CBCS SCHEME

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17ME44

Fourth Semester B.E. Degree Examination, Jan./Feb. 2021
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 following terms with SI units:
i) Capillarity
ii) Surface tension
iii) Kinematic viscosity
iv) Specific volume. **(06 Marks)**

b. Derive relation for pressure intensity and surface tension;
i) Liquid droplet ii) Soap bubble. **(06 Marks)**

c. A cube of 250mm sides, 300N weight slides down an inclined plane at 30° to horizontal. An oil film of thickness 0.5mm is between inclined plane and cube surface. Uniform velocity of slide is 3 m/sec. Determine the dynamic viscosity and kinematic viscosity if specific density of oil is 900 kg/m^3. **(08 Marks)**

OR

2 a. State and prove Hydrostatic law. **(06 Marks)**

b. Explain working of U-tube differential manometer, with neat sketch. **(06 Marks)**

c. A circular plate of 3m in diameter is submerged in oil of specific gravity 0.9, such that its greatest and least depths below the free surface are 3.5m and 2m respectively. Determine total pressure on one face and the depth of centre of pressure. **(08 Marks)**

Module-2

3 a. Derive continuity equation in 3-dimensional co-ordinates. **(06 Marks)**

b. Explain different types of fluid flows. **(06 Marks)**

c. A 2-dimensional flow is given by velocity potential $\phi = x(2y - 1)$. Determine the velocity at point P(2, 3). Find also the stream function. **(08 Marks)**

OR

4 a. Derive Bernoulli's equation for a fluid flow. List the assumptions made. **(08 Marks)**

b. Differentiate between venturimeter and orificemeter. **(04 Marks)**

c. A venturimeter with a throat diameter 10cm and area ratio 4 is provided in a vertical pipeline carrying oil of specific gravity 0.90. The difference in elevation of throat section and entry of venturimeter is 40cm. The differential u-tube mercury manometer shows a deflection of 30cm. Find: i) Discharge of oil ii) Pressure difference. Assume $C_d = 0.98$. **(08 Marks)**

Module-3

5 a. Derive relation for viscous flow through circular flow and obtain relation for head loss. **(10 Marks)**

b. A lubricating oil of viscosity 1.0 poise and specific gravity 0.9 is pumped through 30mm diameter pipe. The pressure drop per metre length is 20kN/m^2. Determine: i) Mass flow rate ii) Reynold's iii) Shear stress at pipe wall iv) Power required per 50m length of pipe to maintain the viscous flow. **(10 Marks)**

OR

6 a. Derive Darcy's equation for fluid flow through circular pipe. **(06 Marks)**
b. Define HGL and TEL, with sketch. **(04 Marks)**
c. Determine flow rate of water through a pipe of diameter 20cm and length 50m, when one end of pipe is connected to tank and the other end of pipe is open to the atmosphere. The pipe is horizontal and height of water in tank is 10mts above pipe axis. Consider all losses and assume f = 0.01. **(10 Marks)**

Module-4

7 a. Define lift and drag force. Derive relations with neat sketch. **(10 Marks)**
b. Experiments were conducted in a wind tunnel with a speed of 50km/hour on a flat plate of size 2m long and 1m wide. Density of air is 1.15kg/m^3. Coefficients of lift and drag are 0.75 and 0.15 respective. Determine Drag and lift force. **(10 Marks)**

OR

8 a. Define model similitude and explain. List the applications. **(08 Marks)**
b. The force 'F' acting on a screw propeller is given by, $F = \rho D^2 V^2 \phi\left(\frac{\rho D^3 V^2}{T}, \frac{ND}{V}, \frac{\rho VD}{\mu}\right)$ where T is Torque, 'D' diameter, V is velocity, N is RPM, ρ is density and viscosity of fluid 'μ'. Use Buckingham π method. **(12 Marks)**

Module-5

9 a. Derive relation for velocity of sound in terms of Bulk Modulus. **(08 Marks)**
b. Explain the terms: i) Mach Cone ii) Mach Number. **(04 Marks)**
c. An aero plane is flying at a height of 12km where the temperature is -53°C. Find the speed of the plane, if Mach Number is M = 2. Assume K = 1.4 and R = 287J/kg K. **(08 Marks)**

OR

10 a. Explain the importance of CFD. Mentions the applications of CFD. **(10 Marks)**
b. Explain types of sonicflows with neat sketch. **(06 Marks)**
c. Explain normal shock and oblique shock. **(04 Marks)**

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