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17ME44

Fourth Semester B.E. Degree Examination, Dee.241144Wn.2020
Fluid Mechanics

Time: 3 hrs. Max. Marks: 100

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

Module-1

I a. Define the following fluid properties :
i) Density ii) Specific weight iii) Specific volume iv) Specific gravity. **(04 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 rpm. Calculate the power lost is the bearing for a sleeve length of 90mm. The thickness of the of film is 1.5mm. **(08 Marks)**

c. A U tube manometer is used to measure the pressure of oil of specific gravity 0.85 flowing in a pipe line. It left end is connected to the pipe and the right limb is open to the atmosphere. The under of pipe is 100mm below the level of mercury (specific gravity of mercury = 13.6) in the right limb. If the difference of mercury level in the two limbs is 160mm. Determine the absolute pressure of the oil in the pipe. **(08 Marks)**

OR

2 a. Derive an expression for total pressure force and depth of centre of pressure for an inclined plane surface submerged in liquid. **(10 Marks)**

b. Determine the total pressure and centre of pressure on an isosceles triangular plate of base 4m and altitude 4m where if immersed vertically in an oil of specific gravity 0.9 the base of the plate coincides with the free surface of oil. **(06 Marks)**

c. Define the terms : i) Buoyancy ii) Centre of buoyancy
iii) Meta centre iv) Meta centric height. **(04 Marks)**

Module-2

3 a. Derive continuity equation is Cartesian co-ordinates for a fluid flow in 3 dimensions. **(08 Marks)**

b. Distinguish between :
i) Steady and unsteady flow
ii) Uniform and non uniform flow
iii) Laminar and turbulent flow. **(06 Marks)**

c. Obtain a stream function to the following velocity components $u = x + y$ and $v = x - y$. **(06 Marks)**

OR

4 a. The water is flowing through taper pipe of length **100m** having diameters 600mm at upper end and 300mm at the longer end at the rate of 50 litres/sec. The pipe has a slope of 1 in 30. Find the pressure at the lower end if the pressure at the higher level is 19.62 N/cm^2. **(08 Marks)**

b. Derive an expression for discharge through a triangular notch. **(06 Marks)**

c. An oil of specific gravity 0.8 is flowing through venturimeter having inlet diameter 20cm and throat diameter 10cm. The oil mercury differential nanometer shows a reading of 25cm. calculate the discharge of oil through horizontal venturimeter. Take $C_d = 0.98$. **(06 Marks)**

Module-3

5 a. Derive an expression for velocity distribution for Hagen — Poiseuille flow occurring in a circular pipe. Hence prove that the maximum velocity is twice the average velocity of the flow. **(10 Marks)**

b. A fluid viscosity 0.7Ns/m^2 and specific graivity 1.3 is flowing through a circular pipe of diameter 100mm, the maximum shear stress. At the pipe wall is given as 196.2N/m`. Find i) the pressure gradient ii) the average velocity iii) Reynolds number of the flow. **(10 Marks)**

OR

6 a. Derive the Darcy Weisbach equation. **(08 Marks)**

b. Differentiate between major and minor energy losses. **(04 Marks)**

c. An oil of specific gravity 0.7 is flowing through a pipe of diameter 300mm at the rate of 500 litre/sec. fmd the head lost due to friction and power required to maintain. The flow for a length of 1000m. Take v = 0.29 stokes. **(08 Marks)**

Module-4

7 a. Write a short note on boundary layer separation and method to control it. **(08 Marks)**

b. A flat plate 1.5m x 1.5m moves at 50km/hr in stationary air of density 1.15kg/m^3. If the coefficient of drag and left are 0.15 and 0.75 respectively. Determine : i) the lift force ii) the drag force iii) the resultant force iv) power required to keep the plate in motion. **(08 Marks)**

c. State the difference between stream lined body and bluff body with neat sketch. **(04 Marks)**

OR

8 a. What is dimensional homogeneity'? Explain with examples. **(04 Marks)**

b. What is similitude? Explain the following : i) Geometric similarity ii) Dynamic similarity **(08 Marks)**

c. Show by Buckingham's it theorem that the frictional torque T of a disc of diameter D rotating at speed N in a fluid of viscosityµ and density `p' in a flow is given by **T =** D$^)$N^{2}p4)

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D2Np **(08 Marks)**

Module-5

9 a. Define : i) Mach number ii) Subsonic flow iii) Sonic flow iv) Supersonic flow. **(08 Marks)**

h. An Airplane is flying at an height of 15km. where the temperature is -50°C. The speed of the plane is corresponding to M = 2.0. Assuming K = 1.4 and **R =** 287 J/kg K. fmd the speed of plane. **(06 Marks)**

c. A projectile is travelling in air having pressure and temperature as 8.829 N/cm^2 and 2°C if the mach angle is 40° find the velocity of the projectile Take K = 1.4 and R = 287 J/kg K. **(06 Marks)**

OR

10 a. Explain the meaning of CFD and its application. **(06 Marks)**

b. Define the following terms and write the relevant equation for the same i) stagnation temperature ii) stagnation pressure. **(08 Marks)**

c. 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 is irks)