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10ME/AU36B

# Third Semester B.E. Degree Examination, June/July 2016
## Fluid Mechanics

Time: 3 hrs. Max. Marks:100

**Note:** ***Answer FIVE full questions, selecting at least TWO questions from each part.***



### PART – A

1 a. Define the following terms: i) Specific weight ii) Kinematic viscosity iii) Specific gravity iv) Specific volume. **(04 Marks)**

b. Calculate the dynamic viscosity of an oil, which is used for lubrication between a square plate of size $0.8m \times 0.8m$ and an inclined plane with angle of inclination 30°. The weight of the square plate is 300 N and it slides down the inclined plane with a uniform velocity of 0.3 m/s. The thickness of oil film is 1.5 mm. **(06 Marks)**

c. Define the capillarity. Obtain an expression for capillary ripe of a liquid. **(05 Marks)**

d. Define surface tension. Prove that the relationship between surface tension and pressure inside a droplet of liquid is given by, $P = \frac{4\sigma}{d}$. **(05 Marks)**

2 a. State and prove the Pascal's law. **(10 Marks)**

b. Derive an expression for total pressure and centre of pressure for a vertically immersed surface. **(10 Marks)**

3 a. A wooden cylinder of Sp.gr. = 0.6 and circular in cross-section is required to float in oil (Sp.gr. = 0.9). Find the L/D ratio for the cylinder to float with its longitudinal axis vertical in oil, where L is the height of cylinder and 'D' is its diameter. **(10 Marks)**

b. Define the equation of continuity. Obtain an expression for continuity equation for a three-dimensional steady incompressible flow. **(10 Marks)**

4 a. Derive Bernoulli's equation and state the assumptions made. **(10 Marks)**

b. A non-uniform part of a pipe line 5 m long is laid at a slope of 2 in 5. Two pressure gauges each fitted at upper and lower ends read 20 $N/cm^2$ and 12.5 $N/cm^2$. If the diameters at the upper and lower ends are 15 cm and 10 cm respectively. Determine the quantity of water flowing per second. **(10 Marks)**

### PART – B

5 a. Define venturimeter. Derive the expression for rate of flow through venturimeter. **(10 Marks)**

b. Using Buckingham's π-theorem, show that the velocity through a circular orifice is given by, $V = \sqrt{2gH}\phi\left[\frac{D}{H}, \frac{\mu}{\rho VH}\right]$, where H is the head causing flow. D is the diameter of the orifice, 'μ' is co-efficient of viscosity, 'ρ' is the mass density and 'g' is the acceleration due to gravity. **(10 Marks)**

6 a. Derive Darcy's formula to calculate the frictional head loss in a pipe. **(08 Marks)**

b. Define the terms : i) Hydraulic gradient line ii) Total energy line. **(04 Marks)**

c. Determine the rate of flow of water through a pipe of diameter 20 cm and length 50 m when one end of the pipe is connected to a tank and other end of the pipe is open to the atmosphere. The pipe is horizontal and height of water in the tank is 4 m above the centre of pipe. Consider all minor losses and take f = 0.009. **(08 Marks)**

7 a. Derive an expression for Hagen-Poiseuille's formula. **(12 Marks)**

b. A fluid of visocosity 0.7 N-S/$m^2$ and Sp.gr. 1.3 is flowing through a circular pipe of diameter 100 mm. The maximum shear stress at the pipe wall is given as 196.2 N/$m^2$. Find : (i) the pressure gradient (ii) The average velocity and (iii) Reynold's number of the flow. **(08 Marks)**

8 a. Explain the terms: lift and drag. **(04 Marks)**

b. A flat plate 1.5m × 1.5m moves at 50 km/hour in stationary air of density 1.15 kg/$m^3$. If the co-efficients of drag and lift are 0.15 and 0.75 respectively. Determine

i) The lift force ii) The drag force iii) The resultant force and

iv) The power required to keep the plate in motion. **(06 Marks)**

c. Explain the following terms:

i) Mach number ii) Subsonic flow iii) Sonic flow iv) Super sonic flow. **(04 Marks)**

d. Find the velocity of bullet fired in standard air if the Mach angle is 30°. Take R = 287.14 J/kg K and K = 1.4 for air. Assume temperature as 15°C. **(06 Marks)**

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