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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S3 (S, FE) / S1 (PT) (S, FE) Examination December 2023 (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 10 marks Marks

1 a) Distinguish between dynamic viscosity and kinematic viscosity. (4)

b) Explain the following terms i) centre of pressure ii) centre of buoyancy iii) meta-centre. (6)

2 Determine the difference of pressure between pipes A and B when connected to an inverted U-tube differential manometer containing oil of specific gravity 0.8 as the manometric fluid. The pipe A conveys water and a fluid of specific gravity 0.9 flows through the pipe B. The position of manometric liquid in the left limb is 80 cm above the centre line of the pipe A. The position of manometric liquid in the right limb is 50 cm above the centre line of pipe B. The difference in level of oil in two limbs is 15 cm. The pressure of fluid in the pipe B is $5x10^4$ N/m^2 and the barometer reading is 730 mm of mercury. With the help of a neat sketch, calculate the pressure in pipe A in meters of water absolute. (10)

3 a) Differentiate between local acceleration and convective acceleration. (4)

b) The stream function for a 2-D flow is given by $\psi = 2xy$, calculate the velocity at the point P (2,3). Find the velocity potential function ϕ. (6)

4 a) Define the term flow net. List any four uses of flow net. (4)

b) Distinguish between circulation and vorticity. (6)

PART B

Answer any three full questions, each carries 10 marks

5 a) Explain Navier-Stokes equations in rectangular and cylindrical co-ordinates. (4)

b) Explain the working of pitot tube and pitot static tube with the help of schematic sketches. (6)

6 The inlet and throat diameters of a horizontal venturimeter are 30 cm and 10 cm (10)

respectively. The liquid flowing through the meter is water. The pressure intensity at inlet is 13.734 N/cm^2 while the vacuum pressure head at throat is 37 cm of mercury. Find the rate of flow. Assume that 4% of differential head is lost between the inlet and throat. Find the value of C_d for the venturimeter.

7 a) Compare between the laminar and turbulent flows in pipes. (6)

b) Explain Moody's chart. State its uses in pipe flow. (4)

8 a) In a pipe of diameter 350 mm and length 75 m, water is flowing at a velocity of 2.8 m/s. Find the head lost due to friction using i) Darcy- Weisbach equation ii) Chezy's formula for which Chezy's constant C=55. Assume kinematic viscosity of water as 0.012 stokes. (6)

b) Explain the concept of equivalent pipe. Derive an expression for equivalent pipe. (4)

PART C

Answer any four full questions, each carries 10 marks.

9 a) Explain any three methods to prevent boundary layer separation with suitable sketches. (6)

b) List any four characteristics of a boundary layer. (4)

10 For the velocity profile for laminar boundary layer $\frac{u}{U} = \frac{3}{2}\left(\frac{y}{\delta}\right) - \frac{1}{2}\left(\frac{y}{\delta}\right)^3$, determine the boundary layer thickness, shear stress and drag force in terms of Reynolds number. (10)

11 A plate 450 mm x 150 mm has been placed longitudinally in a stream of crude oil which flows with a velocity of 6 m/s. Take specific gravity of crude oil as 0.925 and kinematic viscosity as 0.9 stokes. Calculate i) the thickness of boundary layer at the trailing edge of the plate ii) shear stress at the trailing edge iii) the friction drag on the plate. (10)

12 Derive suitable parameters to present the thrust developed by a propeller using dimensional analysis. Assume that the thrust P depends upon the angular velocity ω, speed of advance V, diameter D, dynamic viscosity μ, mass density ρ and elasticity of the fluid medium which can be denoted by the speed of sound in the medium C. (10)

13 a) The ratio of lengths of a submarine and its model is 30:1. The speed of submarine (prototype) is 10 m/s. The model is to be tested in a wind tunnel. Find the speed of air in wind tunnel. Also determine the ratio of the drag between (6)

the model and its prototype. Take the value of kinematic viscosities for sea water and air as 0.012 stoke and 0.016 stoke respectively. The density for sea water and air is given as 1030 kg/m^3 and 1.24 kg/m^3 respectively.

b) Determine the dimensions of the following quantities i) specific weight ii) angular acceleration iii) kinematic viscosity iv) power (4)

14 a) Explain i) geometric similarity ii) kinematic similarity iii) dynamic similarity. (6)

b) List and explain any four applications of Model testing. (4)

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