CBCS SCHEME

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15ME44

Fourth Semester B.E. Degree Examination, Aug./Sept. 2020
Fluid Mechanics

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Give reasons:
- (i) Viscosity of liquids varies with temperature.
- (ii) Thin objects float on free surface of static fluid.
- (iii) Meta centric height determines stability of floating body.
- (iv) Rise of water in a capillary tube.
- (v) Mercury is used as manometric fluid.
- (vi) Free surface of water in capillary tube is concave. **(06 Marks)**

b. The space between two square flat parallel plates is filled with oil. Each side of the plates is 800 mm. Thickness of the oil film is 20 mm. The upper plate moves at a uniform velocity of 3.2 m/s. When a force of 50 N applied to upper plate. Determine
- (i) Shear stress.
- (ii) Dynamic viscosity of oil in poise.
- (iii) Power absorbed in moving the plate.
- (iv) Kinematic viscosity of oil, if specific gravity of oil is 0.90 **(10 Marks)**

OR

2 a. Derive equation for total pressure and centre of pressure for a plane surface immersed vertically in a static mass of fluid. **(08 Marks)**

b. A wooden block of specific gravity 0.75 floats in a water. If the size of the block is $1m \times 0.5m \times 0.4m$. Find its metacentric height. **(08 Marks)**

Module-2

3 a. Distinguish between:
- (i) Uniform and Non-uniform flows.
- (ii) Compressible and incompressible flows.
- (iii) Rotational and irrotational flows.
- (iv) Laminar and turbulent flows. **(08 Marks)**

b. Velocity potential function for a two dimensional fluid flow is given by $\phi = x(2y-1)$. Check the existence of flow. Determine the velocity of flow at P(2, 3) and the stream function. **(08 Marks)**

OR

4 a. Derive an expression for discharge through rectangular notch. **(08 Marks)**

b. A pipe line is carrying an oil of specific gravity 0.87, the diameter of the pipe changes from 200 mm at section 'A' to 500 mm at section B which is 4 m higher than A. If the pressure at A and B is 100 kPa and 60 kPa respectively and if the discharge is 200 kg/sec. Determine (i) loss head (ii) flow direction. **(08 Marks)**

Module-3

5 a. Prove that the ratio of maximum velocity to average velocity in a viscous flow of fluid through a circular pipe is 2.0. **(08 Marks)**

b. Calculate (i) The pressure gradient along flow, (ii) The average velocity (iii) The discharge for an oil of viscosity 0.02 N-S/m^2 flowing between two stationary parallel plates 1 m wide maintained 10 mm apart. The velocity midway between the plates is 2 m/s. **(08 Marks)**

OR

6 a. Derive Darcy-Weisbach equation for determining loss of head due to friction in a pipe. **(08 Marks)**

b. Identify and explain any four minor losses in pipes. **(08 Marks)**

Module-4

7 a. Explain the methods to control the boundary layer separation. **(08 Marks)**

b. The experiments were conducted in a wind tunnel with a wind speed of 50 km/hr on a flat plate of size 2 m long and 1 m wide. The density of air is 1.15 kg/m^3. The coefficients of lift and drag are 0.75 and 0.15 respectively.
Determine : (i) The lift force (ii) The drag force
(iii) The resultant force (iv) Power exerted by air on the plate **(08 Marks)**

OR

8 a. Explain the difference between stream line body and bluff body. **(06 Marks)**

b. The pressure difference ' ΔP ' for a viscous flow in a pipe depends upon the diameter of the pipe D, length of pipe L, velocity of flow 'V', viscosity of fluid 'μ' and the density of fluid 'ρ'. Using Buckingham's theorem. Show that the relation for pressure difference ' ΔP ' is given by,

$$\Delta P = \rho V^2 f\left[\frac{1}{R_e}, \frac{L}{D}\right]$$ **(10 Marks)**

Module-5

9 a. Show that the velocity of sound wave in compressibe fluid medium is given by, $C = \sqrt{\frac{P}{\rho}}$ for isothermal process. **(10 Marks)**

b. Find the sonic velocity for the following fluids:
(i) Crude oil of Specific gravity 0.8 and bulk modulus is 153036 N/cm^2.
(ii) Mercury having a bulk modulus of 2648700 N/cm^2. **(06 Marks)**

OR

10 a. Show that the stagnation temperature and static temperature related by $\frac{T_0}{T} = 1 + \frac{(\gamma - 1)}{2}.M^2$ where $\gamma = \frac{C_P}{C_V}$, M = Mach number **(08 Marks)**

b. Explain the applications of CFD and philosophy behind it. **(08 Marks)**

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