Reg No.:_______________ Name:__________________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B.TECH DEGREE EXAMINATION(S), MAY 2019

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)	With a neat diagram explain the working of a continuous gravity decanter.	(6)
	b)	A paint sample is tested in a cup-and-bob viscometer that has an outer radius of 5 cm, an inner radius of 4.9 cm and a bob length of 10 cm. When the outer cylinder is rotated at a speed of 4 RPM, the torque on the bob is 0.0151 Nm. Determine the shear stress and shear rate.	(6)
	c)	Discuss the thermal (with respect to temperature) variation of viscosity of gases.	(3)
2	a)	Detail about the rheological classification of non-newtonian fluids. Give some examples in chemical engineering practice.	(6)
	b)	Liquids are more compressible than gases at same temperature. Comment on this statement	(2)
	c)	A wooden cylinder of specific gravity 0.6 and diameter 0.4 m is required to float in an oil of specific gravity 0.8. Find the maximum length of the cylinder in order that it may float vertically in water. Calculate the maximum length if the fluid is water. Give your inferences.	(7)
3	a)	Use Knudsen number to analyze the concept of Continuum.	(4)
	b)	A U-Tube manometer is used to measure the pressure of water in a pipe line which is in excess of atmospheric pressure. The right limb of the manometer contains mercury and is open to atmosphere. The contact between water and mercury is in the left limb. Determine the gauge pressure of water in the main line, if the difference in levels of mercury in the U-Tube is 100 mm and the free surface of mercury is in level with centre of the pipe. Take the specific gravity of mercury as 13.6 . Sketch the arrangement.	(9)
	c)	Calculate the specific volume and specific mass of a Jatropha oil sample having specific gravity of 0.92.	(2)

PART B

Answer any two full questions, each carries 15 marks.

4 a) There cannot be any flow orthogonal to a stream tube. Comment on this statement. If the statement is true, how to estimate discharge through a stream tube? (5)

b) Derive Navier-Stoke's Equations in three dimensions (10)

5 a) A two dimensional flow is described by the velocity components: $u = 5x^3$ and $v = -15x^2y$. Determine the stream function, velocity and acceleration at a point P (x=1m, y=2m). (8)

b) Energy loss is more in turbulent flow than in laminar flow with respect to similar flow conditions. Do you agree with this? If yes, why this variation occurs? How to quantify the fluid particle shear stresses in both the flow types? (4)

c) Differentiate between steady and unsteady flow. (3)

6 a) Derive the equation of continuity from fundamental principles. (7)

b) Gasoline (specific gravity 0.8) is flowing upwards a vertical pipeline which tapers from 300 mm to 150 mm diameter. A gasoline-mercury differential manometer is connected between 300 mm and 150 mm pipe sections to measure the rate of flow. The distance between the manometer tapings is 1 m and the manometer reading is 500 mm of mercury. Find (i) Differential pressure head reading in terms of gasoline head (ii) Rate of flow. Neglect friction and other losses between tapings. (8)

PART C

Answer any two full questions, each carries 20 marks.

7 a) Derive an equation to find the flow rate using a rectangular notch equation. (5)

b) A venturimeter has its axis vertical, the inlet and throat diameters being 150 mm and 75 mm respectively. The throat is 225 mm above inlet and venturimeter coefficient of discharge = 0.96. Petrol of specific gravity 0.78 flows up through the meter at a rate of 0.029 m3/s. Find the pressure difference between inlet and throat. Assume frictional head loss between inlet and throat as 7.5% of the velocity head at throat section. (8)

c) From the laminar flow consideration through a closed circular pipe, prove that mean velocity at any section is half of the maximum value at that section. What about the mean velocity if the flow is turbulent in nature. (7)

8 a) Petroleum Naptha with specific gravity 0.667 is pumped through a horizontal pipeline of 20 cm diameter and 1.6 km long at a rate of 20 litres/s. The pump has an overall efficiency of 72% and requires 7.5 kW to pump the fluid. (i) Estimate (8)

the dynamic viscosity of Naphtha (ii) Is the flow laminar? (iii) If the flow is laminar, what is the maximum velocity of flow at any section of the pipeline? (iv) Estimate the wall shear stress.

b) State Prandtl's one-seventh power law (3)

c) Provide a sketch and explain the working of any two commonly used valves in Chemical Engineering practice for flow regulation. (5)

d) What is transition Reynolds Number? Compute the velocity of flow of an oil with specific gravity 0.92 and kinematic viscosity 10.0 cSt, flowing through a constant diameter pipe of 50 mm. Take Re= 2550 (4)

9 a) Explain the working of (i) Pitot tube (ii) Rotameter (8)

b) Explain the features of Moody's chart. (4)

c) The diameter of a horizontal pipe which is 425 mm is suddenly enlarged to 650 mm. The rate of flow of water through the pipe is 0.36 m^3/s. If the intensity of pressure in the smaller pipe is 145 kN/m^2, estimate: (i) Loss of head due to sudden enlargement (ii) Intensity of pressure in the larger pipe (iii) Change in pressure if the change of section is gradual, without any loss (8)

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