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15ME44

Fourth Semester B.E. Degree Examination, June/July 2018
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. Define following terms with SI units : i) Mass density ii) Kinematic viscosity iii) Capillarity iv) Compressibility. **(08 Marks)**

b. A circular shaft of diameter 30mm is rotating in a journal bearing of length 20cm. Speed of shaft is 360 rpm. The clearance between shaft and bearing is 0.6mm and dynamic viscosity is 0.2 N-S/m^2. Determine Torque and Power required to rotate the shaft at given speed. **(08 Marks)**

OR

2 a. State and prove Hydrostatic law. **(04 Marks)**

b. Define Meta centre and explain its importance in stability of floating bodies. **(04 Marks)**

c. Determine the total hydrostatic force and its location on a circular plate immersed in a tank containing oil. The circular plate is inclined at 30^0 to free surface of oil and nearest point of it circumference is 1.2m below free surface. Diameter of circular plat is 5m and specific gravity of oil is 0.90. **(08 Marks)**

Module-2

3 a. Derive continuity equation in Cartesian co-ordinates for a fluid flow in 3 – Dimensions. **(06 Marks)**

b. Differentiate between : i) Steady flow and Unsteady flow ii) Viscous flow and Turbulent flow iii) Uniform and Non – Uniform flow. **(06 Marks)**

c. Define and explain stream function and velocity potential function. **(04 Marks)**

OR

4 a. State assumptions in Bernoulli's equation and derive the relation. **(06 Marks)**

b. Differentiate between Venturi meter and Orifice meter. **(04 Marks)**

c. A 30cm × 15cm venturimeter is inserted in a vertical pipeline carrying oil of specific gravity 0.85, the flow of oil is upwards. Throat section is 50cms above inlet section of venturimeter. The oil mercury differential manometer gives a reading of 30cms of mercury. Find the rate of oil flow in lts/sec and pressure difference between inlet and throat section. Assume $C_d = 0.96$. Neglect all losses. **(06 Marks)**

Module-3

5 a. Derive Hagen Poiseuille equation for laminar flow through a circular pipe. **(08 Marks)**

b. Oil of viscosity 10 Poise flows between two parallel plates are kept at a distance of 50mm apart. Find the rate of oil flow between the plates if the pressure drop per meter length is 0.3N/cm^2. Width of plate is 200mm and length of plate is 1.8m. Specific gravity is 0.85. **(08 Marks)**

OR

6 a. Derive Darcy – Weisbach relation for a fluid flow through a pipe. **(08 Marks)**

b. Determine rate of water flow through a pipe of diameter 20cm and length 50m, with one end connected to a tank and other end of pipe is open to the atmosphere. The pipe is horizontal and height of water level in the tank is 7.5m above pipe axis. Consider all losses and assume f = 0.01. Draw HGL. **(08 Marks)**

Module-4

7 a. Explain the term : i) Lift ii) Drag iii) Displacement thickness iv) Momentum thickness. **(08 Marks)**

b. A thin plate is moving in air at a velocity of 5m/s. The length of plate is 0.6m and width 0.5m. Find the thickness of boundary layer at the end of the plate and drag force on one side of the plate. Take density of air as 1.24 kg/m^3 and the kinematic viscosity 0.15 stokes. **(08 Marks)**

OR

8 a. Explain importance of dimensional analysis in the model similitude. Explain Rayleigh method of the dimensional analysis. **(06 Marks)**

b. The frictional torque T of a disc of diameter D depends on speed N, in a fluid of dynamic viscosity μ and density of fluid ρ in a turbulent fluid flow. By Bukingham Pi method, develop a relation for frictional torque T. **(10 Marks)**

Module-5

9 a. Derive an expression for velocity of sound in a fluid. **(08 Marks)**

b. An Aeroplane is flying at an height of 15km where the temperature is -50^{0}C. The speed of the plan is corresponding to Mach number 2.0. Assume K = 1.4 , R = 287 J/kg ^{0}K. Find the speed of the plane. **(08 Marks)**

OR

10 a. Define the following terms : i) Mach number ii) Mach cone iii) Zone of action iv) Subsonic flow v) Supersonic flow. **(10 Marks)**

b. Explain the meaning o CFD and its applications. **(06 Marks)**

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