National Program on Technology Enhanced Learning

CONDUCTION AND RADIATION

Assignment 2

1. Make suitable assumptions wherever required with justification
2. Assume any missing data

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(1) An absorbing and emitting gas at a uniform temperature of T_g= 1000 K flows between two very long parallel plates which are regarded as black and are maintained at a uniform temperature of T_1=T_2= 600 K. The spacing between the plates, L is 1m. Calculate the absorption coefficient of the gas if the amount of cooling required at each wall surface is q = 37 kW/m^2.

(2) The steady state temperature distribution in a one dimensional wall of constant thermal conductivity of 45W/mK and thickness 55 mm is observed to be T = 200 – 2000 x^2 where T is in $^\circ$ C and x is in metres (measured from the left end of the wall).

(a) What is the volumetric heat generation, q_v in W/m^3.
(b) Determine the heat flux at the two walls.
(c)What is the relationship between the wall heat fluxes and the heat generation rate?

(3) A heat sink (similar to the one you saw in class) is made of 30 rectangular aluminium fins of thickness 1.5 mm each and 50 mm length. The heat sink and the fins are 250 mm deep in the direction perpendicular to the plane of the paper. The inter-fin spacing is uniform and is also 1.5 mm. The total height of the fin (fin + unfinned portion of the base) is 95 mm. The heat sink loses heat by natural convection with a "h" value of 7.5 W/m^2K and the ambient temperature is 303 K. The heat sink is connected to electronic equipment that dissipates 200 W of heat. The heat sink is operating at steady state and the thermal conductivity of the fin material is 205 W/mK. Accounting for heat transfer from the fin and the unfinned portion of the fin base, determine the base temperature (assuming the whole base is at one temperature that is also the operating temperature of the equipment). You make make a reasonable assumption of the fin tip heat loss and can later justify it quantitatively.