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Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S3 (S,FE) / S1 (PT) (S,FE) Examination June 2024 (2015 Scheme)

Course Code: ME203

Course Name: MECHANICS OF FLUIDS

Max. Marks: 100 Duration: 3 Hours

PART A

Answer any three full questions, each carries 10marks

Marks

1 a) Define the property Viscosity. Discuss the effect of temperature on viscosity of fluids. (4)

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 in the bearing for a sleeve length of 90mm. The thickness of the oil film is 1.5mm. (6)

2 a) A U-Tube manometer is used to measure the pressure of water in a pipe line, which is in excess of atmospheric pressure. The right limb of the manometer contains mercury and is open to atmosphere. The contact between water and mercury is in the left limb. Determine the pressure of water in the main line, if the difference in level of mercury in the limbs of U- tube is 10 cm and the free surface of mercury is in level with the centre of the pipe. If the pressure of water in pipe line is reduced to 9810 N/m^2, calculate the new difference in the level of mercury. Sketch the arrangement in both cases. (10)

3 a) Differentiate between Lagrangian and Eulerian method of fluid flow analysis. (3)

b) Derive the expression for continuity equation in three-dimensional cartesian coordinate. (7)

4 a) Define the following. (4)

i) Stream lines ii) Stream tube iii) Path lines iv) Streak lines

b) The velocity potential function for a two-dimensional flow is $\phi = x(2y-1)$. At a point P (4,5), determine: (6)

(i) The velocity

(ii) The value of stream function.

PART B

Answer any three full questions, each carries 10marks

5 a) Derive Euler's equation of motion. Obtain Bernoulli's equation from Euler's equation. (6)

b) The pitot-static tube placed in the centre of a 300mm pipe line has one orifice pointing upstream and other perpendicular to it. The mean velocity in the pipe is 0.80 of the central velocity. Find the discharge through the pipe if the pressure difference between the two orifice is 60mm of water. Take co-efficient of pitot tube as $C_v = 0.98$ (4)

6 a) A pipe 200m long slopes down at 1 in 100 and tapers from 600mm diameter at the higher end and 300mm diameter at the lower end, and carries 100 litres/sec of oil (Sp.gravity 0.8). If the pressure gauge at the higher end reads 60kN/m^2, determine: (10)

(i) Velocities at the two ends.

(ii) Pressure at the lower end. Neglect all losses.

7 a) Derive the expression for frictional head loss for flow of viscous fluid through a circular pipe. (10)

8 a) An oil of specific gravity 0.7 is flowing through a pipe of diameter 300mm at the rate of 500 litres/s. Find the head lost due to friction and power required to maintain the flow for a length of 1000m. Take υ= 0.29 stokes. (6)

b) Differentiate between major losses and minor losses in pipes. List any two minor losses. (4)

PART C

Answer any four full questions, each carries 10marks.

9 a) Derive expression for Displacement Thickness and Momentum Thickness for flow over a flat plate. (10)

10 a) Find the displacement thickness, the momentum thickness and energy thickness for the velocity distribution in the boundary layer given by $\frac{u}{U} = 2\left(\frac{y}{\delta}\right) - \left(\frac{y}{\delta}\right)^2$. (10)

11 a) Derive the expression for Von Karman momentum integral equation. (10)

12 a) State Buckingham's π- theorem. (3)

b) The efficiency η of a fan depends on density ρ , dynamic viscosity μ of the fluid, angular velocity ω, diameter D of the rotor and the discharge Q. Express η in terms of dimensionless parameter. (7)

13 a) The pressure difference Δp in a pipe of diameter D and length *l* due to turbulent flow depends on the velocity V, viscosity μ, density ρ, and roughness k. Using Buckingham's π- theorem, obtain the expression for Δp (10)

14 a) Explain the three types of similarities which exist between model and prototype. (6)

b) Define the following dimensionless numbers: (4)

(i) Froude's number

(ii) Mach's number.

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