Total No. of Questions—**8**] [Total No. of Printed Pages—**4+1**

Seat No.	

[4657]-514

S.E. (Mechanical/Automobile) (First Semester)

EXAMINATION, 2014

FLUID MECHANICS

(2012 PATTERN)

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

N.B. **:—** (*i*) Answer *four* questions out of **8**.

(*ii*) Attempt Q. No. **1** *or* Q. No. **2**, Q. No. **3** *or* Q. No. **4**, Q. No. **5** *or* Q. No. **6**, Q. No. **7** *or* Q. No. **8**.

(*iii*) All the four questions should be solved in one answer-book and attach extra supplements if required.

(*iv*) Draw diagrams wherever necessary.

(*v*) Use of scientific calculator is allowed.

(*vi*) Assume suitable data wherever necessary.

1. (*a*) State and prove Pascal's law. [6]

P.T.O.

(*b*) Stream function is defined as :

$$\psi = x^3 - 3xy^2.$$

Determine whether the flow is rotational or not. Also deduce the expression of velocity potential. [6]

Or

2. (*a*) A Newtonian liquid of kinematic viscosity 3 stokes flows over a flat horizontal plate of surface area 0.8 m^2. Velocity at y meters from plate is given as $u = 2y - 2y^3$ in m/s. If shear force on plate is 0.352 N, find the density of liquid. [6]

(*b*) Prove that streamlines and equipotential lines are orthogonal to each other. [6]

3. (*a*) Derive an expression for Bernoulli's equation along stream-line. [6]

(*b*) A liquid of viscosity of 34.5 poise is flowing between two horizontal plates 50 mm apart with a maximum velocity of 2.5 m/s. Calculate :

(*i*) The discharge per meter width

(*ii*) Shear stress at the plates

(*iii*) The difference in pressure between two plates. [6]

Or

4. (*a*) Two orifices are placed in a vertical wall in such a way that lower one is 30 cm above the ground while upper one is 6 m above the first one. Horizontal distance travelled by the jet from top orifice is 3 times than the one travelled by lower jet. Both distances are measured at ground level. Assume C_v = 0.96 for both orifices, find the head of water behind the wall. [6]

(*b*) Derive expression for velocity distribution for flow in fixed parallel plates. [6]

5. (*a*) Derive an expression for Dupuit's equation. [6]

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

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

Or

6. (*a*) Explain :

(*i*) Reynolds number

(*ii*) Weber number

(*iii*) Euler number. [6]

(*b*) Power is to be transmitted through 300 mm dia., 500 m long pipe fitted with a nozzle at the end. The inlet is from a reservoir where water level is 90 m above the nozzle. Calculate the maximum power which can be transmitted and diameter of nozzle required. Take $f = 0.03$. [7]

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

(*b*) A truck having a projected area of 6.5 m^2, travelling 70 km/hr, has a total resistance of 2000 N. Of this 40% is due to rolling friction and 20% due to skin friction. The rest is due to pressure drag. Find the coefficient of pressure drag. Take $\rho = 1.22$ kg/m^3 for air. [4]

Or

8. (*a*) A metallic ball of diameter 0.04 m drops in a fluid of specific gravity 0.7 and viscosity is 20 poise. Density of ball = 12000 kg/m^3. Determine : [6]

(*i*) Drag force exerted on ball

(*ii*) Pressure drag and friction drag

(*iii*) Terminal velocity of the ball.

(*b*) Write a short note on "Separation of Boundary Layer its Control". [7]