2106

Code No: 5221AQ

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech II Semester Examinations, August - 2017

ADVANCED HEAT AND MASS TRANSFER

(Thermal Engineering)

Time: 3hrs **Max.Marks:75**

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A. Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.

PART - A

5 × 5 Marks = 25

1.a) Explain various terms in general heat conduction equation. [5]
b) List out and compare types of finite difference methods used in steady and transient state heat conduction problems. [5]
c) Explain briefly the significance of thermal entry regions. [5]
d) Mention assumptions and correlations of film condensation for different geometries. [5]
e) Discuss the Significance of non-dimensional numbers in mass transfer. [5]

PART - B

5 × 10 Marks = 50

2.a) Derive the General Heat Conduction Equation in Cartesian co-ordinates.
b) A carbon steel ($K=54 w/m^0C$) rod with a cross-section of an equilateral triangle (each side 5 mm) is 80 mm long. It is attached to a plane wall which is maintained at a temperature of 400^0C. The surrounding environment is at 50^0C and unit surface conductance is $90 w/m^2$. Calculate the heat dissipated by the rod. [5+5]

OR

3. Write a brief note on time constant and response of temperature in case of transient heat conduction. [10]

4.a) State and explain momentum equation.
b) What is dimensional analysis and how it is used for forced convection method. [5+5]

OR

5.a) Differentiate implicit and explicit schemes of finite difference methods.
b) Develop FDE formulation for 1 –D steady state heat conduction in a slab of thickness L and energy generated q w/m^3. Solve if $q = 8 \times 10^2$ w/m^3, $k = 20$ w/m/k, the temperature at the wall are 22^0C inside and 230^0C outside. Take the thickness of the wall as 0.5 m and make at least five divisions. [5+5]

6. A furnace in the form of a cube of 2 m side has gas in it at 1500 K. The analysis of gas is 16% CO_2, 10% H_2O and the rest are non radiating gases. Determine the emissivity of the gas body. The total pressure is 1 atm. [10]

OR

7. Dry air at 30^0C flows over a flat plate at 30^0C which is covered with a water film. The velocity of the flow of air is 6 m/s. The plate is 1 m long. Determine the average convection mass transfer coefficient and also the mass of water evaporated per second. Given diffusion, $D_{AB} = 2.6 \times 10^{-6}$, Sc = 0.615, Density of water vapor at 30^0C is $P_w = 0.03$ Kg/m^3. [10]

8. A thin wall container of length 200 mm with a hot process fluid at 50^0C is placed in a quiescent cold water bath at 10^0C. Heat transfer at inner and outer surface of the container may be approximated by free convection from a vertical plate. Determine the overall heat transfer coefficient between hot process fluid and cold water bath. Assume the properties of hot process fluid as that of water. [10]

OR

9. Food preparation in the form of horizontal cylinder of 5 cm dia is to be heated by condensation of steam over its surface. Compare the heating rates when the surface is at 40^0C for steam temperatures of 100^0C and 120^0C. [10]

10. Explain the physical significance of the mass transfer coefficient and describe the analogy between heat transfer and mass transfer. [10]

OR

11. Write short notes on any two of the following
a) Diffusion and convective Mass Transfer analogies.
b) Gas Radiation.
c) Dimensional analysis. [10]

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