Code No. : 5198

FACULTY OF ENGINEERING
B.E. 3/4 (Mech.) II Semester (Suppl.) Examination, January 2012
HEAT TRANSFER

Time: 3 Hours] [Max. Marks: 75

Note : *Answer **all** questions of Part **A**.*
*Answer **five** questions from Part **B**.*

PART – A **(25 Marks)**

1. Draw the control volume and write energy balance terms for a hollow spherical container. (Assume constant temperatures outside and inside of the container.) $2^1/_2$
2. How do you select the "constant's sign" with respect to the boundary condition, when separable variables method is used in 2-D steady state condition heat transfer ? $2^1/_2$
3. In a rectangular fin, when thickness very less than width, one dimensional heat transfer is assumed. How do you assume in case of pin fin and what will be its effect on heat dissipation ? $2^1/_2$
4. Mention the parameters defined to use Croses and Heisler charts for a finite slab, for specified temperature condition. $2^1/_2$
5. What is the difference between Nusselt number and Biot number ? $2^1/_2$
6. Mention any three differences between dimensionless numbers of free and forced convection over cylinders. $2^1/_2$
7. Under what conditions can a real surface be assumed as black body surface. $2^1/_2$
8. Show that mathematically, the rate of heat transfer by radiation is very low. $2^1/_2$
9. When a bucket containing cold water pour hot water into it. Which type of heat exchange took place ? Parallel or counter flow ? Why ? $2^1/_2$
10. What do you do to increase the number of bubbles forming on a surface ? What is the effect of number of bubbles on rate of heat transfer ? $2^1/_2$

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PART – B (5×10=50 Marks)

11. A thermopane window consists of two 5 mm thick glass sheets separated by 10 mm stagnant air gap. The convection heat transfer coefficient for inner and outside air are $10 w/m^2-k$ and $50 w/m^2-k$ respectively.

    a) Determine the rate of heat loss per square meter of the glass surface for a temperature difference of 60°C between inside and out side air.

    b) Compare the result with the heat loss, if the window had only a single sheet of glass of thickness 5mm instead of thermopane.

    c) Compare the result with heat flow, if window has no stagnant air (i.e., a sheet of glass, 10 mm. thick).

12. A 50mm thick iron plate is initially at 225°C. Its both surfaces are suddenly exposed to an environment at 25°C with convection coefficient of 500 w/m^2-k.

    a) Calculate the center temperature, 2 minutes after the start of exposure.

    b) Calculate the temperature at the depth of 10 mm from the surface, after 2 minute of exposure.

    c) Calculate the energy removed from the plate per square metre during this period.

13. Air at 27°C and 1 atm flows over a flat plate at a speed of 2 m/sec. Calculate the boundary layer thickness at distances of 0.2 and 0.4 m from leading edge of the plate. If the plate is at uniform temperature of 60°C, calculate rate of heat transfer from first 0.4 m of plate.

14. A pipe carrying steam runs in a large room and exposed to air at 30°C. The pipe surface temperature is 200°C. Diameter of the pipe is 20 cm. If the total heat loss per metre length of the pipe is 1.9193 kW/m. Determine the emissivity of the pipe surface.

15. A shell and tube type heat exchanger is to heat 10,000 kg/h of water from 16°C to 84°C by hot engine oil flowing through a shell. The oil makes a single shell pass, entering at 160°C and leaving at 94°C with an average heat transfer coefficient of 400 W/m^2 K. The water flows through 11 brass tubes of 22.9 mm inside diameter and 25.4 mm outside diameter with each tube making four passes through the shell. Assume fully developed flow, determine required tube length per pass.

16. A vertical plate 350 mm high and 420 mm wide, at 40°C, is exposed to saturated steam at 1 atm. Calculate :

    i) Film thickness at the bottom of the plate

    ii) Maximum velocity at the bottom of the plate

    iii) Total heat flux to the plate.

    Assume vapour density is small compared to that of the condensate.

17. Two large parallel plates at temperature 1000 K and 600 K have emissivity of 0.5 and 0.8 respectively. A radiation shield having emissivity 0.1 on one side and 0.05 on the other side is placed between the plates. Calculate the heat transfer-rate by radiation per square metre with and without radiation shield.
