

Reg No.: _____

Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Fourth semester B.Tech examinations (S), September 2020

Course Code: CH202**Course Name: PROCESS HEAT TRANSFER (CH)**

Max. Marks: 100

Duration: 3 Hours

PART A*Answer any two questions. Each question carries 15 marks.*

- 1 a) Derive the expression for temperature distribution in a hollow cylinder without internal energy generation. Also obtain the expression for heat flux. State your assumptions properly. 9
- b) Explain the significance of Biot and Fourier Numbers. 6
- 2 a) An aluminium sphere of weight 2.5 kg is initially kept at a temperature of 350 °C. It is suddenly immersed into a fluid kept at 20 °C. The convective heat transfer coefficient is 58 W/m²K. Estimate the time required to cool the sphere to 100 °C using lumped capacity analysis method. Given density of aluminium = 2700 kg/m³, specific heat = 900 J/kgK, thermal conductivity = 205 W/mK. 9
- b) Describe different types of boundary conditions applied to heat conduction problems. 6
- 3 a) What is meant by thermal resistance? Explain the electrical analogy for solving heat transfer problems. 5
- b) Derive the expression for critical thickness of insulation for a cylindrical system. Explain optimum thickness of insulation. 8
- c) State Fourier's law of heat conduction 2

PART B*Answer any two questions. Each question carries 15 marks*

- 4 a) Develop the expression for Reynold's analogy between momentum and heat transfer. State the expression for Colburn analogy. 15
- 5 a) Describe the basic construction of a shell and tube heat exchanger with a neat diagram. 15
- 6 a) Air at a temperature of 300 °C flows with a velocity of 10 m/s over a flat plate of length 0.5 m. Compute the cooling rate per unit width of the plate needed to maintain it at a surface temperature of 27 °C. (Given properties of air at 437 K are 7

kinematic viscosity = $5.21 \times 10^{-4} \text{ m}^2/\text{s}$, thermal conductivity = 0.0364 W/m K , $Pr = 0.686$, Specific heat = 1.021 kJ/kg K).

- b) A grey surface is maintained at a temperature of 827°C . If the maximum spectral emissive power at that temperature is $1.37 \times 10^{10} \text{ W/m}^2$, determine the emissivity of the body and the wavelength corresponding to the maximum spectral intensity of radiation. 8

PART C

Answer any two questions. Each question carries 20 marks.

- 7 a) List out the types of evaporators. Briefly describe the construction and operation of the long tube vertical evaporator and the plate type evaporator. 20
- 8 a) Distinguish between dropwise and film wise condensation. 6
- b) Write down the Rohsenow correlation and Zuber correlation for pool boiling. 8
- c) Briefly describe the factors affecting condensation. 6
- 9 a) Briefly describe various types of fins. 8
- b) Define fin efficiency and effectiveness. 8
- c) Write down the Nusselt equation for determination of condensation heat transfer coefficient. 4