

Total No. of Questions—12]

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S.E. (Mechanical/S/W) (First Semester) EXAMINATION, 2010

FLUID MECHANICS

(2008 COURSE)

Time : Three Hours

Maximum Marks : 100

N.B. :— (i) Answer any *three* questions from each Section.

(ii) Answers to the two Sections should be written in separate answer-books.

(iii) Neat diagrams must be drawn whenever necessary.

(iv) Figures to the right indicate full marks.

(v) Your answers will be valued as a whole.

(vi) Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.

(vii) Assume suitable data, if necessary.

SECTION I

(Unit I)

1. (a) State and explain Newton's law of viscosity.

[4]

P.T.O.

(b) A 0.12 m disc rotates on a table separated by an oil film of 0.018 m thickness. Find the viscosity of oil if the torque required to rotate the disc at 60 r.p.m. is 4×10^{-4} Nm. Assume the velocity gradient in the oil film to be linear. [8]

(c) Differentiate between the Eulerian and Lagrangian methods of representing fluid flow. [6]

Or

2. (a) What is capillarity ? Derive expression for height of capillary rise. [6]

(b) Derive the continuity equation in Cartesian coordinates. [6]

(c) Define stream function and velocity potential. Show that the streamlines and equipotential lines form a net of mutually perpendicular lines. [6]

(Unit II)

3. (a) Derive expressions for total pressure and centre of pressure for a vertically immersed surface. [6]

(b) Explain briefly different types of equilibrium of floating bodies. [4]

(c) A solid cube of sides 1 m each is made of a material of relative density 0.5. The cube floats in a liquid of relative density 0.95 with two of its faces horizontal. Determine its stability. [6]

Or

4. (a) Describe the experimental method of determination of the metacentric height of a floating object. [6]
- (b) A 3.6 m by 1.5 m wide rectangular gate is vertical and is hinged at point 0.15 m below the centre of gravity of the gate. The total depth of water is 10 m. What horizontal force must be applied at the bottom of the gate to keep the gate closed ? [10]

(Unit III)

5. (a) State and prove Bernoulli's equation. What are limitations of the Bernoulli's equation ? [6]
- (b) Describe an orificemeter and find an expression for measuring discharge of fluid through a pipe with this device. [6]
- (c) What is a Pitot tube ? How is it used ? [4]

Or

6. (a) Describe an Venturimeter and find an expression for measuring discharge of fluid through a pipe with this device. [8]
- (b) What is a notch ? How are the notches classified ? Find an expression for measuring discharge of fluid across a triangular notch. [8]

SECTION II

(Unit IV)

7. (a) Derive Hagen-Poiseuille equation and state the assumptions made. [6]
- (b) Oil of viscosity 0.05 Ns/m^2 is flowing between two stationary parallel plates 1 m wide and maintained 10 mm apart. The velocity midway between the plates is 3 m/s. Find : [10]
- (i) Pressure gradient along flow
 - (ii) Average velocity
 - (iii) Discharge of oil

Or

8. (a) What is dimensional homogeneity ? Explain how dimensional analysis helps in analysis of fluid flow problem. [8]
- (b) Explain in brief the Buckingham π -theorem as method of dimensional analysis. [8]

(Unit V)

9. (a) Derive Darcy-Weisbach formula for calculating loss of head due to friction in pipe. [8]

- (b) What is Syphon ? Where is it used ? [4]
- (c) Derive an expression for the power transmission through the pipes. [4]

Or

10. (a) What do you mean by Hydraulic Gradient line and Energy Gradient line ? [6]
- (b) Define the terms major energy losses and minor energy losses in pipe. [6]
- (c) What is an equivalent pipe ? [4]

(Unit VI)

11. (a) Why is it necessary to control the growth of boundary layer on most of the bodies ? What are the methods for such control ? [6]
- (b) How will you determine whether a boundary layer flow is attached flow, detached flow or on the verge of separation ? [8]
- (c) What is CFD methodology ? [4]

Or

12. (a) Define drag force and lift force of an object immersed in a fluid. Distinguish between the friction drag and the pressure drag. [8]

- (b) Derive an expression for the lift produced on a rotating cylinder placed in a uniform flow field such that the axis of the cylinder is perpendicular to the direction of flow. [6]
- (c) What is Magnus effect ? [4]