Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B.TECH DEGREE EXAMINATION, APRIL 2018

Course Code: ME203

Course Name: MECHANICS OF FLUIDS (ME)

Max. Marks: 100 Duration: 3 Hours

PART A

Answer any three full questions, each carries 10 marks Marks

1 a) Explain technical reason for the following: (4)
i) Certain insects are able to walk on surface of water.
ii) Rise of water in trees

b) A U-tube differential mercury manometer is connected between two pipes X and Y. Pipe X contains a fluid (Sp.gr. = 1.59) under a pressure of 103 kN/m^2 and pipe Y contains oil (Sp.gr. = 0.8) under a pressure of 172 kN/m^2. Pipe X is 2.5 m above pipe Y. The mercury level in the limb connected to pipe X is 1.5 m below the centreline of pipe Y. The level of mercury in the limb connected to pipe Y is below the level of mercury (Sp.gr. = 13.6) in the other limb. Find the manometer reading in centimetres of mercury and show the same as a schematic diagram. (6)

2 a) State and explain the Newton's law of viscosity. Explain with examples the classification of fluids on the basis of this law. (4)

b) A vertical rectangular gate of 4m width and 2m depth is hinged at a point 0.25 m below the centre of gravity of the gate. If the top edge of gate is 5 m below free surface of water and total depth of water is 7 m, what horizontal force must be applied at the bottom to keep the gate closed? (6)

3 Distinguish between: (10)
i) Steady flow and unsteady flow ii) Uniform flow and non-uniform flow
iii) Rotational and irrotational flow iv) Laminar flow and Turbulent flow

4 a) Describe the following terms: (4)
i) Stream lines ii) Path lines iii) Streak lines iv) Stream tubes.

b) A velocity field is defined by $V = 2y^2\hat{i} + 3x\hat{j} + 0\hat{k}$. Compute the velocity, local acceleration and convective acceleration at point (1, 2, 0). (6)

PART B

Answer any three full questions, each carries 10 marks

5 a) Compare Venturimeter and orifice meter with respect to construction, principle, merits and demerits. (4)

b) A Venturimeter whose throat diameter is 1/3rd of pipe diameter is fitted in a horizontal pipe of 300 mm diameter carrying water. The pressure in pipe line is 13.8 N/cm^2 (gauge) and vacuum in throat is 37.5 cm of mercury. Determine the rate of flow through the pipeline. Take C_d=0.98. (6)

6 a) Comparerectangular notch and triangular notch with respect to construction and advantages. (4)

b) Explain the working principle of Pitot tube and Pitot-static tube with neat sketches. (6)

7 a) An existing compound piping system to transport water from one station to another station consists of 1800 m of 50 cm, 1200 m of 40 cm and 600 m of 30 cm diameter pipes of same material connected in series. It is decided to change these existing pipes with new pipes of uniform diameter. Calculate diameter of new pipes to be used so as maintain same discharge and loss of head as in previous situation. (4)

b) Derive Chezy's formula for loss of head due to friction in a circular pipe. (6)

8 a) Define hydraulic gradient and total energy line. Explain its significance in fluid mechanics. (4)

b) Explainthe major and minor (any five) energy losses related to pipe flow. (6)

PART C

Answer any four full questions, each carries 10 marks

9 Explain the following:

a) Displacement thickness (2)

b) Momentum thickness (2)

c) Energy thickness (2)

d) Separation of boundary layer with figure. (4)

10 Draw a neat diagram and explain the concept of boundary layer development along a long thin plate. Describe the details of various regions in the boundary layer. (10)

11 For the velocity profile for laminar boundary layer $\frac{u}{U} = 2\left(\frac{y}{\delta}\right) - 2\left(\frac{y}{\delta}\right)^3 + \left(\frac{y}{\delta}\right)^4$ obtain an expression for boundary layer thickness, shear stress, drag force on one side of the plate and coefficient of drag in terms of Reynolds number. (10)

12 a) State Buckingham's - π theorem. Explain dimensional homogeneity with the help of an example. (4)

b) Define and explain Froude number,Reynold's number, Weber's number and Mach number (6)

13 The variables controlling the motion of a floating vessel (ship) through water are the drag force F, the speed V, the length L, dynamic viscosity μ, the density ρ and acceleration due to gravity g. Derive an expression for drag force F by dimensional analysis. Hence show that the drag force is a function of Reynold's number and Froude number. (10)

14 Explain different laws on which models are designed for dynamic similarity. (10)

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