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Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Third Semester B.Tech Degree (S,FE) Examination December 2022 (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) A hollow circular plate of 2 m external and 1 m internal diameter is immersed vertically in water such that centre of plate is 4 m deep from water surface. Find the total pressure force and depth of centre of pressure. (4)

b) The space between two square flat parallel plates is filled with oil. Each side of the plates is 800 mm. Thickness of the oil film is 20 mm. The upper plate moves at a uniform velocity of 3.2 m/s. When a force of 50 N is applied to upper plate, determine (6)

(i) Shear stress

(ii) Dynamic viscosity of oil in poise

(iii) Power absorbed in moving the plate

(iv) Kinematic viscosity of oil if the specific gravity of oil is 0.90.

2 a) Distinguish between a) steady flow and unsteady flow (6)

b) uniform and non-uniform flow c) laminar and turbulent flow

b) Derive the 3D continuity equation. (4)

3 a) Define the terms velocity potential function, stream function and establish the relation between them. (6)

b) The stream function for a non-uniform flow is given by $\psi = 2xy$. Calculate velocity of point at P (2,3). Find the potential function. (4)

4 a) Define gauge pressure, vacuum pressure and absolute pressure. How are they related? (4)

b) If 10,000 litres of a certain liquid weigh 1329 N, find (6)

a) Specific weight b) Mass density c) Specific volume d) Specific gravity

PART B

Answer any three full questions, each carries 10 marks

5	a)	Derive Darcy-Weisbach equation for determining loss of head due to friction in a pipe.	(6)
	b)	Identify and explain any four minor losses in pipes.	(4)
6	a)	Derive the Euler's equation of motion and then obtain Bernoulli's equation.	(5)
	b)	A pipeline carrying oil of specific gravity of 0.87 changes its diameter from 200 mm at point A to 500 mm diameter at point B which is 4 m higher. If the pressure at A and B are 9.81 N/cm^2 and 5.886 N/cm^2 respectively and the discharge is 200 lps, determine the loss in head and direction of flow.	(5)
7	a)	Derive the equation of discharge through a venturimeter..	(5)
	b)	A venturimeter is used to measure liquid flow rate of 759 kilo litres per minute. The difference in pressure across the venturimeter is equivalent to 8 m of the flowing liquid. The pipe diameter is 19 cm. Calculate the throat diameter of the venturimeter. Assume the coefficient of discharge for the venturimeter as 0.96.	(5)
8	a)	Derive an expression for loss of head due to sudden enlargement of pipe.	(5)
	b)	An oil of viscosity 0.1 N-s/m^2 and relative density 0.9 is flowing through a circular pipe of diameter 100 mm and length 500 m. The rate of flow of liquid through the pipe is 3.5 litres/s. Find the pressure drop in a length of 300 m and the shear stress at the pipe wall.	(5)

PART C

Answer any four full questions, each carries 10 marks.

9	a)	What are the various methods of dimensional analysis? Describe Buckingham's pi-theorem for dimensional analysis.	(5)
	b)	Show by method of dimensional analysis that the resistance R to the motion of a sphere of diameter D moving with uniform velocity V through a fluid having density ρ and viscosity μ may be expressed as $R = \rho D^2 V^2 f\left(\frac{\mu}{\rho V D}\right)$.	(5)
10		The pressure difference Δp in a pipe of diameter D and length l due to viscous flow depends on the velocity V, viscosity μ and density ρ. Using Buckingham's pi theorem obtain an expression for Δp.	(10)
11	a)	Define the terms a) Boundary layer thickness b) Energy thickness c) Lift d) Drag.	(4)
	b)	Explain the various methods of preventing the separation of boundary layer.	(6)

12 a) Explain the following dimensionless terms (4)

a) Euler number b) Reynolds number c) Fraud number d) Weber number.

b) Explain a) Geometric similarity b) Kinematic similarity and c) Dynamic similarity. (6)

13 a) With a neat sketch, explain the development of boundary layer over a horizontal flat plate which is kept in a flow field. (10)

14 a) The velocity profile of a laminar boundary layer flow is given by (10)

$$\frac{u}{U} = 2\left(\frac{y}{\delta}\right) - \left(\frac{y}{\delta}\right)^2$$

Find expressions for displacement thickness δ^* and momentum thickness θ in terms of boundary layer thickness δ.

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