Reg No.:_______________ Name:__________________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B.TECH DEGREE EXAMINATION(S), MAY 2019

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) Deduce Pascal's Law. (5)

b) Dynamic viscosity of oil used for lubrication between a shaft (journal) and bearing is 6 poise. The shaft is of diameter 400 mm and rotates at 190 rpm. Calculate the power lost in the bearing for 90 mm long Journal bearing arrangement. Thickness of oil is 1.5 mm. (5)

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

3 How can you classify fluid flow? (10)

4 The velocity vector for 2D incompressible , fluid flow is given by (10)
$V = (y^3/3 + 2x - x^2y)i + (xy^2 - 2y - x^3/3)j$
Find a) whether the flow is possible or impossible.
b) Whether the flow is rotational or irrotational.

PART B

Answer any three full questions, each carries 10marks.

5 Derive Hagen Poiseuille equation for fully developed laminar flow in a circular pipe. (10)

6 A pipe 300 m long has a slope of 1 in 100 and tapers from 1.2 m diameter at the higher end to 0.6 m diameter at the lower end. Quantity of water flowing is 5400 litres per minute. If the pressure at the higher end is 68.67 kPa. Find the pressure at the lower end. (10)

7 An oil of specific gravity 0.9 and viscosity 10 poise is flowing through a pipe of diameter 110 mm. The velocity at the centre is 2 m/s, find : (10)
(i) the pressure gradient in the direction of flow
(ii) shear stress at the pipe wall; (iii) Reynold's number; and (iv) velocity at a distance 30 mm from the wall.

8 Explain the principle of venturi meter with a neat sketch and establish an expression for the rate of flow through it. (10)

PART C

Answer any four full questions, each carries 10marks.

9 What do you understand by boundary layer? Illustrate with reference to flow over flat plate. (10)

10 Define the following (10)
   i. Laminar Boundary Layer
   ii. Turbulent boundary Layer
   iii. Laminar Sub Layer
   iv. Boundary Layer Thickness

11 Air flows over a flat plate of 1 m x 1m at a velocity of 6 m/s. Determine (10)
   (a) Boundary layer thickness at the end of the plate
   (b) Shear stress at the middle of the plate

(c) Total drag per unit length on the sides of the plate.

Take density of air = 1.2 kg/m^3 and Kinematic viscosity of air = 0.15×10^{-4} m^2/s

12 The pressure drop ΔP in a pipe of diameter D, length L, due to turbulent flow depends on mass density ρ and viscosity μ of the flowing fluid, mean velocity of flow V and average height K of roughness projections on the pipe surface. Obtain a dimensionless expression for ΔP by Buckingham's π theorem. Hence show that (10)

$h_f = 4fLV^2/2dg$.

13 Explain the different types of hydraulic similarities that must exist between a prototype and its model. (10)

14 A 2.5m ship model was tested in fresh water (ρ =1000 kg/m^3) and measurements indicated that there was a resistance of 45 N when the model was moved at 2 m/s. Workout the velocity of 40m prototype. Also calculate the force required to drive the prototype at this speed through sea water (ρ =1025 kg/m^3). (10)

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