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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Fourth Semester, B.E. - Automobile Engineering

Semester End Examination; June - 2017

Fluid Mechanics

Time: 3 hrs *Max. Marks: 100*

***Note**: i) Answer **FIVE** full questions, selecting **ONE** full question from each unit.*
ii) Missing data, if any shall be assume suitably. iii) Draw pencil sketches only.

UNIT - I

1 a. Define the term viscosity. Derive an equation for dynamic viscosity of fluid and kinematic viscosity of fluid. 10

b. A 30 mm diameter, 40 mm long cylinder of density 7800 kg/m^3 falls due to its own weight at uniform rate of 0.2 m/s inside a tube of larger diameter. If lubricating oil of constant thickness of viscosity 0.09 Pa.S is maintained between cylinder and tube. Determine the clearance between them. 10

2 a. Define and prove Pascal's law. 10

b. A U-tube is made of two capillaries of diameter 0.8 mm and 1.2 mm respectively which is immersed partially in water. If position of the tube is vertical, determine the difference in level of water in the tube. 10

UNIT - II

3 a. Derive an expression for total pressure and center of pressure exerted on a submerged vertical plane surface by a static liquid. 10

b. A rectangular gate 2 m long and 1.5 m wide lies in a vertical plane with its centre 2.5 m below water surface. Calculate magnitude and direction of total pressure on the gate. 10

4 a. Write a note on the stability conditions of floating bodies. 10

b. A cylindrical body is 2 m in diameter and 2.5 m long and weights 22 kN. Specific weight of seawater is 10.25 kN/m^3. Show that body does not float with its axis vertical. 10

UNIT - III

5 a. Differentiate between the following types of flows :

i) Steady and Unsteady flow ii) Uniform and Non-uniform flow 10

iii) Laminar and Turbulent flow.

b. The velocity potential function(ϕ) is given by,

$$\phi = \frac{-xy^3}{3} - x^2 + \frac{x^3y}{3} + y^2$$ 10

i) Calculate velocity components in x and y direction

ii) Check possibility of fluid flow.

6 a. Derive Euler's equations of motion along a stream line. Also derive Bernoulli's equation and list the assumptions made. 10

b. Gasolines with relative density 0.8 flows in unward direction through a vertical pipe. The pipe diameter changes from 200 mm to 100 mm. A gasoline mercury differential nanometer is used to measure the flow rate. The distance of the tapping is 1 m with gauge reading of 60 cm of mercury. Find the gauge reading in terms of gasoline head and rate of flow of gasoline. 10

UNIT - IV

7 a. For laminar flow between the stationary parallel plates obtain an expression for velocity distribution. 10

b. A lubricating oil of viscosity of 1 poise and specific gravity 0.9 is pumped through a 30 mm diameter pipe. If the pressure drops per meter length of pipe is 20 kN/m^2. Determine: 10

i) Mass flow rate in kg/min ii) Shear steers at pipe walls

iii) Power required per 50 m length of pipe to maintain flow.

8 a. Define the terms :

Subsonic flow, Sonic flow, Supersonic flow, Mach angle and Mach cone. 10

b. An aeroplane is flying at 950 km/h through still air having absolute pressure of 80 kN/m^2 and temperature of -7°c. Calculate stagnation pressure, stagnation temperature, and stagnation density on the stagnation point on the hole of the plate. 10

Take R = 287 J/kg.k and $\gamma = 1.4$ far air.

UNIT - V

9 a. What are the energy losses that occurred when fluid flows through pipes? Derive an expression for loss of head due to friction in pipes. 10

b. A pipe line of 600 mm diameter is 1.5 km long. To increase the discharge, another pipeline of same diameter is introduced parallel to the first in the second half of length. If f = 0.04 and head at inlet is 300 mm, calculate the increase in discharge. Neglect minor energy losses and f is Darcy friction factor. 10

10 a. Explain the significance of the following non-dimensional numbers :

i) Reynolds's number ii) Froude's number 10

iii) Weber number iv) Euler's number.

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, 10

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

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