CBCS SCHEME

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21AE/AS33

# Third Semester B.E. Degree Examination, June/July 2023
## Fluid Mechanics

Time: 3 hrs. Max. Marks: 100

***Note: Answer any FIVE full questions, choosing ONE full question from each module.***



### Module-1

1 a. Define the following terms:
(i) Weight density (ii) Dynamic viscosity
(iii) Bulk modulus (iv) Capillary **(10 Marks)**

b. An oil of thickness 1.5 mm is used for lubrication between a square plate of size $0.9\text{m} \times 0.9\text{m}$ slides down an inclined plane having an inclination $20^\circ$ with the horizontal. The weight of square plate is 392.4 N and it slides down the plane with a uniform velocity of $0.2\ \text{ms}^{-1}$. Find the kinetic viscosity of oil specific gravity of the oil is 0.7. **(10 Marks)**

**OR**

2 a. Derive an expression for total pressure force and depth of pressure of a vertical surface submerged in water. **(10 Marks)**

b. A differential manometer is connected at the points A and B of two pipes as shown in Fig. Q2 (b). The pipe A contains a liquid of Sp.Gr = 1.5 while pipe B contains a liquid of Sp.Gr = 0.9. The pressure at A and B are 1 kgf/cm$^2$ and 1.80 kgf/cm$^2$ respectively. Find the difference in mercury level in the differential manometer. **(10 Marks)**

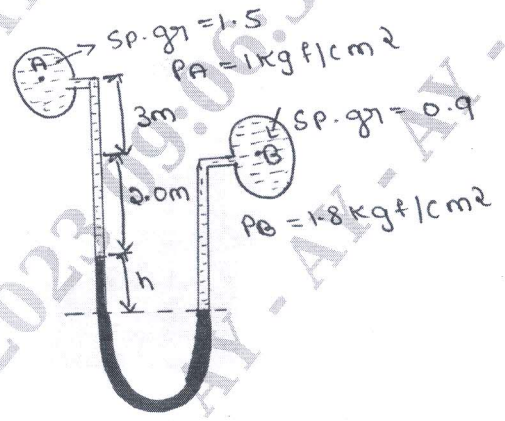


Fig. Q2 (b)

### Module-2

3 a. Derive the continuity equation in 3D Cartesian co-ordinates. **(10 Marks)**

b. If for a two-dimensional 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 $\psi$ at point P. **(10 Marks)**

**OR**

4 a. Derive the differential form of momentum equation. **(12 Marks)**

b. Prove that the product of the slope of velocity potential function and stream function. **(08 Marks)**

## Module-3

5 a. Starting from fundamentals derive bernoullis equation of motion. **(10 Marks)**

b. A pipe of diameter 400 mm carries water at a velocity 25 $ms^{-1}$. The pressure at the point A and B are given as 29.43 $N/cm^2$ and 22.56 $N/cm^2$ respectively. While the datum head at A and B are 28 m and 30 m. Find the loss of head between A and B. **(10 Marks)**

**OR**

6 a. List down the non-dimensional number used for model analysis and define them. **(08 Marks)**

b. Derive on the basis of dimensional analysis suitable parameters to present the thrust developed by a propeller. Assume that the thrust T depends on angular velocity $\omega$, Speed of propeller V, diameter D, dynamic velocity $\mu$, mass density $\rho$, elasticity of the fluid medium which can be denoted by the speed of sound in the medium C. **(12 Marks)**

## Module-4

7 a. Using the suitable sketch, derive Von Karman's integral equations. **(10 Marks)**

b. A flat plate $2m \times 2m$ moves at 40 km/hr in stationary air density 1.25 $kg/m^3$. If the coefficient of drag and lift are 0.2 and 0.8 respectively. Find

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

(iv) The power required to keep the plate in motion. **(10 Marks)**

**OR**

8 a. Determine the firction drag acting on one side of a smooth plate of length 0.5 m with width 0.15 m place longitudinally in an air stream of 1 $ms^{-1}$ at sea level and find the boundary layer thickness and the shear stress at trailing edge of plate. **(12 Marks)**

b. Define the term : (i) Mach number (ii) Mach angle (iii) Sonic flow

(iv) Subsonic flow **(08 Marks)**

## Module-5

9 a. Derive the velocity of sound or pressure wave in the fluid medium. **(10 Marks)**

b. With the suitable sketch, explain laminar and turbulent boundary layer separation. **(10 Marks)**

**OR**

10 a. Derive the Bernoulli's equation in adiabatic process. **(10 Marks)**

b. Define normal shock waves and write down the variation of properties through it. **(10 Marks)**

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