

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF MECHANICAL AND PRODUCTION ENGINEERING

(11)

Final Semester Examination
Course No.: ME 4613
Course Title: Applied Heat Transfer

Summer Semester: A.Y. 2021-2022
Time: 3 Hours
Full Marks: 150

There are 06 (Six) Questions. Answer all of them. Marks in the margin indicate full marks. Do not write on this question paper. Symbols carry their usual meanings. Assume reasonable values for any missing data. Programmable calculators are not allowed.

1. (a) Show the concentration profile of any species in a semi-infinite medium during transient mass diffusion and describe the penetration depth. [3X05]
(b) Describe the characteristics and physical significance of Schmidt number (Sc) and Lewis number (Le) in mass convection process. CO1/PO1
(c) Describe the process of Equimolar Isothermal Counterdiffusion of two gases A and B in mass transfer. P1
2. Draw the typical boiling curve for water at 1 atm pressure and identify the different boiling regimes. Also, explain the characteristics of each regime in details. [15]
CO2/PO2
P1
3. (a) Develop the equation of average heat transfer coefficient h for the case of laminar film condensation for vertical and inclined Plates and compare them [20]
CO3/PO3
P1, P2
(b) Develop the equation of Log Mean Temperature Difference (LMTD) for counter-flow heat exchangers and the effectiveness relation for the double-pipe parallel-flow heat exchanger. [25]
CO3/PO3
P1, P2
4. Hot air at atmospheric pressure and 80°C enters an 8-m-long uninsulated square duct of cross section $0.2\text{ m} \times 0.2\text{ m}$ that passes through the attic of a house at a rate of $0.15\text{ m}^3/\text{s}$ (Fig. 1). The duct is observed to be nearly isothermal at 60°C . Determine the exit temperature of the air and the rate of heat loss from the duct to the attic space. [25]
CO4/PO4
P1, P3
5. 6-m-long section of an 8-cm-diameter horizontal hot water pipe shown in Fig. 2 passes through a large room whose temperature is 20°C . If the outer surface temperature of the pipe is 70°C , determine the rate of heat loss from the pipe by natural convection. [25]
CO4/PO4
P1, P3
6. A 2-shell passes and 4-tube passes heat exchanger is used to heat glycerin from 20°C to 50°C by hot water, which enters the thin-walled 2-cm-diameter tubes at 80°C and leaves at 40°C (Fig. 3). The total length of the tubes in the heat exchanger is 60 m. The convection heat transfer coefficient is $25\text{ W/m}^2\text{ }^\circ\text{C}$ on the glycerin (shell) side and $160\text{ W/m}^2\text{ }^\circ\text{C}$ on the water (tube) side. Determine the rate of heat transfer in the heat exchanger (a) before any fouling occurs and (b) after fouling with a fouling factor of $0.0006\text{ m}^2\text{ }^\circ\text{C/W}$ occurs on the outer surfaces of the tubes. [25]
CO4/PO4
P1, P3

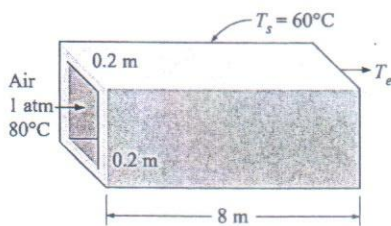


Figure: 1

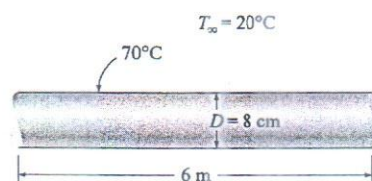


Figure: 2

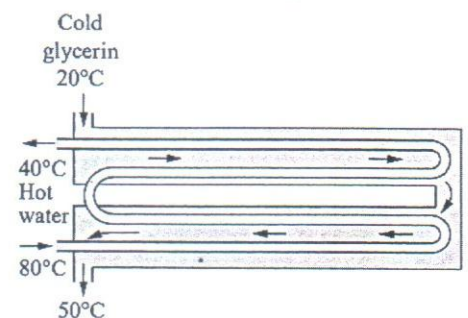


Figure: 3