HTO CHE 2253

Make Up Question paper

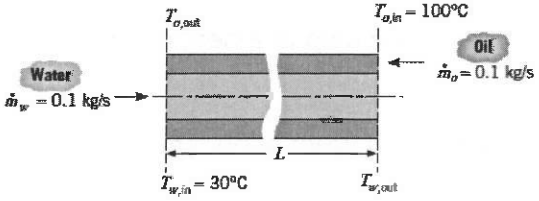
Type: DES

Q1. Define thermal diffusivity. Derive the heat diffusion equation for cartesian coordinates. (4)

Q2. What is the heat loss through a glass window (1 m by 3 m on a side) whose inner and outer surface temperatures of 5 mm thick are 15 and 5^{0}C? The thermal conductivity of glass is 1.4 W/m. K. (3)

Q3. Steel balls 12 mm in diameter are annealed by heating to 1150 K and then slowly cooling to 400 K in an air environment for which T_∞= 325 K and h= 20 W/m^2.K. Assuming the properties of the steel to be k= 40 W/m.K, ρ=7800 kg/m^3, and c= 600 J/kg. K, estimate the time required for the cooling process. (3)

Q4. A concentric tube heat exchanger for cooling lubricating oil is comprised of a thin-walled inner tube of 25-mm diameter carrying water and an outer tube of 45-mm diameter carrying the oil. The exchanger operates in counterflow with an overall heat transfer coefficient of 60 W/m^2. K and the tabulated average properties.

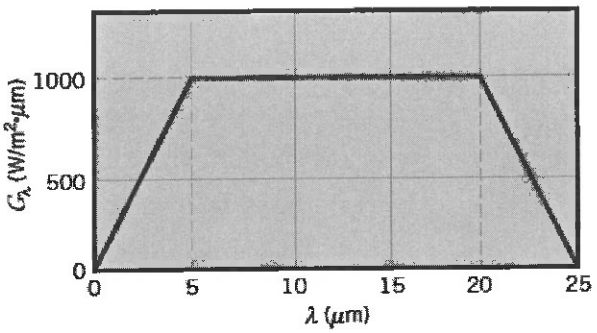


Properties	Water	Oil
ρ (kg/m^3)	1000	800
c_p (J/kg · K)	4200	1900
ν (m^2/s)	7×10^{-7}	1×10^{-5}
k (W/m · K)	0.64	0.134
Pr	4.7	140

$$NTU = \frac{UA}{C_{min}} = \frac{1}{C_r - 1} \ln\left(\frac{\varepsilon - 1}{\varepsilon C_r - 1}\right)$$

(a) If the outlet temperature of the oil is 60°C, determine the total heat transfer and the outlet temperature of the water. (b) Determine the length required for the heat exchanger. Use both LMTD and NTU method to solve the problem. (5)

Q5. What are three important concepts of a black body? The spectral distribution of surface irradiation is as follows:



What is the total irradiation? (3)

Q6. Explain extraterrestrial solar irradiation, Rayleigh, and Mie scattering for environmental radiation. (2)

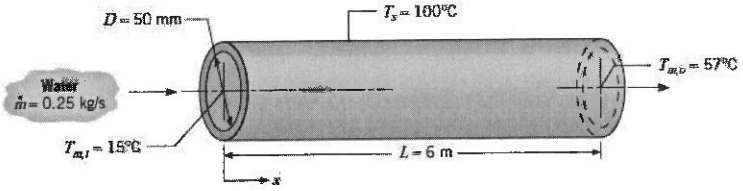
Q7. A plane wall of thickness $2L = 40$ mm and thermal conductivity $k = 5$ W/m.K experiences uniform volumetric heat generation, while convection heat transfer occurs at both of its surfaces ($x = -L, +L$), each of which is exposed to a fluid of temperature $T = 20°C$. Under steady-state conditions, the temperature distribution in the wall is of the form $T(x) = a + bx + cx^2$, where $a = 82.0°C$, $b = -210°C/m$, $c = -2X\ 10^4\ °C/m^2$, and x is in meters. The origin of the x-coordinate is at the midplane of the wall. (a) What is the volumetric rate of heat generation in the wall? (b) Determine the surface heat fluxes, at +L and -L. (4)

Q8. Describe the working of any two types of evaporators with the help of a neat diagram Define the Capacity and economy of evaporators.. (3)

Q9. With the help of a neat diagram explain various types of condensation. (3)

Q10. Calculate the thermal diffusivity of pure aluminum at 300K with ρ=2702 kg/m^3 Cp=903 J/kg K k= 237 W/m K. Define Conduction, Convection and Radiation. (2)

Q11. Steam condensing on the outer surface of a thin-walled circular tube of diameter D=50mm and length L=6m maintains a uniform outer surface temperature of 100°C. water flows through the tube at a rate of 0.25Kg/s and its inlet and outlet temperatures are 15 and 57 °C respectively. What is the average convection coefficient associated with the water flow? Consider Cp=4178 J/Kg.k.



(5)

Q12. A cartridge electrical heater is shaped like a cylinder of length L= 200 mm and outer diameter D= 20 mm. Under normal operating conditions the heater dissipates 2 kW while submerged in a water flow that is at 20°C and provides a convection heat transfer coefficient of h=5000 W/m^2. K. Neglecting heat transfer from the ends of the heater, determine its surface temperature T_s. If the water flow is inadvertently terminated while the heater continues to operate, the heater surface is exposed to air that is also at 20°C but for which h= 50 W/m^2. K. What is the corresponding surface temperature? What are the consequences of such an event? (3)

Q13. With the help of a neat diagram clearly explain various modes of pool boiling. (3)

Q14. Explain with a help of a neat diagram various types of heat exchangers. (4)

Q15. Estimate the cooling rate per unit width of the plate needed to maintain it at a surface temperature of 27°C. Air at a pressure of 6 kN/m^2 and a temperature of 300°C flows with a velocity of 10 m/s over a flat plate 0.5 m long. Pr=0.687, υ=5.21X10^{-4} m^2/s, k=36.4X10^{-3}W/m.K (3)