Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B.TECH DEGREE EXAMINATION(R&S), DECEMBER 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) The pressure difference between two points A and B in a pipe conveying oil of specific gravity 0.9 is measured by an inverted U-tube and the column connected to B stands 1.2 m higher than that of A. A pressure gauge attached at A reads $9.81*10^5$ N/m^2 , determine the pressure in the pipe at B. (5)

b) A hollow equilateral triangular plate of side 4 m on the outside and 2m in the hollow portion is immersed in water with its plane vertical, with its vertex downwards and base upwards, base being parallel to the free surface at a depth of 1m below the free surface. Determine the hydrostatic pressure force on one side of the plate and the depth of centre of pressure. (7)

c) Define the following terms: (i) Streamline (ii) Path line (iii) Streak line. (3)

2 a) A solid cylinder of diameter 3m has a height of 2 m. Find the metacentric height of the cylinder when it is floating in water with its axis vertical. The specific gravity of the cylinder is 0.6. State whether the body is stable or not. (7)

b) What is a pressure distribution diagram? What are the applications of such diagram? (4)

c) Calculate the velocity at the point (3, 3) for the velocity potential (4)

$$\phi = \frac{\left(y^2 - x^2\right)}{2} + xy + 6$$

3 a) Derive the continuity equation for a three dimensional flow in Cartesian co-ordinates (6)

b) For the velocity potential function $\phi = \frac{3\left(y^2 - x^2\right)}{2}$, determine the corresponding stream function. Also estimate the discharge per unit depth in the *Z* direction passing between the streamlines through the points (1, 3) and (3, 3). (6)

c) Explain Circulation and Vorticity (3)

PART B

Answer any two full questions, each carries 15 marks.

4 a) An orifice meter with orifice diameter 15 cm is inserted in a pipe of 30 cm diameter. The pressure gauges fitted upstream and downstream of the orifice meter give readings of $14.715*10^4$ N/m^2 and $9.81*10^4$ N/m^2 respectively. Find the rate of flow of water through the pipe. Take C_d =0.6 (7)

b) State and prove Bernoulli's equation, mentioning the assumptions underlying it. (6)

c) What is kinetic energy correction factor ? (2)

5 a) A bend in horizontal pipeline conveying water gradually reduces from 0.6 m to 0.3 m diameter and deflects the flow through angle of 60^0. At the larger end the gauge pressure is 171.65 kN/m^2. Determine the magnitude and direction of the force exerted on the bend, (i) when there is no flow, (ii) when the flow is 876 l/s. (10)

b) What is a Cipoletti weir. Show how the effect of end contraction is compensated in a Cippoletti weir (5)

6 a) A tank is in the form of a hemisphere of 3m diameter and having a cylindrical upper part of 3 m diameter and 5 m height. Find the time required to empty it through an orifice of 50 mm diameter at its bottom if the tank is initially full of water. Take C_d=0.62. (8)

b) Water flows over a rectangular weir 2 m wide at a depth of 200 mm and afterwards passes through a triangular right angled weir. Taking C_d for the rectangular and triangular weir as 0.61 and 0.58 respectively, find the depth over the triangular weir. (7)

PART C

Answer any two full questions, each carries20 marks.

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

b) Determine the rate of flow of water through a pipe of diameter 20 cm and length 50 m when one end of the pipe is connected to a tank and other end of the pipe is open to the atmosphere. The pipe is horizontal and the height of water in the tank is 4 m above the centre of the pipe. Consider all losses and take f=0.036 (10)

8 a) Define Hydraulic Gradient Line and Total Energy Line (5)

b) A plate of 600 mm length and 400 mm wide is immersed in a fluid of specific (10)

gravity 0.9 and kinematic viscosity 10^{-4} m^2/s. The fluid is moving with a velocity of 6 m/s. Determine (i) boundary layer thickness and (ii) shear stress at the end of the plate. Also find the drag force on one side of the plate

c) Explain the phenomenon of boundary layer separation (5)

9 a) Explain "Moody's Chart". What is its use in pipe flow? (4)

b) Two parallel plates kept 0.1 m apart have laminar flow of oil between them with a maximum velocity of 1.5 m/s. Calculate the discharge per unit width, the shear stress at the plates, the difference in pressure between two points 20 m apart, the velocity gradient at the plates and velocity at 0.02 m from the plate. Take viscosity of oil to be 2.453 Ns/m^2. (10)

c) Explain with neat sketches the growth of boundary layer over a flat plate (6)

****