Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S7 (R, S) Examination November 2024 (2019 Scheme)

Course Code: RAT473

Course Name: FUNDAMENTALS OF MOMENTUM, HEAT AND MASS TRANSFER

Max. Marks: 100 **Duration: 3 Hours**

Heat and mass transfer data book may be permitted.

PART A

Answer all questions, each carries 3 marks. Marks

1		State and explain Newton's law of viscosity.	(3)
2		Differentiate between steady flow and unsteady flow.	(3)
3		Explain Reynold's experiment.	(3)
4		Discuss system and control volume-based approach in fluid mechanics.	(3)
5		Explain the significance of thermal diffusivity.	(3)
6		State and explain Fourier's law of conduction.	(3)
7		Define Grashoff's number? Explain its significance.	(3)
8		Explain the governing law of convective heat transfer.	(3)
9		Discuss the concept of black body. Mention the properties of black body.	(3)
10		Define mass transfer coefficient, write its unit.	(3)

PART B

Answer any one full question from each module, each carries 14 marks.

Module I

11	a)	State Hydrostatic law. Derive the mathematical representation of the same.	(10)
	b)	Calculate the pressure in terms of oil (specific gravity = 0.9) equivalent to 4.5m of water	(4)

OR

12	a)	Explain the classification of fluids and represent them in shear stress – rate of deformation graph. Mention at least one example for each classification.	(8)
	b)	Explain in detail the concept of continuum. Differentiate between macroscopic and microscopic approach.	(6)

Module II

13 a) Obtain the differential form of continuity equation in 3-D. (10)

b) What are the assumptions used in deriving Bernoulli's theorem. (4)

OR

14 a) Water is flowing through a pipe having diameter 300 mm and 200 mm at the bottom and upper end respectively. The intensity of pressure at bottom is 24.525 N/cm^2. Pressure at upper end is 9.81 N/cm^2. Determine the difference in datum head if rate of flow is 40 litre/s. (10)

b) Differentiate between laminar flow and turbulent flow. (4)

Module III

15 a) Derive general heat conduction equation in cartesian coordinate with necessary diagram. (14)

OR

16 a) A steel pipe with 50 mm outer diameter is covered with a 6.4 mm asbestos insulation (k = 0.166 W/mK) followed by a 25 mm layer of fibre-glass insulation (k = 0.0485 W/mK). The pipe wall temperature is 393 K and the outside insulation temperature is 311 K. Calculate the interface temperature between the asbestos and fibre-glass. (14)

Module IV

17 a) Describe the concept of hydrodynamic and thermal boundary layer with neat diagram. (8)

b) Explain the terms – displacement thickness, momentum thickness and energy thickness (6)

OR

18 a) Atmospheric air at 20 ^0C flows over a flat plate with a velocity of 3 m/s. If the plate is 280 mm wide and at 56 ^0C, estimate the following quantities at x = 280 mm. (14)

i) Hydrodynamic boundary layer thickness.

ii) Thermal boundary layer thickness.

iv) Local convective heat transfer coefficient.

v) Average convective heat transfer coefficient.

vi) Rate of heat transfer by convection from the plate.

Module V

19 a) State Fick's law of diffusion. Explain each term used in Fick's law with units. (7)

b) Describe Plank's law of thermal radiation. (7)

OR

20 a) Explain the radiative properties of a surface and classify bodies based on it. (6)

b) The molecular weights of the two components A and B of a gas mixture are 24 and 28 respectively. The molecular weight of gas mixture is found to be 30. If the mass concentration of the mixture is 1.2 kg/m^3, determine the following. (8)

i) Molar fractions of A & B

ii) Mass fractions of A & B

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