is exposed to an air stream at 20°C. The convective heat transfer coefficient is 20 W/m^2-K. If the fin base temperature is is 150°C, determine the rate of heat transfer and Fin efficiency.

c) How a radiation network is is constructed between two grey surfaces exchanging radiant heat energy? 4

Q-5 a) With the help of Buckingham π-theorem show that for a forced convection $Nu = C\,Re^m\,Pr^n$. 8

b) An 8 cm diameter Orange, approximately spherical in shape, undergoes ripening process and generates 5000W/m^{3}of energy. If the external surface of the orange is at 6.5°C calculate the temperature at the center and also find the heat flow from the outer surface. Take k =0.22W/m-K for the orange. Assume steady state heat transfer. 6

c) A 3.2 mm stainless steel wire, 30 cm long has a voltage of 10 Volt impressed on it. The outer surface temperature of the wire is maintained at 93°C. Calculate the center temperature of the wire. Take resistivity (ρ) of the wire as 70 x 10^{-8} ohm-m and the thermal conductivity as 22.5 W/mK. 6

Q-6 a) 10 mm OD pipe carries a cryogenic fluid at 80K. This pipe is encased by another pipe of 15mm OD, and the space between them is evacuated. The outer pipe is at 280K. Emissivity of inner and outer surfaces is 0.2 and 0.3 respectively. (i) Determine the radiant heat flow rate over a pipe length of 5m. (ii)If a radiation shield of diameter 12mm and emissivity 0.05 on both sides is placed between the pipes, determine the percentage reduction in heat flow. (iii) What is the equilibrium temperature of the shield? 10

b) A spherical tank, 1 m in diameter is maintained at a temperature of 120°C and exposed to a convection environment with h = 25W/m^2-K and temperature of ambient is 15°C. What thickness of urethane foam (k = 20 x 10^{-3} W/m-K) should be added to ensure that the outer temperature of the insulation does not exceed 40°C? What percentage reduction in heat loss results from installing this insulation? 6

c) Define effectiveness and NTU of a heat exchanger. 4

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