Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Third semester B.Tech examinations (S) September 2020

Course Code: CH205

Course Name: FLUID AND PARTICLE MECHANICS-I

Max. Marks: 100 Duration: 3 Hours

PART A

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

1 a) Explain the working of a coaxial cylinder viscometer with neat figure. State the expression for the measurement of viscosity. (5)

b) A cylinder contains fluid at a gauge pressure of 350 kN m^{-2}. Express this pressure in terms of a head of (i) water (ρ_{H_2O} = 1000 kg m^{-3}). (ii) mercury (relative density 13.6). Calculate the absolute pressure in the cylinder if the atmospheric pressure is 101.3kNm^{-2}. (5)

c) The space between two parallel plates 5 mm apart is filled with crude oil. A force of 2 N is required to dag the upper plate at a constant velocity of 0.8 m/s. the lower plate is stationary. The area of the upper plate is 0.09 m^2. Determine (1) the dynamic viscosity and (2) the kinematic viscosity of the oil in stokes if the specific gravity of the oil is 0.9. (5)

2 With neat sketch, explain the working and expression to determine the pressure difference using (i) Simple manometer (ii) Differential manometer (iii) Inclined tube manometer. (15)

3 a) A rigid steel container is partially filled with a liquid at 15 atm. The volume of the liquid is 1.232 L. At a pressure of 30 atm, the volume of the liquid is 1.231 L. Find the average bulk modulus of elasticity of the liquid over the given range of pressure if the temperature after compression is allowed to return to its initial value. Determine the coefficient of compressibility. (5)

b) With neat sketch explain the working of continuous gravity decanter. State expression for the performance of gravity decanter. (5)

c) A solid cylinder 2 m in diameter and 2 m high is floating in water with its axis vertical. If the specific gravity of the material of cylinder is 0.65. Find its metacentric height. State also whether equilibrium is stable or unstable. (5)

PART B

Answer any two full questions, each carries 15 marks.

4 a) The velocity components in a 2D plane motion of a fluid are $u = \frac{y^2 - x^2}{(x^2 + y^2)^2}$ and $v = \frac{-2xy}{(x^2 + y^2)^2}$. (10)

(i) Show that fluid is incompressible and flow is irrotational.

(ii) Show that the points (2, 2) and (1, 2-√3) are located on the same stream line.

(iii) Determine the discharge across a line joining point (1, 1) and (2, 2) given that the thickness of the fluid stream normal to the x-y plane is '*t*'.

b) Explain the Boundary-layer formation in straight tubes with neat sketch. (5)

5 A pipe bend tapers from a diameter of d_1 of 500 mm at inlet to a diameter of d_2 of 250 mm at outlet and turns the flow through an angle θ of 45°. Measurements of pressure at inlet and outlet show that the pressure p_1 at inlet is 40 kNm^{-2} and the pressure p_2 at outlet is 23 kNm^{-2}. If the pipe is conveying oil which has a density ρ of 850 kg m^{-3}, calculate the magnitude and direction of the resultant force on the bend when the oil is flowing at the rate of 0.45 m^3/s. The bend is in a horizontal plane. (15)

6 a) Sketch and explain boundary-layer separation and wake formation in pipe flow. (7)

b) Derive Bernoulli's equation from Euler's equation stating all assumptions. (8)

PART C

Answer any two full questions, each carries 20 marks.

7 a) Prove that the shear stress distribution in a pipeline follows a straight line equation. (8)

b) A 4 mm diameter horizontal, 40 m long pipe is attached to a reservoir containing 20 ℃ water. The surface of the water in the reservoir is 4 m above the pipe outlet. Assume a laminar flow and estimate the average velocity in the pipe. Also, calculate the length of the entrance region. (7)

c) State and prove Prandtl one seventh power law. (5)

8 a) Derive the expression for estimation of flow rate through venturimeter. (10)

b) With neat sketch explain any two valves using in process industries. (10)

9 a) Water at 20 ℃ is pumped at constant rate of 9 m^3/h from a large reservoir resting on the floor to the open top of an experimental absorption tower. The point of discharge is 5 m above the floor, and frictional loss in the 50 mm pipe from the reservoir to the tower amount to 2.5 J/kg. If the pump can deliver 0.1 kW, determine the height of the water level in the reservoir. (8)

b) Water flows at the rate of 0.015 m^3/s through a 100 mm diameter orifice used in a 200 mm pipe. What is the difference in pressure head between the upstream section and venacontracta section? Take co-efficient of contraction C_c=0.6 and C_v=1. (5)

c) Sketch and explain the estimation of flow rate using Rectangular and Triangular weirs. (7)

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