

Heat Transfer

P. Pages : 2

Time : Three Hours

**NIR/KW/18/3787**

Max. Marks : 80

- Notes :
1. All questions carry marks as indicated.
 2. Solve **any five** questions.
 3. Due credit will be given to neatness and adequate dimensions.
 4. Assume suitable data whenever necessary.
 5. Diagrams and chemical equations should be given whenever necessary.
 6. Illustrate your answers whenever necessary with the help of neat sketches.

1. a) Derive the general heat conduction equation in Cartesian co-ordinates. Also state other forms of generation heat conduction equation. **12**
 b) Explain the significance of Biot number in unsteady state heat transfer. **4**
2. a) What are the assumptions made when we find out the expression for temperature distribution in fins. Derive an expression for temperature distribution in an infinitely long fin. **10**
 b) A steel ball 80mm in diameter is initially at 485°C. It is suddenly dipped in a bath having uniform temperature of 85°C. The convective heat transfer coefficient at the surface of the ball is 20 w/m² °C. Calculate the time required to attain a temperature of 115°C. Specific heat of steel ball is 460 J/kg °C. Density of steel ball 7800 kg/m³, K of steel 43 w/m °C. **6**
3. a) Explain the concept and use of thermal of hydrodynamic boundary layer. **8**
 b) Water flowing at a velocity of 12 m/s in a straight tube of 60 mm dia, the tube surface temperature is maintained of 70°C and the flowing water is heated from the inlet temperature of 15°C to an outlet temperature of 45°C. Taking the physical properties of water at its mean bulk temperature, Calculate
 1) Heat transferred.
 2) Length of the tube.
 Properties of water are :
 Density = 995.7 kg/m³
 Specific heat = 4174 kJ/kg C
 Thermal conductivity = 61.718 x 10⁻² w/m °C.
 Kinematic viscosity = 0.805 x 10⁻⁶ m²/s
 Prandtl No. 5.42. **8**
4. a) What are different types of boiling? Explain the pool boiling curve. **8**
 b) Differentiate between film wise & dropwise condensation. Write expressions to evaluate 'h' for condensation on horizontal & inclined tubes. **8**
5. a) How do you evaluate the performance of an evaporator? Explain multiple effect evaporator system and the different flow arrangements in a multiple effect evaporator system. Write the energy and mass balance equations for forward feed & back ward feed evaporator system. **10**

- b) In a Certain double pipe heat exchange hot water flows at a rate of 5000 kg/h and gets cooled from 95°C to 65°C. At the same time 50,000 kg/hr of cooling water at 30°C enters the heat exchanger. The flow conditions are such that overall heat transfer coefficient remains constant of 2270 w/m² °C. Determine the heat transfer area required of the effectiveness, assuming two streams are in parallel flow. Assume for both the streams Cp = 4.2 kJ/kg C. **6**
6. a) Explain the laws of radiation. **10**
- b) A black body is at a temperature of 260°C. Calculate its emissive power. If the emissive power is to be increased by 60%, to what temperature the surface of black body needs to be raised. **6**
7. a) How do you evaluate the suitability of heat Exchanger. Explain effectiveness of heat exchanger of NTU method. **8**
- b) Derive expression for time temperature distribution in an unsteady state heat transfer. **8**
8. Write short notes on :- **any four.** **16**
- 1) Thermic Fluids.
 - 2) Heat transfer in packed and fluidised bed.
 - 3) Critical thickness of insulation.
 - 4) Baffles in heat exchanger.
 - 5) Steps in Design of heat exchanger.
