U.S.N | | | | | | | | | | |

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

(An Autonomous Institution affiliated to VTU, Belagavi)

Third Semester, B.E. - Mechanical Engineering

Semester End Examination; Dec. - 2019

Fluid Mechanics

Time: 3 hrs *Max. Marks: 100*

***Note**: Answer **FIVE** full questions, selecting **ONE** full question from each unit.*

UNIT - I

1 a. Define the following properties of fluids giving their units; 6

i) Specific weight ii) Specific volume iii) Specific gravity

b. Prove that the pressure inside a droplet of liquid in excess of outside pressure is given by $p = \frac{4\sigma}{d}$. 6

c. A Square plate size 1 m × 1 m weight 350 N slides drown on inclined plane with a uniform velocity of 1.5 m/s. The plane is inclined at an angle of 22.61° to the horizontal oil film of 1 mm is maintained between square plate and the plane. Calculate the dynamic viscosity of the oil. 8

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

b. An open tank contains water up to a depth of 2 m and above it an oil of sp.gr 0.9 for depth of 1 m. Find the pressure intensity, i) at the interface of the two liquids and ii) at the bottom of the tank. 6

c. Calculate the capillary rise in a glass tube of 2.5 mm diameter when immersed vertically in water. Take surface tension σ = 0.0725 N/m for water. 4

UNIT - II

3 a. Derive an expression for total pressure and centre of pressure for an inclined plane surface submerged in liquid. 10

b. A rectangular plane surface 2 m wide and 3 m deep lies in water such a way that its plane makes an angle with free surface of the water. Determine total pressure and posit ion of centre of pressure when the upper edge is 1.5 m below the free water surface. 10

4 a. Define meta centre. Derive an expression for meta centric height of floating body. 10

b. A solid cylinder of diameter 4.0 m has a height of 3 m. Find the meta centric height of the cylinder when it is floating in water with its axis vertical. The specific gravity of the cylinder is 0.6. Also explain the stability of this cylinder. 10

UNIT - III

5 a. Distinguish between; 6

i) Steady flow and Unsteady flow

ii) Uniform flow and Non uniform flow

iii) Compressible flow and Incompressible flow

Contd…2

b. The following case represent the two velocity components determine the third component of velocity such that they satisfy the continuity equation $v = 2y^2$ $w = 2xyz$. 4

c. If for a two-dimensioal potential flow, the velocity potential is given by $\phi = x(2y - 1)$, determine the velocity at the point $P(4, 5)$. Determine also the value of stream function ϕ at the point P. 10

6 a. What are the assumptions made in deriving the Euler's equation of motion? Derive the Euler's equation of motion and obtain the Bernoulli's equation. 10

b. What is a venturi meter? Derive an expression for the discharge through a venturi meter. 10

UNIT - IV

7 a. Define; i) Displacement thickness ii) Momentum thickness. 4

b. Derive an expression for Displacement thickness. 6

c. Find the displacement thickness, the momentum thickness and energy thickness for the velocity distribution in the boundary layer given by, 10

$\frac{u}{v} = \frac{y}{\delta}$ where u is the velocity at a distance y from the plate and

$u = v$ at $y = \delta$ (the boundary layer thickness)

8 a. Derive an expression for the loss of head due to friction in a pipe (Darcy-Weisbach equation). 10

b. Water is flow through a pipe of diameter 20 cm with a velocity of 3 m/s. Find the loss of head due to friction for a length of 5 m if the coefficient of friction is given by, 10

$f = 0.02 + \frac{0.09}{R_e^{0.3}}$ Where R_e is the Reynold's number.

The Kinematic viscosity of water is given by 0.01 stoke.

UNIT - V

9 a. Prove that the maximum velocity in a circular pipe for a viscous flow is equal to the two times the average velocity of flow. 10

b. An oil of viscocit 0.1 N s/m^2 and specific gravity 0.9 is flowing through a circular pipe of diameter 5 cm and length 300 m. The rate of flow through the pipe is 3.5 l/s. Find the pressure drop in a length of 300 m and also the shear stress at the pipe wall. 10

10 a. Using Rayleigh's method find an expression for drag force 'F'on a smooth sphere of diameter 'D'moving with a uniform velocity 'V'in a fluid of density 'ρ'and dynamic viscosity'μ'. 10

b. The pressure diffrence 'ΔP' in a pipe of diameter 'D' and length 'L' due to the viscous flow depends on the velocity 'V', viscosity 'μ' and density 'ρ'.using Buckingham's Π theorem prove that $\Delta P = \frac{\mu v}{D}\phi\left(\frac{L}{D}, \frac{\rho DV}{\mu}\right)$ 10

* * *