Code No.: 3084

FACULTY OF ENGINEERING

B.E. III/IV Year (Mech.) II Semester (Main) Examination, May/June 2011

HEAT TRANSFER

Time : 3 Hours] [Max. Marks : 75

Answer **all** *questions from Part A.*
Answer any **five** *questions from Part B.*

Part A — (Marks :25)

1. State types of boundary conditions used in conduction heat transfer.
2. How is maximum heat transfer calculated in case of infinite bodies?
3. What is meant by dimensionless similarity variable?
4. How is a real surface usually approximated in radiation heat transfers? Justify (Gray Surface or Diffuse Surface).
5. Does a rough surface of a heat exchanges make difference in rate of heat transferred? Why?
6. How is the error calculated in finite difference technique applied to equations.
7. What are the boundary conditions used in fin approximation as thermocouple?
8. What is the general form of empirical formulae in free & forced heat transfer? Explain the parameter.
9. How can you calculate the heat emitted by a surface in a particular range of wavelength?
10. Define Reynold's number in condensation heat transfer and explain all the parameters involved.

Part B — (Marks :50)

11. Consider a 0.8m high and 1.5 m wide double-pane window consisting of two 4mm layers of glass (k= 0.78 w/m^0c) separated by a 10mm wide stagnant air space (k= 0.026 w/m^0c). Determine the steady rate of heat transfer through this double-pane window and the temperature of its inner surface for a day during which the room is maintained at 20^0 while outdoor temperature is -10^0c. Take convection heat transfer coefficients on the inner and outer surfaces of the window to be $10w/m^{20}c$ and 40 $w/m^{20}c$.

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12. A 3mm diameter and 5m long electric wire is tightly wrapped with a 2mm thick plastic cover whose thermal conductivity is 0.15w/m^{0}C. Electrical measurements indicate that a current of 10A passes through the wire and there is a voltage drop of 8v along the wire. If the insulated wire is exposed to a medium at 30^{0}C with a heat transfer coefficient of 12w/m^2 ^{0}C.

    (i) Determine the temperature at the interface of the wire and the plastic cover in steady operation.

    (ii) Determine whether doubling the thickness of the plastic cover will increase or decrease the interface temperature.

13. Steam in a healing system flows through tubes whose outer diameter is 3 cm and whose walls are maintained at a temperature of 120^{0}C. Pin fin of aluminium (F =180w/m^{0}C) of 3cm long and 0.25 cm diameter are attached to the tube. Heat is transferred to the surroundings at 25^{0}C with a heat transfer coefficient of 60w/m^{20}C. Determine the increase in heat transfer.

14. A long 10cm diameter whose external surface is 110^{0}C passes through some open area that is not protected against winds. Determine the rate of heat loss from the pipe per unit of its length when the air is at atom pressure and 10^{0}C and the wind is blowing across the pipe at a velocity of 8m/sec.

15. The temperature of the filament of an incandescent light bulb is 2500k. Assuming the filament to be a black body determine the fraction of the radiant energy emitted by the filament that falls in the visible range. Also determine the wavelength at which the emission of radiation from the filament peaks.

16. Hot oil is to be cooled in a double– tube counter flow heat exchanger. The copper inner tubes have a diameter of 2cm and negligible thickness. The inner diameter of the outer tube (the shell) is 3cm. Water flows through the tube at a rate of 0.5Kg/s and the oil through the shell at rate of 0.8Kg/s. Taking the average temperatures of the water and the oil to be 45^{0}C and 80^{0}C, respectively determine the overall heat transfer coefficient of this heat exchanges.

17. Saturated Steam at atmospheric pressure condenses on a 2m high and 3m wide vertical plate that is maintained at 80^{0}C by circulating cooling water through the other side. Determine (a) the rate of heat transfer by condensation to the plate.