Total No. of Questions—**12**] [Total No. of Printed Pages—**7**

Seat No.	

[4262]-106

S.E. (Civil) (II Sem.) EXAMINATION, 2012

FLUID MECHANICS I

(2008 PATTERN)

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

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

(*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.

SECTION I

1. (*a*) The dynamic viscosity of an oil used for lubrication between a shaft and sleeve is 6 poise. The shaft is of diameter 0.4 m and rotates at 190 rpm. Calculate the power lost in the bearing for a sleeve length of 90 mm. The thickness of the oil film is 1.5 mm. [8]

(*b*) Write short notes on the following : [10]

(*i*) Mass density

(*ii*) Specific gravity

(*iii*) Reynolds number

(*iv*) Froude number

(*v*) Compressibility.

Or

2. (*a*) Using Buckingham's π-theorem, show that the velocity through a circular orifice is given by : [8]

$$v = \sqrt{2gH}\ f\left[D/H, \frac{\mu}{\rho VH}\right]$$

where H is the head causing flow, D is the diameter of the orifice, μ is coefficient of viscosity, ρ is mass density and '*g*' is the acceleration due to gravity.

(*b*) Write short notes on the following : [10]

(*i*) Viscosity

(*ii*) Surface tension

(*iii*) Advantages of model analysis

(*iv*) Capillarity

(*v*) Weight density.

3. (*a*) Derive an expression for total pressure and depth of centre of pressure from free surface of liquid, at inclined plane surface submerged in the liquid. [8]

(*b*) A rectangular pontoon is 5 m long, 3 m wide and 1.20 m high. The depth of immersion of the pontoon is 0.80 m in sea water. If the centre of gravity is 0.6 m above the bottom of the pontoon, determine the metacentric height. The density for sea water = 1025 kg/m^3. [8]

Or

4. (*a*) Explain the procedure of computing the resultant hydrostatic force on a curved surface. [8]

(*b*) What is meant by stability of floating body ? Explain the stability of floating body with respect to metacentric height. Give neat sketches. [8]

5. (*a*) Explain types of fluid flow. [8]

(*b*) If for a two-dimensional flow, the velocity potential $\phi = x\,[2y - 1]$, determine the velocity at the point P (4, 5). Determine also the value of stream function ψ at the point P. [8]

Or

6. (*a*) Explain any *one* method of drawing flownet. Show that the streamlines and equipotential lines intersect each other orthogonally. What are the uses of flownet ? [8]

(*b*) Derive the continuity equation for one-dimensional flow, clearly stating the assumptions made in it. [8]

SECTION II

7. (*a*) A horizontal venturimeter with inlet and throat diameters 300 mm and 100 mm respectively is used to measure the rate of flow of water. The pressure intensity at inlet is 125 kN/m^2 while vacuum pressure head at the throat is 30 cm of mercury. Assuming that 3% of head is lost in between inlet and throat, find the value of coefficient of discharge for the venturimeter and rate of flow. [8]

(*b*) What is an orifice ? How are the orifices classified ? [6]

(*c*) Starting from Euler's equation along a streamline, integrate it to the Bernoulli's equation. Also list the limitations of Bernoulli's equation. [4]

Or

8. (*a*) In an experiment on determination of hydraulic coefficients of sharp edged orifice, 2.5 cm of diameter, it was found that the jet issuing horizontally under a head of 1 m travelled a horizontal distance of 1.4 m from vena contracta in a course of vertical drop of 0.53 m from the same point. Further if a flat plate held normal to the jet at vena contracta, the force of 5.6 N would be exerted on the plate. Determine C_c, C_v and C_d for the orifice. [8]

(*b*) What is 'Vena contracta' ? Why is it taken as an ideal position for applying Bernoulli's Theorem ? [4]

(*c*) Write a short note on cavitation. [6]

9. (*a*) For the velocity profile

$$\frac{u}{U} = \left(\frac{y}{\delta}\right)^n,$$

calculate the shape factor $H = \frac{\delta^*}{\theta}$ as well as energy thickness δ^{**}. [10]

(*b*) Establish relation between Daecy-Weisbach friction factor and Reynolds Number for laminar flows in pipe. [6]

Or

10. (*a*) Oil of relative density 0.92 and dynamic viscosity 1.05 poise flows between two fixed parallel plates 12 mm apart. If the mean velocity is 1.4 m/s, calculate the maximum velocity of flow, velocity and shear stress at a distance of 2 mm from one of the plates and loss of head over a distance of 25 m. [10]

(*b*) What is boundary layer ? Explain with neat sketch the development of boundary layer over a smooth flat plate. [6]

11. (*a*) A pipeline of 0.3 diameter carries liquid at the rate of 0.540 m^3/s. If the sp. gravity of the liquid is 0.80 and its kinematic viscosity is 0.023×10^{-4} m^2/s, determine the maximum permissible height of the protrusions upto which the pipe acts as smooth pipe and the height of the protrusions beyond which the pipe would become rough. [10]

(*b*) State what are the minor losses in pipe flow and derive the equation for loss of head due to sudden contraction. [6]

Or

12. (*a*) Three pipes 300 m, 150 m, 200 m long having diameters 300 mm, 200 mm and 250 mm respectively are connected in a series in the same order. Pipe having 300 mm diameter is connected to the reservoir. Water level in the reservoir is 15 m above the pipe axis which is horizontal. The respective friction factor for the three pipes are 0.018, 0.02 and 0.019. Determine the flow rate, magnitude of loss in each pipe section, and the diameter when the three pipes are replaced by a single pipe (f = 0.016) to give the same discharge. Neglect the minor losses. [10]

(*b*) Explain the use of Moody's Diagram. [6]