CBCS SCHEME

USN | | | | | | | | | | |

17ME44

Fourth Semester B.E. Degree Examination, Dec.2023/Jan.2024
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 fluid properties
i) Density ii) Weight density iii) Specific volume
iv) Specific gravity v) Surface tension. **(10 Marks)**

b. Explain the phenomenon of capillarity. Obtain an expression for capillarity rise of a fluid. **(06 Marks)**

c. A cylinder contains of liquid of volume of $0.02m^3$ at a pressure of 700Pa, when compressed to reach a volume of $0.019m^3$. The pressure is increased to 1400Pa. Find bulk modulus of electricity. **(04 Marks)**

OR

2 a. Obtain the total pressure and the centre of pressure on an inclined plane surface immersed in a fluid. **(10 Marks)**

b. An annular plate 3m external diameter and 1.5m internal diameter is immersed in water with its greatest and least depths below water surface at 3.6m and 1.2m respectively. Determine the total pressure and the position of centre of pressure on one face of the plate. **(10 Marks)**

Module-2

3 a. Explain the following :
i) Steady flow and unsteady flow
ii) Uniform Flow and Non uniform flow
iii) Laminar Flow and Turbulent flow
iv) Rotational Flow and irrotational Flow **(12 Marks)**

b. The velocity components in a flow are given by u = 6y and V = -6x. Find
i) Whether the Flow is possible?
ii) Stream Function ψ. **(08 Marks)**

OR

4 a. Derive an expression for Bernoulli's equation from the first principles and also mention the assumptions mode. **(10 Marks)**

b. A 25cm diameter pipe carries oil of specific gravity 0.9 at a velocity of 3m/s. At another section of diameter is 20cm. Find the velocity at this section and mass flow rate of oil. **(10 Marks)**

Module-3

5 a. Derive Hagen – Poiseuille equation for a viscous flow through a circular pipe. **(10 Marks)**

b. Water at 15°C flows between two large parallel plates at a distance of 1.6mm apart. Determine : i) The maximum velocity ii) Pressure drop per unit length iii) Shear stress at the walls of the plates if the average velocity is 0.2m/s. The viscosity of water at 15°C is given as 0.01 poise. **(10 Marks)**

OR

6 a. Derive Darcy's equation for head losses due to friction in a circular pipe. **(10 Marks)**

b. At a sudden enlargement of water main from 0.24m to 0.48m diameter. The hydraulic gradient rises by 10mm. Estimate the rate of flow. **(10 Marks)**

Module-4

7 a. Define the following :
i) Drag ii) Lift iii) Momentum thickness iv) Mach number v) Mach cone. **(10 Marks)**

b. Define stream lined Body and Bluff Body. **(04 Marks)**

c. A circular disc 3m in diameter is held normal to a 26.4m/s wind of density 0.0012gm/cc. What force is required to hold it at rest? Assume coefficient of drag of disc = 1.1. **(06 Marks)**

OR

8 a. What is dimensional analysis? State Bucklingham π theorem and explain the procedure to determine π groups. **(10 Marks)**

b. The efficiency η of fan depends on the density ρ, the dynamic viscosity μ of the fluid, the angular velocity ω, diameter D of the rotor and discharge Q. Express η in term of dimensionless parameter. **(10 Marks)**

Module-5

9 a. Obtain an expression for velocity of sound in a compressible fluid in terms of change of pressure and change of density. **(10 Marks)**

b. A projectile travels at speed of 1500Km/hour at 20°C temperature and 0.1MPa air pressure. Calculate the Mach number and Mach angle. Take $\gamma = 1.4$, for air and R = 287 J/Kg K. **(10 Marks)**

OR

10 a. Define the terms
i) Sub sonic flow
ii) Sonic flow
iii) Supersonic flow **(06 Marks)**

b. What are the applications of CFD? **(04 Marks)**

c. A projectile travels in air of pressure 15N/cm^2 at 10°C at speed of 1500Km/hr. Find the Mach number and Mach angle. Assume $\gamma = 1.4$ and R = 287J/Kg K. **(10 Marks)**

* * * * *