(1)

MAY 2016

Total No. of Questions—**12**] [Total No. of Printed Pages—**4+1**

Seat No.	

[4957]-106

S.E. (Civil) (Second Semester) EXAMINATION, 2016

FLUID MECHANICS-I

(2008 Pattern)

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

N.B. :— (*i*) Answers to the two Sections should be written in separate answer-books.

(*ii*) Answer any *three* questions from each section.

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

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

(*v*) Use of calculator is allowed.

(*vi*) Assume suitable data, if necessary.

Section I

1. (*a*) Show by dimensional analysis, that the power P developed by a hydraulic turbine is given by : [10]

$$P = \rho N^3 D^5 \, f(N^2D^2/gH)$$

where ρ is the mass density of liquid, N is the rotational speed, D is the diameter of runner, H is the working head and g is the gravitational acceleration.

(*b*) Explain viscosity and explain the effect of temperature on viscosity for liquids and gases. [4]

(*c*) Calculate the gauge pressure and the absolute pressure within :

(*i*) A droplet of water 0.2 cm in diameter

P.T.O.

(*ii*) A jet of water 0.2 cm in diameter.

Assume the surface tension of water as 0.07 N/m and atmospheric pressure as 101.3 N/m^2. [4]

Or

2. (*a*) Write short notes on the following : [10]

(*i*) Mass density

(*ii*) Specific gravity

(*iii*) Reynolds number

(*iv*) Froude number

(*v*) Compressibility.

(*b*) A vertical cylinder of diameter 30 mm rotates concentrically inside another cylinder of diameter 30.2 mm. Both the cylinders are 100 mm long. The space between the cylinders is filled with liquid of viscosity 0.015 Ns/m^2. Calculate torque required to rotate the cylinder at 4000 r.p.m. Also calculate power lost. [8]

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

(*b*) A block of wood has a horizontal cross-section 500 mm × 500 mm and height *h*. It floats vertically in water. Sp. Gravity of wood is 0.55. Find maximum height of the block so that it can remain in stable equilibrium. [8]

Or

4. (*a*) A solid cube of sides 0.5 m each is made of material of Relative Density 0.6. The cube floats in a liquid of relative density 0.90 with two of its faces horizontal. Examine its stability. [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*) Show that the streamlines and equipotential lines intersect each other orthogonally. What are the uses and limitations of flow net ? [8]

(*b*) The velocity components in two-dimensional rotational flow of an incompressible fluid are : [8]

$u = y^3/3 - x^2y + 2x$

$v = xy^2 - 2y - x^3/3$

Obtain the expression for velocity potential and stream function.

Or

6. (*a*) Derive the continuity equation for one-dimensional flow, stating the assumption made in deriving the equation. [8]

(*b*) Define and explain briefly the following : [8]

(*i*) Circulation and vorticity

(*ii*) Streamline and path line

(*iii*) Velocity potential and stream function

(*iv*) Steady, unsteady flow.

Section II

7. (*a*) What do you mean by an orifice meter ? Derive an expression for flow rate through orifice meter. [10]

(*b*) State the Bernoulli's equation. List out the assumptions of Bernoulli's equation. [4]

(*c*) Explain the terms briefly : [4]

(*i*) Potential head,

(*ii*) Velocity head.

Or

8. (*a*) A 20 cm × 10 cm venturimeter is installed in a vertical pipe carrying water. The flow is in upward direction. The difference of levels between the throat and inlet is 60 cm. The water-mercury differential manometer gives deflection of 15 cm of mercury. Find the discharge of water. Take coefficient of meter as 0.97. [10]

(*b*) Derive Euler's equation of motion for one-dimensional flow. Also derive Bernoulli's equation from it. [8]

9. (*a*) Derive the expression for the velocity distribution and the shear stress for viscous flow between two large stationary plates. [8]

(*b*) Write short notes on : [8]

(*i*) Falling sphere viscometer

(*ii*) Boundary layer separation and its control.

Or

10. (*a*) What is boundary layer ? Explain with neat sketch the development of boundary layer over a smooth flat plate. [8]

(*b*) Two horizontal plates kept at 80 mm apart have laminar flow of oil of viscosity 1.2 N.s/m^2 between them. The maximum velocity of flow is 1.8 m/s. [8]

Find :

(*i*) Discharge per meter width

(*ii*) Shear stress at the plate

(*iii*) Velocity gradient at the plate

(*iv*) Pressure difference between two points 12 m apart.

11. (*a*) Show that the value of Darcy's friction factor for fully developed laminar flow through a circular pipe is given by $f = 64/R_e$. [8]

(*b*) Write short notes on : [8]

(*i*) Prandtl's mixing length theory

(*ii*) Hydrodynamical smooth and rough pipes.

Or

12. (*a*) What are the equivalent pipes ? Explain in detail the major and minor losses in pipes. [8]

(*b*) Derive Karman-Prandtl equation for velocity distribution in turbulent flow near hydrodynamically smooth boundary. [8]