Total No. of Questions—**8**] [Total No. of Printed Pages—**4**

Seat No.	

[5252]-516

S.E. (Mechanical/Auto.) (Second Semester) EXAMINATION, 2017

FLUID MECHANICS

(2015 Course)

Time : Two Hours **Maximum Marks : 50**

N.B. :— (*i*) Neat diagram must be drawn wherever necessary.

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

(*iii*) Use of logarithmic tables, slide rule, Mollier charts, Electronic pocket calculator, Steam tables and p-h chart is allowed.

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

1. (*a*) Explain :

(*i*) Surface tension

(*ii*) Compressibility

(*iii*) Vapour pressure. [6]

(*b*) The velocity vector in a fluid flow is given $V = (2x^3)\hat{i} - (5x^2 y)\hat{j} + (2tz)\hat{k}$. Obtain expression for velocity vector and acceleration vector at a point (2, 1, 3) at time $t = 1$ s Also calculate the value of velocity and acceleration at the given point. [6]

Or

2. (*a*) Derive an expression for continuity equation. [6]

P.T.O.

(*b*) A square plate 6m × 6m is placed in a liquid of specific gravity 0.8 at an angle of 30° with free liquid surface. A square hole of 1.5m × 1.5m is cut exactly in centre of the plate. Its greatest and the least depths below the free liquid surface are 5m and 2m respectively. Determine the total pressure on one face of the plate and position of centre of pressure. [6]

3. (*a*) Derive Euler's equation for flow along stream line and deduce the Bernoulli's equation for the same. [6]

(*b*) A 0.2 m diameter pipe carries liquid in laminar region. A Pitot tube placed in the flow at a radial distance of 15 mm from the axis of the pipe indicates velocity of 0.5 m/s.

Calculate :

(*i*) The maximum velocity

(*ii*) The mean velocity

(*iii*) The discharge in the pipe. [6]

Or

4. (*a*) Derive an expression of velocity and shear stress distribution for laminar flow between fixed parallel plates. [6]

(*b*) The inlet and throat diameters of horizontal venturimeter are 30 cm and 10 cm respectively. The liquid flowing through the meter is water. The pressure intensity at inlet is 13.734 kN/m^2 while vacuum pressure head at the throat is 37 cm of mercury. Find the rate of flow. Assume that 4% of the differential heads is lost between the inlet and outlet. Find also the value of C_d for venturimeter. [6]

5. (*a*) A 2500 m long pipeline is used for transmission of power. 120 kW power is to be transmitted through the pipe in which water having a pressure of 4000 kN/m² at inlet is flowing. If the pressure drop over the length of pipe 800 kN/m² and f = 0.042. Find : [7]

(*i*) Diameter of the pipe.

(*ii*) Efficiency of transmission.

(*b*) Explain :

(*i*) Mach Number

(*ii*) Froude Number

(*iii*) Euler Number. [6]

Or

6. (*a*) Discharge Q of a centrifugal pump can be assumed to be dependent on density of liquid ρ, viscosity of liquid μ, pressure, impeller diameter D, and speed N in RPM. Using Buckingham π-theorem, show that : [7]

$$Q = ND^3\phi\left[\frac{gH}{N^2D^2}, \frac{v}{ND^2}\right]$$

(*b*) Derive an expression for Darcy-Weisbach equation. [6]

7. (*a*) Write a short note on "Boundary layer formation over flat plate. [7]

(*b*) For the following velocity profiles in the boundary layer. Show that whether the boundary is attached, detached or on the verge of separation : [6]

(*i*) $u/U = 2\eta - \eta^2 + 3\eta^3$

(*ii*) $u/U = -2\eta + \eta^3 + 2\eta^4$,

(*iii*) $u/U = 2\eta^2 + 5\eta^3 + 2\eta^4$ where $\eta = y/\delta$.

Or

8. (*a*) Derive an expression for displacement, momentum and energy thicknesses. [9]

(*b*) What is drag and Lift ? Explain different types of drag on an immersed body. [4]