

Code No: 56020

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**B. Tech III Year II Semester Examinations, May - 2019****HEAT TRANSFER**
(Common to ME, AME)**Time: 3 hours****Max. Marks: 75****Answer any five questions**
All questions carry equal marks

1. Derive the general heat conduction equation in Cartesian system and hence deduce the expression for temperature distribution through a plane wall. [15]
- 2.a) Distinguish between steady state conduction and unsteady state conduction.
b) A 3cm diameter aluminium sphere of thermal conductivity 204 W/mK, density 2700 kg/m³, specific heat 0.896 kJ/kg K is initially at 175⁰ C. It is suddenly immersed in a well-stirred fluid at 25⁰ C. The temperature of the sphere is lowered to 100⁰ C in 42 sec. Calculate the heat transfer coefficient. [7+8]
- 3.a) What are Heisler Charts? Explain the significance in solving transient conduction problems.
b) A coal pallet of 1mm diameter sphere is to be heated by radiation with a source at 1200 K from 300 K to 900 K. Determine the time required. Take density =1350 kg/m³. Specific heat 1260 J/kg K, conductivity = 0.26 W/mK. [7+8]
- 4.a) Describe Buckingham's method of π -terms to formulate a dimensionally homogenous equation.
b) A flat plate 1m wide and 1.5 m long is to be maintained at 90⁰ C in air when free stream temperature is 10⁰ C. determine the velocity at which air must flow over the plate so that the rate of energy dissipation from the plate is 3.75kW. [7+8]
5. A vertical plate measuring 180 mm \times 180mm and at 50⁰ C is exposed to atmosphere at 10⁰ C. Compare the free convection heat transfer from this plate with that which would result due to forced convection over the plate at a velocity equal to twice the maximum velocity which would occur in free convection boundary layer. [15]
- 6.a) What are the modes of heat transfer in film boiling?
b) Estimate the power required to boil water in a copper pan, 0.35 m in diameter. The pan is maintained at 120⁰ C by an electric heater. What is the evaporation rate? Estimate the critical heat flux. [7+8]
- 7.a) What do you mean by fouling factor? What are the causes of fouling?
b) A counter flow heat exchanger is employed to cool 0.55 kg/s ($C_p = 2.45$ kJ/kg⁰ C) of oil from 115⁰ C to 40⁰ C by the use of water. The inlet and outlet temperatures of cooling water are 15⁰ C and 75⁰ C, respectively. The overall heat transfer coefficient is expected to be 1450 W/m² K. Using the NTU method, calculate the following: (i) The mass flow rate of water, (ii) the effectiveness of the heat exchanger and (iii) the surface area required. [7+8]
- 8.a) What do you mean by a radiation shield? Where is it used?
b) Write short notes on radiation from gases, vapours and flames. [7+8]