path line and streak line, stream tube and give the |
| | example of each. [3] |
| 6. (a) | What is velocity potential and stream function? [2] |
| (<i>b</i>) | Define: |
| | (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] |
| (<i>b</i>) | Define coefficient of contraction, coefficient of discharge and |
| | coefficient of velocity. [3] |
| [5352]-506 | $_{2}$ |
| | |

| 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 3m × 1.5m is held horizontally in water moving at 1.25 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 P and assume that the laminar boundary layer exists up to Re = 5×10^5 .

[5352]-506 3 P.T.O.

- **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 kg/m³ and dynamic viscosity 1.5 poise is pumped through a 100 mm diameter and 600 m long pipe at a rate of 0.01 m³/s.

Find:

- (i) Reynolds' number,
- (ii) Calculate the pressure required at the pump, if outlet, which is free to atmosphere is 25m 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 m diameter delivers a discharge of 0.01 m³/sec. This pipe has sudden expansion of 0.10 m diameter at a section. If the pressure at just upstream of sudden expansion is 25 kN/m², determine pressure at just downstream. Take specific weight of water as 9.79 kN/m³. [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] [5352]-506

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 $11.25 \, \mathrm{s}^{-1}$.

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]

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