Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
FOURTH SEMESTER B.TECH DEGREE EXAMINATION(S), DECEMBER 2019

Course Code: CH202

Course Name: PROCESS HEAT TRANSFER

Max. Marks: 100 Duration: 3 Hours

PART A

Answer any two questions. Each question carries 15 marks.

1	a)	Write the mathematical formulation of one-dimensional, steady state heat conduction in a hollow cylinder with constant thermal conductivity in the region $a \leq r \leq b$. The temperatures and heat transfer coefficients of the inside and outside fluids are T_a and T_b and h_a and h_b respectively.	8
	b)	Derive the expression for critical thickness of insulation for a spherical system.	7
2	a)	The composite wall of a furnace consists of an inner layer of silica brick, 15 cm thick (k =1.04W/m^{0}C) and an outer layer of insulating brick, 20 cm thick (k =0.2 W/m ^{0} C). The inside temperature of the furnace is 800 ^{0} C and the interface temperature is 705 ^{0} C. Calculate (a) the rate of heat loss through the furnace wall (b) the outside temperature of the insulating brick layer.	8
	b)	Derive the expression for temperature distribution in a solid undergoing transient heat flow with negligible internal resistance.	7
3	a)	Describe the development of velocity and thermal and boundary layers for flow over a flat plate.	8
	b)	State Fourier's Law of heat conduction.	2
	c)	Define thermal conductivity and thermal diffusivity.	5

PART B

Answer any two questions. Each question carries 15 marks

4	a)	Using dimensional analysis develop a relationship between Nu, Re, Pr for forced convection heat transfer.	8
	b)	State and explain laws of black body radiation.	7
5	a)	Ethylene glycol at 60 ^{0} C with a mean velocity of 4cm/s enters a 6m long heated section of a thin walled 2.5 cm ID tube after passing through an isothermal calming section. In the heated path the tube wall is maintained at a uniform temperature of 100 ^{0} C by condensing steam on the outer surface of the tube. Calculate the exit temperature of glycol. At 60 ^{0} C properties of ethylene glycol are Cp= 2564 J/kg K,	8

$\rho = 1.088$ kg/m^3, $\nu = 4.75 \times 10^{-6}$ m^2/s, k= 0.26 W/m^{0}C, Pr = 51.

b) With a neat diagram describe the basic construction of a shell and tube heat exchanger. 7

6 a) Develop the expression for Reynold's analogy between momentum and heat transfer. State the assumptions properly. 8

b) Water at the rate of 4080 kg/hr is heated from 35 ^{0} C to 75 ^{0} C by an oil having a specific heat of 1900 J/kg K. The exchanger is of a counter flow double pipe design. The oil enters at 110 ^{0} C and leaves at 75 ^{0} C. Determine the area of the heat exchanger necessary to handle this load if the overall heat transfer coefficient is 320 W/m^{2}K. 7

PART C

Answer any two questions. Each question carries 20 marks.

7 a) Derive the expressions for temperature distribution and heat flux for an infinitely long fin of uniform cross section. 10

b) Using a boiling curve describe the regimes of pool boiling. 10

8 a) Describe the construction and operation of (i) Short tube vertical evaporator (ii) Falling film evaporator. 10

b) Compare and contrast dropwise and filmwise condensation. 10

9 a) Describe the different feeding arrangements in multiple-effect evaporators. Also discuss their merits and demerits. 10

b) Briefly describe (i) Critical heat flux for nucleate pool boiling (ii) Factors affecting condensation. 5

c) Bring out the significance of (i) Bond No. (ii) Jakob No. 5