Code No.: 6345

FACULTY OF ENGINEERING

B.E. (III/IV Year) (Mech.) II Semester (Main) Examination, June 2010

HEAT TRANSFER

Time : 3 Hours] [Max. Marks : 75

Answer **all** *questions from Part A.*
Answer any **five** *Questions from Part-B.*
**Use of "Heat Transfer Data Book" permissible.*

Part A – (Marks : 10 × 2½ = 25)

1. Briefly explain the physical significance of "critical radius of insulation" as applied to a cylindrical shell.
2. State and explain the Stefan-Boltzmann law of radiation heat transfer, giving the nomenclature involved in it.
3. Define "fin efficiency "(η) and "fin effectiveness" (ε) and give the relationship between the two.
4. What do you physically mean by a "lumped body'. When can it be mathematically assumed to be feasible?
5. State Buckingham's π–theorem and mention its usefulness in fluid-flow and heat-transfer problems.
6. Explain the physical significance of "Prandth number" giving relevant mathematical expression for the same.
7. State and explain Kirchhoff's laws of radiation.
8. Define and distinguish between "White" and "Black" bodies.
9. How does "fouling factor" adversely affect heat exchanger performance?
10. Define and distinguish between "Pool" and "flow" boiling.

Part B – (Marks : 5 × 10 = 50)

11. A 0.35m thick plane wall has its two surfaces maintained at 35°C and 115°C. It is given that the thermal conductivity varies with temperature, but data is provided only for temperatures of 0°C and 100°C, at which the values of thermal conductivity are given to be 26$W/m–k$ and 32 $W/m–K$, respectively. Evaluate the heat flux through the wall assuming that thevariation of thermal conductivity with temperature is Linear.

[P.T.O.

12. A 2.5cm round rod projects from the inside wall of a furance into a gas at 1200°C. The wall temperature is 800°C, while the rod is of length 10cm and of thermal conductivity 38 $W/m\text{-}K$. The convection heat transfer coefficient offered on the surface has been found to be 55 $W/m^2\text{–}K$. Calculate the tip temperature and also the rate of heat flow through the rod into the wall.

13. A cube–shaped casting of each side 15cm is made of cast iron { $k = 35\ W/mk$, $Cp = 486\ J/kgK$, $\int = 7750\ kg/m^3$ } and is at an initial uniform temperature of 400°C throughout. It is suddenly exposed to an atmosphere at 40°C, with a convection heat transfer coefficient of 30 $W/m^2\text{–}K$.Estimate the time the casting takes to get cooled down to a temperature of 200°C.

14. Atmospheric air at 30°C flows with a velocity of 0.915 m/s over an isothermal vertical flat plate, held at 45.6°C throughout, and of length 61cm. Find the velocity boundary layer thickness and the skin friction coefficient at the trailing edge of the plate and also calculate the net drag force over the entire plate. What is the pumping power needed to be expanded?

15. Saturated water, at a temperature of 100°C, is boiled using a heating element made of copper, that is immersed in water. Measurements reveal that the surface heat flux is 400 Kw/m^2. Determine the surface temperature of the heating element.

16. Determine the net rate of heat exchange by radiation between two black plates of dimensions $2m \times 2m$, when they are arranged such that they are perpendicular to each other and have a common edge, while their surfaces are maintained at temperatures of 800 K and 600 K, respectively.

17. A shell and tube heat exchanges has one shell passes and four tube passes. The hot fluid enters the tubes at 200°C and leaves at 100°C, while the cold fluid enters the shell at 20°C and leaves at 90°C. The overall heat transfer coefficient, based on a heating area of 12m², has a value of 290.75 $W/m^2\text{–}K$. Determine the heat transfer rate between the fluids for the above configuration.