C

0800MET203122102

Pages: 3

Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Third Semester B.Tech Degree Regular and Supplementary Examination December 2022 (2019 Scheme)

Course Code: MET203

Course Name: MECHANICS OF FLUIDS

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions. Each question carries 3 marks Marks

1 The pressure at a point in a fluid is 15 cm of mercury column. Express it in N/m^2 of absolute pressure and gauge pressure. (3)

2 Distinguish between the following: (3)

(i) Density and relative density

(ii) Ideal and real fluids

(ii) Dynamic and kinematic viscosity

3 Differentiate between the rotational and irrotational flows. (3)

4 Show that the stream lines and equipotential lines form a net of mutually perpendicular lines. (3)

5 Discuss the limitations of Bernoulli's equation. (3)

6 Explain the working of Pitot-static tube. (3)

7 Explain the concept of vena-contracta. (3)

8 What is cavitation? What is its significance in fluid flow? (3)

9 Explain the significance of laminar sub-layer in boundary layer. (3)

10 Define Reynold's Number. What is its significance? (3)

PART B

Answer any one full question from each module. Each question carries 14 marks

Module 1

11(a) Derive an expression for the depth of centre of pressure from free surface of liquid of a vertical plane surface submerged in the liquid. (7)

(b) A stone weighs 392.4 N in air and 196.2 N in water. Compute the volume of stone and its specific gravity. (7)

12(a) With a neat sketch, explain the conditions of equilibrium for floating and submerged bodies. (7)

(b) U-tube manometer is used to measure the pressure of water in a pipe line, (7)

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 arrangements in both cases.

Module 2

13(a) Show that the product of the slope of the equipotential line and the slope of the constant steam function line at the point of intersection is -1. (6)

(b) A fluid flow field is given by $V= x^2y\ i+y^2z\ j - (2xyz+yz^2)k$. Prove that the flow field represents a possible case steady incompressible fluid flow. Also calculate the velocity and acceleration at the point (2, 1, 3). (8)

14(a) A two-dimensional velocity field is given by $u = 2xy$, $v = -x^2y$. Compute (8)

(a) velocity at (1,1)

(b) convective acceleration at (1,1)

(c) local acceleration

(b) If the velocity field is given by $u = x^2 - y^2 + x$ and $v = -(2xy + y)$, (6)

determine the velocity potential and the stream function.

Module 3

15(a) Derive an expression for the continuity equation in Cartesian coordinates. (7)

(b) Water is flowing at the rate of 20 litres/s through a tapering pipe. The diameters at the bottom and upper ends are 250 mm and 150 mm respectively. If the intensities of pressure at the bottom and upper ends are 250 kN/m^2 and 150 kN/m^2 respectively, find the difference in datum head. (7)

16(a) Derive an expression for the Bernoullis's equation (7)

(b) Water is flowing through a pipe having diameter 300 mm and 200 mm at the bottom and upper end respectively. The intensity of pressure at the bottom end is 24.525 N/cm^2 and the pressure at the upper end is 9.81 N/cm^2. Determine the difference in datum head if the rate of flow through pipe is 40 lit/s. (7)

Module 4

17 Derive Hagen-Poiseuille equation from the fundamentals and state the assumptions made. Sketch the shear stress and velocity distribution across the circular pipe. (14)

18(a) A syphon of diameter 200 mm connects two reservoirs having a difference in elevation of 20m. The length of syphon is 500 m and the summit is 3.0 m above the water level in the upper reservoir. The length of the syphon from upper reservoir to the summit is 100 m. Find out the discharge through syphon. Neglect minor lessees. The coefficient of friction, f = 0.005. (10)

(b) Explain the difference between major and minor losses in pipes. List any two minor losses. (4)

Module 5

19 Derive expressions for the displacement, momentum and energy thickness in connection with the boundary layer theory. (14)

20 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 an expression for Δp. (14)

*****