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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

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

Course Code: CE203

Course Name: FLUID MECHANICS - I

Max. Marks: 100 Duration: 3 Hours

PART A

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

1 a) A cylinder contains a fluid at a gauge pressure of 350 kN/m^2. Express the pressure in terms of head of (a) water, (b) mercury. What would be the absolute pressure in the cylinder if the atmospheric pressure is 101.3 kN/m^2? (5)

b) An annular ring cut in a sheet metal has 1.5 m outer diameter and 1.0 m inner diameter. It is inserted vertically in a liquid of relative density 0.90 with its centre 1.75 m below the surface. Calculate the total force on one side of this ring and the location of the centre of pressure. (10)

2 a) A ship 60 m long and 10 m wide displaces 15000 kN of water. A weight of 200 kN is displaced across the deck through a distance of 5 m and the ship is tilted through 4.5^0. The moment of inertia of the ship about the fore - and - aft axis is 80 % of the circumscribing rectangle. The centre of buoyancy is 2 m below the water surface. Determine the metacentric height and the position of the centre of gravity of the ship. Take specific gravity of water as 1.03. (10)

b) Show that the streamlines and equipotential lines form a net of mutually perpendicular lines. (5)

3 a) Differentiate between the Eulerian and Lagrangian methods of representing fluid flow. (3)

b) The stream function for a flow field is represented by $\Psi = 2xy$. Show that the flow exists and is irrotational. (7)

c) Distinguish between: (5)

(i) Steady flow and Unsteady flow.

(ii) Uniform flow and Non uniform flow.

PART B

Answer any two full questions, each carries 15 marks.

4 a) 215 l of gasoline (specific gravity 0.82) flow per second upwards in an inclined (12)

venturimeter fitted to a 300 mm diameter pipe. The venturimeter is inclined at 60° to the vertical and its 150 mm diameter throat is 1.2 m from the entrance along its length. Pressure gauges inserted at the entrance and throat show pressures of 0.141 N/mm^2 and 0.077 N/mm^2 respectively. Calculate discharge coefficient of the venturimeter. If instead of pressure gauges, the entrance and throat of the venturimeter are connected to the two limbs of a U-tube mercury manometer, determine its reading in mm of differential mercury column.

b) Explain how a piton tube can be used to find out velocity at any point in a pipeline. (5)

5 a) Explain the methods of experimental determination of orifice coefficients. (6)

b) The flow in a rectangular channel is measured by a rectangular weir with crest length 2 m and height 0.6 m. Find the discharge when the head over the weir is 0.3 m. Take C_d as 0.62. Consider velocity of approach. (9)

6 a) Derive Euler's equation of motion and then obtain Bernoulli's equation by integrating it along a streamline. What are the assumptions made in deriving the equation? (8)

b) What is an orifice? How are the orifices classified? (5)

c) What is a Cipolletti weir? (2)

PART C

Answer any two full questions, each carries20 marks.

7 a) Derive Dupuit's equation for pipes in series. (5)

b) Oil of viscosity 0.97 poise and relative density 0.9 is flowing in a horizontal circular pipe of diameter 100 mm and of length 10 m. If 100 kg of oil is collected at the outlet of the pipe in 30 s, calculate the difference in pressure at the two ends of the pipe. Also, verify that the flow is laminar. (10)

c) Name the minor and major losses during the flow of liquid through a pipeline. (5)

8 a) The velocity distribution in the boundary layer is given by: $\frac{v}{V} = \frac{y}{\delta}$, where v is the velocity at a distance y from the plate and v = V at y= δ, δ being the boundary layer thickness. Find (i) the displacement thickness, (ii) the momentum thickness and (iii) the energy thickness. (14)

b) Derive the Darcy-Weisbach equation for head loss in pipes due to friction. (6)

9 a) A city water supply main is 1000 m long and delivers a flow of 100 l/s between (10)

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two reservoirs with a head difference of 15 m. It is proposed to increase the flow by 30 % by adding another pipe from the upstream reservoir in parallel and joining to the main pipe at a suitable location. Assume all pipes are of same diameter and same friction factor (f=0.02). Determine length of the additional pipe.

b) Discuss the development of boundary layer over a flat plate. (5)

c) Discuss the phenomenon of separation of boundary layer over curved surface. (5)

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