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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2017

Course Code: CH205

Course Name: FLUID AND PARTICLE MECHANICS-I (CH)

Max. Marks: 100 Duration: 3 Hours

PART A

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

1 a) One of the important characteristic of fluid is "Weakness of the potential energy associated with the intermolecular forces relative to the kinetic energy associated with the vibrations of the individual molecules; the molecules are too busy vibrating to hang onto one another and thus do not form a long-lived crystal". Explain. (2)

b) Find the density in slugs/ft^3 of air at sea level with 25 ^{o}C temperature and 1 atm pressure. Calculate pressure and density at 1500 m altitude assuming atmosphere follows adiabatic and reversible process. Take C_p/C_v as 1.4 for air. (13)

2 a) Find the apparent viscosity of fluid at 2000 N/m^2 from the data. Predict the type of the fluid. (7.5)

Stress, N/m^2	100	200	500	1000	2000	5000
Strain Rate, 1/s	55	75	110	150	200	300

b) A tubular centrifuge is used to separate chlorobenzene with a density of 1090 kg/m^3 from an aqueous wash liquor having density 1010 kg/m^3. The centrifuge has an inside diameter of 200 mm and rotates at 10000 rpm. The free liquid surface inside the bowl is 60 mm from the axis of rotation. If the centrifugal bowl is to contain equal masses of two liquids, what should be the radial distance from the axis to the top of the overflow of the heavy liquid? (7.5)

3 a) Explain phenomenological laws. Explain the phenomenological law in fluid flow. (3)

b) One cubic foot of water weighs 62.4 lbf under conditions of standard gravity. What is its weight? What is its density? What is its weight on the moon (g = 5.4 m/s^2)? What is its density on the moon? Find all values in SI units. (4.5)

c) Discuss the significance of metacentre and metacentric height. (3)

d) The pressure between two points A and B in a pipe conveying oil of specific gravity 0.8 is measured by an inverted U-tube. The column connected to point b stands 1.6 m higher than that at point A. A commercial pressure gauge attached directly to the pipe at A reads 1.125 kg(f)/cm^2. Determine its reading when attached directly to the pipe at B. (4.5)

PART B

Answer any two full questions, each carries 15 marks.

4 a) Water is draining from an open conical funnel at the same rate at which it is entering at the top. The diameter of the funnel is 1 cm at the top and 0.5 cm at the bottom, and it is 5 cm high. The mass flow rate of water is 60kg/h. Determine the (5)

volumetric flow rate of the water and the value of the Reynolds number entering and leaving the funnel?

b) Stating different assumption, derive Bernoulli equation. State different correction factor included to modify Bernoulli equation. (10)

5 a) The water flows through a 2.5 in inside diameter pipe at velocity of 0.06 m/s and 30 ^{o}C at known pressure. Calculate the Reynolds number in the pipe. If the above pipe diverges and then flow through 6 in inside diameter pipe, what will be the Reynolds number in 5 in pipe? Predict whether the flow is laminar or turbulent. (5)

b) Explain the concept of boundary-layer formation over a flat plate. (2.5)

c) Water flows from a tap at a pressure of 250 kN/m^2 above atmospheric. What is the velocity of the jet if frictional effects are neglected? (7.5)

6 a) Explain the different type of flow based on water flow in a river. (5)

b) Explain Eulerain and Lagrangian approaches. (2.5)

c) A stream function in a two dimensional flow is $\psi = 2xy$. Show that the flow is irrotational and determine corresponding velocity potential ϕ. (7.5)

PART C

Answer any two full questions, each carries 20 marks.

7 a) Water is flowing at Reynolds number 2000 through pipe of 10 cm inside diameter and 10 m length. Then the water flows through another pipe of 20 cm inside diameter and 10 m length after an expansion joint. Find the total pressure drop in the system. (10)

b) Draw a neat sketch of globe valve. Explain the cavitation phenomenon in globe valve. (7)

c) Compare between elbows and bends (3)

8 a) Calculate the frictional pressure drop for a commercial steel pipe with the following characteristics: length L = 30.48 m; inside diameter d = 0.0526 m; pipe roughness e= 0.000045 m; steady liquid flow rate Q= 9.085 m^3/h; liquid dynamic viscosity *p*= 0.01 Pa s; liquid density p= 1200 kg/m^3. Use Blasius equation for calculating friction factor. (10)

b) Draw a neat sketch of rotameter. (3)

c) Explain the different type of joints. Draw neat sketch of each joints. (7)

9 a) What are the relation between Churchill friction factor, Fanning friction factor and Darcy friction factor? (3)

b) Explain equivalent diameter for non-circular pipes and equivalent length for piping elements. (3)

c) Draw friction factor chart and explain the effect of Reynolds number on friction factor. (4)

d) Derive the expression for volumetric flow rate of a fluid in an orifice meter with known dimensions if a manometer is connected to measure the pressure drop. (10)

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