Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Third semester B.Tech examinations (S) September 2020

Course Code: BT201

Course Name: FLUID FLOW AND PARTICLE TECHNOLOGY

Max. Marks: 100 Duration: 3 Hours

PART A

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

1 a) Explain the terms dynamic viscosity and kinematic viscosity. Give their units in SI system. Give reasons as to why do the viscosity of gases increases with increase in temperature and that of liquids decreases with increase in temperature. (4)

b) The specific gravity of Carbon tetrachloride is 1.594. Compute the specific weight, specific volume and density (4)

c) A solid cylinder of diameter 4 m and height 4 m is flowing in water with its axis vertical. The specific gravity of the cylinder is 0.6. Comment on the stability of the body. Substantiate your answer with the help of necessary calculations. (7)

2 a) Explain the terms (i) stream line (ii) streak line (iii) stream tube (iv) path line (4)

b) Explain the Prandtl one-seventh rule for velocity distribution in turbulent flow with relevant sketches and equations. (5)

c) A Couette viscometer consists of two vertical coaxial cylinders of inner and outer diameter 15 cm and 15.1 cm. The height of the cylinders is 25 cm. The space between the inner and outer cylinder is filled with a fermentation broth of whose viscosity is to be measured. If a torque of 12 N. m is required to turn the inner cylinder at a rpm of 100, calculate the viscosity of the broth in SI units. (6)

3 a) A differential mercury manometer is used for measuring the pressure difference between two pipe lines A and B carrying two different fluids. The centre of pipe A is 1.5 m above that of pipe B. The left limb of the manometer is connected to pipe A having the fluid of specific gravity 1.5 and the right limb is connected to pipe B carrying the fluid of specific gravity 0.8. The pressure in pipe A is atmospheric pressure and that of pipe B is 1.5×10^5 N/m^2. The height of liquid from the centre of pipe A in the left limb to the interface of mercury is 2.5 m (8)

The height from the centre of pipe B to the mercury level on the left limb of the manometer is 1 m. Calculate the difference in mercury level in the manometer.

b) Derive the expression for capillary rise and capillary depression. Explain how surface tension plays a dominant role in the phenomena. (7)

PART B

Answer any two full questions, each carries 15 marks.

4 a) In a two-dimensional, incompressible flow the fluid velocity components are given by: $u = x - 4y$ and $v = -y - 4x$. Show that the flow satisfies the continuity equation. Assuming potential flow (irrotational), obtain the expression for the velocity potential. (5)

b) Oil flows from section 1 to 2 through a varying cross sectional area pipe line in which the diameter at section 1 is 20 cm and that at section 2 is 500 cm. Section 2 is 4 m above section 1. Pressure gauges mounted at section 1 and 2 indicates 1 kgf/cm^2 and 0.6 kgf/cm^2 respectively. If the discharge through the pipe is 200 litre/s. Comment on the direction of flow. Your answer should be supported with necessary calculations. Also compute the loss of head in metre of water column and the energy loss in J/kg. (5)

c) Explain the concept of boundary layer and sketch the boundary layer development for (i) flow through pipes and (ii) for flow over flat plates. (5)

5 a) Explain the importance and features of Moody diagram (5)

b) List the assumptions involved in using the Hagen Poiseuille equation and derive the equation. Deduce the equation for average velocity and maximum velocity for laminar pipe flow. (10)

6 a) List any five joints and fittings used in pipe lines with their purpose of each. (5)

b) List and define the terms Kinetic energy correction and momentum correction factor associated with Bernoulli equation. Derive the expression for the kinetic energy correction factor. (10)

PART C

Answer any two full questions, each carries 20 marks.

7 a) Explain the features of fluidization (with appropriate sketches) based on the following regimes (i) Incipient fluidization (ii) Particulate fluidization (iii) Aggregate fluidization (iv) Slugging in fluidized beds (12)

b) Water at 24 ^0C is flowing past a long cylinder at a velocity of 1 m/s in a large (8)

tunnel. The axis of the cylinder is perpendicular to the direction of flow. The diameter of the cylinder is 9 cm. Calculate the drag force per metre length of the cylinder in SI units. Given the following data. Density of water is 1 gcm^3. Viscosity of water is 1 centi-poise. Drag coefficient is 1.4.

8 a) List and explain the comminution laws. (10)

b) A solid-liquid separation system design must consider all stages of the four processes as to (i) pre-treatment (ii) solids concentration (iii) solids separation and (iv) post-treatment. Explain the processes involve in each of the above. (10)

9 a) Air flows through a powdery solid material contained in a packed bed of bed height of 0.5 m depth at a superficial velocity of 3 m/s. The density and viscosity of air is respectively 1.23 kg/m^3 and 18 centi-poise. A manometer connected to a unit registers a pressure drop of 23 mm water. Porosity of the bed is 0.4. Assuming very low Reynold's number (Reynold's number less than 1), calculate the particle diameter. (9)

b) Define the following with respect to particle size analysis: (i) Martin's diameter (ii) Feret diameter (iii) Sauter mean diameter (6)

c) Differentiate between coagulation and flocculation citing the mechanisms involved. Give any one application where the principle of coagulation and flocculation is employed. (5)

****