Total No. of Questions—**12**] [Total No. of Printed Pages—**4+2**

Seat No.	

[4457]-13

S.E. (Mech./Automobile) (First Semester) EXAMINATION, 2013

FLUID MECHANICS

(2008 PATTERN)

Time : Three Hours **Maximum Marks : 100**

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

(*ii*) Answer *three* questions from Section I and *three* questions from Section II.

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

(*iv*) Neat diagrams must be drawn wherever necessary.

(*v*) Figures to the right indicate full marks.

(*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

1. (*a*) Explain Newton's law of viscosity and Slokes' law. [8]

P.T.O.

(*b*) Calculate the capillary rise in a glass tube of 2 mm diameter when immersed in : [8]

(*i*) water

(*ii*) Mercury; both at 20°C

σ_{water} = 0.0075 kgf/m

σ_{Hg} = 0.052 kgf/m at 20°C

Or

2. (*a*) Explain the local and convective acceleration. [8]

(*b*) Prove that equi-potential and streamline are perpendicular to each other. Explain the significance of this perpendicularity. [8]

3. (*a*) Derive the expression for total pressure and centre of pressure for a vertically immersed surface. [8]

(*b*) A cone of base radius R and height H floats in water with its vertex downwards. Show that for stable equilibrium of the cone :

(*i*) $\sec^2\theta > \frac{H}{h}$

(*ii*) $H < \left[\frac{R^2 S^{1/3}}{1 - S^{1/2}}\right]^{1/12}$

where h is depth of immersion, θ is semi-vertex angle of cone and S is specific gravity of cone material. [10]

Or

4. (*a*) Derive an expression for metacentric height of floating body. [10]

(*b*) A helium balloon is at the same pressure and temperature as the surrounding air (101.3 kPa & 20°C) and has a diameter of 3 meters. How much load this balloon can lift if we neglect the weight of the plastic skin of the balloon ? [8]

5. (*a*) State and prove Bernoulli's theorem. [8]

(*b*) Derive an expression for discharge through a venturimeter. [8]

Or

6. (*a*) Derive an expression for measuring discharge of fluid across a right angled V-notch. [8]

(*b*) Explain the working of a pitot tube with a neat sketch. [8]

SECTION II

7. (*a*) The pressure rise ΔP generated by a pump is function of impeller diameter D, the rotational speed N, the fluid density ρ, viscosity μ, and the rate of discharge Q, show that : [10]

$$\Delta P = \rho N^2 D^2 \phi \left(\frac{Q}{ND^3}, \frac{\rho ND^2}{\mu} \right)$$

(*b*) In a flow viscous fluid through circular pipes prove that the velocity distribution is a parabolic curve. [8]

Or

8. (*a*) What are repeating variables ? What points are considered while selecting repeating variables. [8]

(*b*) For laminar flow of an oil having dynamic viscosity μ = 1.766 poise in a 0.3 m diameter pipe, the velocity distribution is parabolic with a maximum point velocity of 3 m/s at the centre of pipe. Find the shearing stress at the pipe wall and within the fluid 50 mm from the pipe wall. [10]

9. (*a*) Explain hydraulic gradient line and total energy line. [8]

(*b*) Explain equivalent pipe. [8]

Or

10. (*a*) Derive Dupit's equation and explain applications of syphon. [10]

(*b*) Derive an expression for power transmission through pipes. [6]

11. (*a*) Define the following : [8]

(*i*) Boundary layer thickness

(*ii*) Displacement thickness

(*iii*) Momentum thickness

(*iv*) Energy thickness.

(*b*) Air with a speed of 60 kmph is blowing over a wooden plain sign board aligned with the direction of flow. Find the boundary layer, displacement and momentum thickness for a point 30 cm from the leading edge. The density and kinematic viscosity of air can be taken as 1 kg/m^3 and 15 mm^2/s respectively. [8]

Or

12. (*a*) Explain drag and lift. [8]

(*b*) A square flat plate of side 25 cm is towed by a water boat at a speed of 10 kmph. The plate is attached to the boat by a long and thin wire that does not disturb the flow. Find the force required to tow the plate μ for water = 1.0×10^{-3} Pa-s. [8]