Reg No.:_______________ Name:__________________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Third Semester B.Tech Degree (S,FE) Examination December 2020 (2015 Scheme)

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 simple U tube manometer is used to measure the vacuum pressure of a liquid of specific gravity 0.85 flowing through a pipe. One end of the manometer is connected to the centre of the pipe and other end is open to atmosphere. The difference in mercury level in the two limbs is 30 cm and height of the liquid in the limb connected to pipe is 20 cm from the centre of the pipe. Determine the pressure in the pipe.	(5)
	b)	A circular annular area of 2 m outer diameter and 1 m inner diameter is immersed vertically in water with the center of the area at 3 m below the water surface. Determine the force exerted on one side of the area and the location of the centre of pressure.	(7)
	c)	Differentiate between absolute and gauge pressure.	(3)
2	a)	Derive the continuity equation in cartesian coordinates for a three-dimensional flow.	(7)
	b)	For the velocity components in a fluid flow given by $u = 2xy$ and $v = a^2 + x^2 - y^2$, show that flow is possible. Obtain the relevant stream function.	(6)
	c)	Differentiate between rotational flow and irrotational flow.	(2)
3	a)	Differentiate between convective and local acceleration.	(2)
	b)	Explain the conditions of equilibrium for submerged bodies with neat sketches.	(4)
	c)	A ship 63 m long and 9 m wide displaces 16000 kN of water. A weight of 200 kN is displaced across the deck through a distance of 5.4 m and the ship is tilted through 5°. The moment of inertia of the ship about the fore - and - aft axis is 75% of the circumscribing rectangle. The centre of buoyancy is 2.1 m below the water surface. Determine the metacentric height and the position of the centre of gravity of the ship. Take specific weight of seawater as 10.25 kN/m^3.	(9)

PART B

Answer any two full questions, each carries 15 marks

4 a) A bend in pipeline conveying water gradually reduces from 0.3 m to 0.15 m diameter and deflects the flow through 60˚ in the anticlockwise direction. At the larger end the gauge pressure is 294.3 kN/m^2. Determine the magnitude and direction of the force exerted on the bend when the flow is 360 litres/s. The pipeline rests on ground. The loss in the bend may be assumed as 10 percent of the kinetic energy at exit of the bend. (12)

b) Define energy correction factor and momentum correction factor. (3)

5 a) A circular tank 2 m diameter has its axis vertical and contains a 10 cm diameter orifice at its bottom. If the coefficient of discharge for the orifice is 0.63, estimate the time required to lower the water surface from 3 m to 4 m height above the bottom. (5)

b) A rectangular channel 8 m wide carries a discharge of 10 m^3/s. Determine the height of a rectangular weir in this channel which can pass this discharge while maintaining an upstream depth of flow of 2 m. Take coefficient of discharge as 0.6 and consider the velocity of approach. (7)

c) Differentiate between a fully submerged orifice and partially submerged orifice. (3)

6 a) A 150 mm x 75 mm venturimeter is provided in a vertical pipeline carrying oil of specific gravity 0.78 at the rate of 0.029 m^3/s in the upward direction. The throat is 225 mm above the inlet. Calculate the pressure difference between the inlet and the throat. Take the coefficient of discharge as 0.96 (7)

b) Explain the classification of weirs. (5)

c) A 45 m long broad crested weir has 0.5 m of water above its crest. Find the maximum discharge over the weir. Take coefficient of discharge is 0.62. Neglect velocity of approach. (3)

PART C

Answer any two full questions, each carries 20 marks.

7 a) Glycerine of viscosity 1.5 Ns/m^2 and density 1260 kg/m^3 flows at a velocity of 5 m/s in a 100 mm diameter horizontal pipe. Estimate: (i) the Reynolds number of flow, (ii) the shear stress at the pipe wall and (iii) the head loss in a length of 12 m of pipe and (iv) power expended by the flow in a distance of 12 m. (10)

b) Differentiate between major loss and minor loss. (4)

c) Derive Dupuit's equation for pipes in series (6)

8 a) A smooth flat plate 1.5 m wide and 20 m long is subjected to flow of water along its length with a velocity of 2 m/s. If laminar boundary layer exists up to a value Re_x equal to 5 x 10^5, find the maximum distance up to which laminar boundary layer persists, and find its maximum thickness. Assume kinematic viscosity of water as 1x $10^{-6}m^2/s$. (6)

b) Define using figure the terms: (i) laminar boundary layer, (ii) turbulent boundary layer and (iii) laminar sublayer. (8)

c) What are the factors affecting the boundary layer thickness? (6)

9 a) On a flat plate 2 m long and 1 m wide, experiments were conducted in a wind tunnel with a speed of 50 km/h. The drag and lift coefficients are found to be 0.18 and 0.9 respectively. Calculate (i) the resultant force on the plate and (ii) the power exerted by the air stream on the plate. Take density of air as 1.15 kg/m^3 (8)

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

c) Define the terms displacement thickness, energy thickness and momentum thickness. (6)

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