Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2018

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) Define the terms gauge pressure, vacuum pressure and absolute pressure. Indicate their relative positions on a chart. (5)

b) A cubical tank has sides of 1.5 m. It contains water in the lower 0.6 m depth. The upper remaining portion is filled with oil of relative density 0.9. Calculate for one vertical side of the tank (i) the pressure force and (ii) position of the centre of pressure. (10)

2 a) A solid cylinder of diameter 30 cm and height 15 cm is to float in in water with its axis vertical in sea water (specific gravity 1.03). If the relative density of the cylinder material is 0.9, examine the stability of cylinder. (9)

b) Derive the continuity equation for one dimensional flow. (6)

3 a) Differentiate between forced vortex flow and free vortex flow (4)

b) A velocity field is given by $u = t^2 + 3y$ and $v = 4t + 5x$. Calculate the acceleration at the point (5, 3) at time t = 2 units. (7)

c) Distinguish between: (4)

(i) rotational flow and irrotational flow.

(ii) streamline and path-line.

PART B

Answer any two full questions, each carries 15 marks.

4 a) A bend in pipeline conveying water gradually reduces from 0.6 m to 0.3 m diameter and deflects the flow through 60^0 in the anticlockwise direction. At the larger end the gauge pressure is 171.675 kN/m^2. Determine the magnitude and direction of the force exerted on the bend when the flow is 876 litres/s. The pipe is lying on a horizontal plane. Neglect the losses in the bend. (12)

b) Define kinetic energy correction factor. (3)

5 a) A 40 metres long weir is divided into 12 equal bays by vertical posts, each 0.6 m wide. Taking $C_d = 0.623$, calculate the discharge over the weir if the head over the crest is 1.20 m and velocity of approach is 2 m/s. (7)

b) A reservoir discharges through a sluice 0.915 m wide and 1.22 m deep. The top of the opening is 0.61 m below the water level in the reservoir and the downstream water level is below the bottom of the opening. Calculate (8)

(i) discharge through the opening if C_d=0.6

(ii) the percentage error if the opening is treated as a small orifice

6 a) A venturimeter 30 cm x 10 cm is provided in a vertical pipeline to measure the flow of oil of relative density 0.85. The difference in elevations of the throat section and entrance section is 40 cm, the direction of flow of oil being vertically upwards. The oil-mercury differential U tube manometer shows a gauge deflection of 20 cm. Calculate the discharge of oil and the pressure difference between the entrance section and throat section. Take the coefficient of discharge as 0.97 and specific gravity of mercury as 13.6. (10)

b) Define coefficient of velocity, coefficient of contraction and coefficient of discharge. Find out the relation among the three. (5)

PART C

Answer any two full questions, each carries 20 marks.

7 a) Derive the Hagen –Poiseulle equation for laminar flow in circular pipes. (10)

b) A horizontal pipe carrying water suddenly increases its diameter from 10 cm to 20cm. Find out the loss of head due to sudden increase in diameter if the discharge through the pipe is 150 litres/s. Also find out the pressure difference between the two sections. (6)

c) Define Hydraulic Grade Line and Total Energy Line. (4)

8 a) The velocity distribution in the boundary layer is given by: $\frac{v}{V} = \frac{3}{2}\eta - \frac{1}{2}\eta^3$ (10)
where v is the velocity at a distance y from the plate, $\eta = \frac{y}{\delta}$ and v = V at y = δ, δ being the boundary layer thickness. Find the displacement thickness and the momentum thickness in terms of δ

b) Differentiate between friction drag and pressure drag (4)

c) What are the factors affecting the boundary layer thickness along a flat plate? (6)

9 a) A 0.3 m diameter pipe 2340 m long is connected with a reservoir whose surface is 72 m above the discharging end of the pipe. If for the last 1170 m, a second pipe of the same diameter is laid beside the first and connected to it, what would be the increase in discharge? Neglect minor losses. Take f=0.02. (10)

b) Oil of specific gravity 0.85 and viscosity 2.5 Poise is flowing through a 30cm diameter pipe kept horizontally. The length of pipe is 2.5 km and the head loss is 20 m. If the flow is laminar, estimate (i) shear stress at the pipe wall (ii) shear stress at a radial distance of 10 cm from the pipe axis and
(iii) the friction factor f. (10)

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