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S.E. (Mech. Engg.) (I Sem.) EXAMINATION, 2009

FLUID MECHANICS

(2003 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 wherever 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]

(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 30 rpm is 4×10^{-4} Nm. Assume the velocity gradient in the oil film to be linear. [8]

(C) Explain the following terms : [6]

(*i*) Surface tension

(*ii*) Compressibility

(*iii*) Mach Number.

P.T.O.

Or

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

(B) What do you mean by convective and local acceleration in the fluid flow ? [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 inclined immersed surface. [6]

(B) Explain briefly the stable, unstable and neutral equilibrium of floating bodies. [4]

(C) A solid cube of sides 1 m each is made of a material of relative density 0.8. The cube floats in a liquid of relative density 1.2 with two of its faces horizontal. Determine its stability. [6]

Or

4. (A) Explain the terms—Metacentre and Metacentric height. [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 20 m. What horizontal force must be applied at the bottom of the gate to keep the gate closed ? [10]

Unit III

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

(B) Describe an orificemeter and find an expression for measuring discharge of fluid through a pipe with this device. [6]

(C) What is Pitot tube ? How is it used ? [4]

Or

6. (A) Describe a Venturi meter and find an expression for measuring discharge of fluid through a pipe with this device. [8]

(B) What is a notch ? How the notches are classified ? Find an expression for measuring discharge of fluid across a Trapezoidal Notch. [8]

SECTION II

Unit IV

7. (A) Establish the relationship between shear stress and pressure gradient in laminar flow. [6]

(B) Oil of viscosity 0.05 Ns/m^2 is flowing between two stationary parallel plates 2 m wide and maintained 15 mm apart. The velocity midway between the plates is 3 m/s. Find :

(*i*) Pressure gradient along flow

(*ii*) Average velocity

(*iii*) Discharge of oil. [10]

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 Moody diagram ? [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 Total Energy 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 Lift and Drag for immersed bodies ? [4]

Or

12. (A) Explain Prandtl's mixing length theory. [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 a streamline body and bluff body ? [4]