CBCS Scheme

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15AE35

Third Semester B.E. Degree Examination, Dec.2016/Jan.2017
Mechanics of Fluids

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Define the following with their S.I. unit:
i) Specific weight
ii) Specific volume
iii) Viscosity. **(06 Marks)**

b. The dynamic viscosity of an oil, used for lubrication between a shaft and sleeve is 6 poise. The shaft is of diameter 0.4m and rotates at 190 r.p.m. Calculate the power lost in the bearing for a sleeve length of 90mm. The thickness of the oil film is 1.5mm. **(10 Marks)**

OR

2 a. State and prove hydrostatic law. **(08 Marks)**

b. For a vertical plane surface submerged in liquid, show that centre of pressure lies below the centre of gravity of the vertical surface. **(08 Marks)**

Module-2

3 a. Differentiate between:
i) Steady and unsteady flow.
ii) Laminar and turbulent flow. **(08 Marks)**

b. For a fluid flow derive an expression for continuity equation in three dimensions in Cartesian coordinates. **(08 Marks)**

OR

4 a. Define velocity potential function and stream function, also give the relation between the same. **(06 Marks)**

b. For a finite control volume fixed in space, derive momentum equation in integral form. **(10 Marks)**

Module-3

5 a. State Bernoulli's theorem for steady flow of an incompressible fluid. Derive an expression for Bernoulli's equation from Euler's equation, also state the assumptions made for such derivations. **(08 Marks)**

b. A pipeline carrying oil of specific gravity 0.87, changes in diameter from 200mm diameter at a position A to 500mm diameter at a position B. Pipe is laid in a slope of 1 in 4 from A to B. If the pressure at A and B are 9.81 N/cm^2 and 5.886 N/cm^2 respectively and the discharge is 200 litres/s, determine the loss of head and direction of flow, given that length of the pipe is 16m. **(08 Marks)**

OR

6 a. The resisting force 'R' of a supersonic plane during flight is dependent upon the length of the aircraft, velocity, air viscosity, air density and bulk modulus of air. Express the functional relationship between these variables and the resisting force using Buckingham's π-theorem. **(10 Marks)**

b. Define and derive an expression for Reynold's number and Mach number. **(06 Marks)**

Module-4

7 a. Derive Von Karman's momentum integral equation for boundary layer flows. **(12 Marks)**

b. Calculate the diameter of a parachute to be used for dropping an object of mass 100kg so that the maximum terminal velocity of dropping is 5m/s. The drag coefficient for the parachute, which may be treated as hemispherical is 1.3. The density of air is 1.216 kg/m^3. **(04 Marks)**

OR

8 a. Define the following:
i) Boundary layer thickness.
ii) Momentum thickness. **(04 Marks)**

b. With a neat sketch, explain boundary layer concept. **(06 Marks)**

c. State and explain Kutta-Joukowski theorem. **(06 Marks)**

Module-5

9 a. Derive an expression for velocity of sound wave in a fluid. **(10 Marks)**

b. Find the velocity of bullet fired in standard air if the Mach angle is 30°. Take R = 287.14 J/kg.K and K = 1.4 for air. Assume temperature as 15°C. **(06 Marks)**

OR

10 a. Sketch the propagation of disturbance or pressure waves in compressible fluids, when Mach number is greater than one, also explain, with respect to the above,
i) Mach angle
ii) Zone of action
iii) Zone of silence. **(08 Marks)**

b. For a compressible flow undergoing adiabatic process, derive Bernoulli's equation. **(08 Marks)**

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