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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2017

Course Code: CE203

Course Name: FLUID MECHANICS – I (CE)

Max. Marks: 100 Duration: 3 Hours

PART A

Answer any two full questions, each carries 15 marks. Marks

1 a) Two pipelines, one carrying oil of relative density 0.9 and other carrying water are connected to a manometer as shown in Figure 1. By what amount, the pressure in water pipeline should be increased so that mercury levels in both the limbs of the manometer become equal? (8)

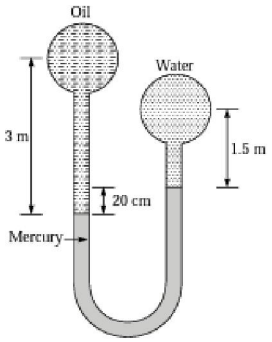

Figure 1.

b) Obtain an expression for centre of pressure of a lamina paced in inclined position. (7)

2 a) Derive continuity equation in three dimensional Cartesian coordinates. (7)

b) A rectangular barge 16 m x 5 m has a depth of immersion of 1.6 m when floating horizontally. The centre of gravity of the barge is 1.9 m above the bottom. Determine the angle of tilt if a 50 kN weight is moved across the deck by 3.5 m. (8)

3 a) In a 2-dimensional steady incompressible flow, the velocity components *u, v* are given by $u = 2x - x^2 y + \frac{y^3}{3}$, $v = xy^2 - 2y - \frac{x^3}{3}$. Determine the acceleration at P(1,3). (6)

b) A door in a tank retaining water is in the form of a quadrant of a cylinder of 1.5 m radius and 1.8 m wide as shown in Figure 2. Calculate the resultant force on the gate. (9)

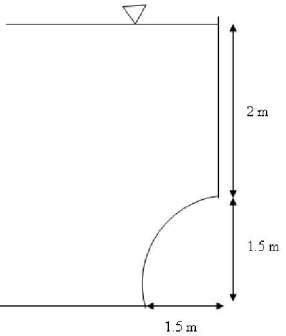

Figure 2

PART B

Answer any two full questions, each carries 15 marks.

4 a) Water is flowing through an inclined venturimeter in the upward direction. The inlet and throat diameters of the venturimeter are 200 mm and 100 mm respectively. The pressure at inlet is 19.62 N/cm^2 (gauge) and at throat is 3.92 N/cm^2(vaccum). The length between inlet and throat of the venturimeter is 500 mm and is inclined at 60^o with horizontal. Find the discharge through the venturimeter. Take C_d=0.98. (9)

b) Differentiate kinetic energy correction factor and momentum correction factor. (6)

5 a) A tank has an upper cylindrical portion of 2.5 m diameter and 3 m high with hemispherical base. Find the time required to empty it through an orifice of 8 cm diameter at the bottom, if the tank is initially full of water. Take C_d=0.6. (10)

b) Explain the experimental method of determination of orifice coefficients. (5)

6 a) Water flows first over a 1 m wide trapezoidal weir at a depth of 0.2 m with a water surface width of 1.5 m and then through a right angled triangular weir installed in a channel. Find the depth of water over the triangular weir if the coefficient of discharge of trapezoidal and triangular weir are 0.62 and 0.6 respectively. (8)

b) Obtain the condition for maximum discharge over a broad crested weir. Also state its discharge equation. (7)

PART C

Answer any two full questions, each carries 20 marks.

7 a) Derive Hagen-Poiseulle equation for laminar flow through circular pipes. (10)

b) Two parallel plates kept 100 mm apart have laminar flow of oil between them with a maximum velocity of 1.5 m/s. Calculate (i) velocity at 2 cm from the plate (ii) pressure difference between two points 20 m apart, if the viscosity of oil is 24.53 Poise. (10)

8 a) Differentiate hydraulic gradient line and total energy line. (5)

b) A 250 mm diameter, 3 km long straight pipe runs between two reservoirs of surface elevation135 m and 60 m. A 1.5 km long 300 mm diameter pipe is laid parallel to the 250 mm diameter pipe from its mid-point to the lower reservoir. Neglecting all minor losses and assuming a friction factor of 0.02 for both pipe, find the increase in discharge caused by addition of 300 mm diameter pipe. (15)

9 a) State the characteristics of boundary layer growth over a flat plate. (5)

b) Explain the methods for controlling boundary layer separation. (5)

c) A smooth flat plate 2 m wide and 2.5 m long is towed in oil of relative density 0.8 at a velocity of 1.5 m/sec along its length. Find the boundary layer thickness at the trailing edge of the plate and power required for towing the plate. Take kinematic viscosity of oil as 1 stokes. (10)

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