CBCS SCHEME

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17AE35

Third Semester B.E. Degree Examination, July/August 2022
Mechanics of Fluids

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. With a neat sketch, give the classification of fluids and state Newton's law of Viscosity. **(08 Marks)**

b. Obtain the expression for the following :
i) Surface tension on liquid droplet
ii) Surface tension on a hollow bubble
iii) Surface tension on a liquid jet
iv) Capillary rise. **(12 Marks)**

OR

2 a. State and explain Hydrostatic Law. **(08 Marks)**

b. A U – tube manometer is used to measure the pressure of water in a pipe line, which is in excess of atmospheric pressure. The right limb of the monometer contains mercury and is open to atmosphere. The contact between water and mercury is in the left limb. Determine the pressure of water in the main line if the difference in level of mercury in the limbs of U – tube is 10cm and the free surface of mercury is in level with centre of pipe. If the pressure of water in pipe line is reduced to 9810 N/m^2, calculate the new difference in the level of mercury. Sketch the arrangements in both cases. **(12 Marks)**

Module-2

3 a. Discuss different types of fluid flow with examples and mathematical form. **(10 Marks)**

b. In a two – dimensional incompressible flow, the fluid velocity components are given by $u = x - 4y$ and $v = -y - 4x$.
Show that velocity potential exists and determine its form. Find also the stream function. **(10 Marks)**

OR

4 a. Discuss different types of Fluid Motion. **(08 Marks)**

b. State and explain Continuity equation in Integral form. **(12 Marks)**

Module-3

5 a. State Bernoullis theorem for steady flow of an incompressible fluid, also drive an expression for : i) Euler's equation of motion ii) Bernoullis equation. **(10 Marks)**

b. A horizontal Venturimeter with inlet diameter 20cm and throat diameter 10cm is used to measure the flow of water. The pressure at inlet is 17.658 N/cm^2 and the vacuum pressure at the throat is 30cm of mercury. Find the discharge of water through Venturimeter. Take Cd = 0.98. **(10 Marks)**

OR

6 a. For Froude Model law obtain the following :
i) Scale ratio for time
ii) Scale ratio for Acceleration
iii) Scale ratio for discharge
iv) Scale ratio for force
v) Scale ratio for pressure intensity. **(10 Marks)**

b. The pressure drop in an Aeroplane model of size 1/10 of its prototype is $80N/cm^2$. The model is tested in water. Find the corresponding pressure drop in the prototype. Take density of Air = 1.24 Kg/m^3 , Viscosity of water is 0.01 poise while the viscosity of Air is 0.00018 poise. **(10 Marks)**

Module-4

7 a. Find The Displacement thickness , The Momentum thickness and Energy thickness for the velocity distribution in the boundary layer given by

$$\frac{u}{U} = 2\left(\frac{y}{\delta}\right) - \left(\frac{y}{\delta}\right)^2 .$$ **(10 Marks)**

b. Obtain the following by considering the flow of a fluid over a plate :
i) Displacement thickness ii) Momentum thickness. **(10 Marks)**

OR

8 a. For the following velocity profile, determine whether the flow has separated or on the verge of separation or will attach with the surface.

i) $\frac{u}{U} = \frac{3}{2}\left(\frac{y}{\delta}\right) - \frac{1}{2}\left(\frac{y}{\delta}\right)^3$ ii) $\frac{u}{U} = 2\left(\frac{y}{\delta}\right)^2 - \left(\frac{y}{\delta}\right)^3$ iii) $\frac{u}{U} = -2\left(\frac{y}{\delta}\right) + \left(\frac{y}{\delta}\right)^2$ **(10 Marks)**

b. Experiments were conducted in a wind tunnel with a wind speed of 50km/hr on a flat plate of size 2m long and 1m wide. The density of Air is $1.15kg/m^3$. The co-efficients of lift and drag are 0.75 and 0.15, determine lift force , drag , resultant force, direction and power exerted by Air as the plate. **(10 Marks)**

Module-5

9 a. Obtain Berboullis equation for :
i) Isothermal process ii) Adiabatic process. **(10 Marks)**

b. A gas with a velocity of 300m/s is flowing through a horizontal pipe at a section where pressure is 6×10^4 N/m^2 and temperature 40°C. The pipe changes in diameter and at this section the pressure is 9×10^4 N/m^2. Find the velocity of the gas at this section if the flow of the gas is adiabatic. Take R = 287 J/kg° K and $\gamma = 1.4$. **(10 Marks)**

OR

10 a. A projectile travels in Air of pressure 10.1043 N/cm2 at 10°C at a speed of 1500 km/hr. Find the Mach number and the Mach angle. Take $\gamma = 1.4$, R = 287 J/kg° K. **(08 Marks)**

b. Obtain the expression for Stagnation pressure , Stagnation temperature and Stagnation density. **(12 Marks)**

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