UNIVERSITY
Faculty of Engineering
Department: Chemical Engineering
Stage: 3rd

Final Examination
Spring Semester (2024-2025)

Course Title: Heat Transfer
Course Code: KOU20452
Time Allowed: 120 minutes
Attached Sheet: Charts and Tables

Answer All Questions

Q1/ The temperatures on the faces of a plane wall 15 cm thick are 375 and 85 °C. The wall is constructed of a special glass with the following properties: k =0.78 W/m·°C, ρ=2700 kg/m³, cp =0.84 kJ/kg·°C. What is the heat flow through the wall at steady-state conditions?

(5)

Q2/ A hot surface at 100 °C is to be cooled by attaching 3-cm-long, 0.25-cm- diameter aluminum pin fins (see Figure 1) (fin efficiency η = 93.5%) (k = 237 W/m. °C) to it, with a center-to-center distance of 0.6 cm. The temperature of the surrounding medium is 30 °C, and the heat transfer coefficient on the surfaces is 35 W/m². °C. Determine the rate of heat transfer from the surface for a 1-m * 1-m section of the plate. Also, determine the overall effectiveness of the fins.

(10)

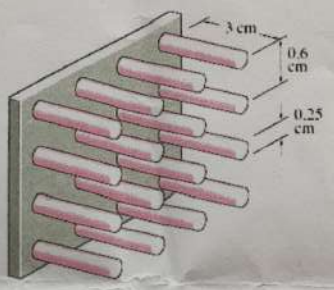

Figure 1

$$T_1 = \frac{(T_2 + 50)h + T_3 + BiT_a}{Bi + 2}$$

Q3/ Calculate the steady-state temperatures for nodes 1 to 6 in Figure 2.

(15)

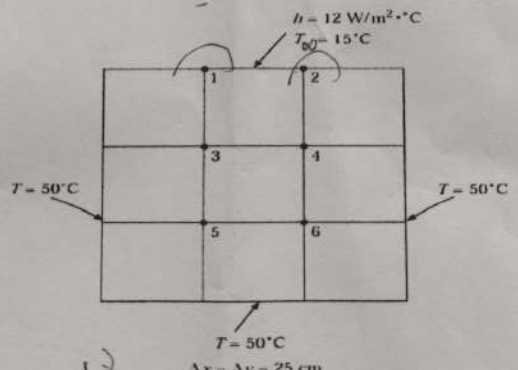

Figure 2

Q4/ A copper sphere having a diameter of 3.0 cm is initially at a uniform temperature of 50 °C. It is suddenly exposed to an air stream of 10 °C with h=15 W/m²·°C. How Long does it take the sphere temperature to drop to 25 °C?

(10)

PCV

(6)

ERSITY
y of Engineering
partment: Chemical Engineering
Stage: 3rd

Final Examination
Spring Semester (2024-2025)

Course Title: Heat Transfer
Course Code: KOU20452
Time Allowed: 120 minutes
Attached Sheet: Charts and Tables

$L = 0.3\ m$

Q5/ A truncated cone 30 cm high is constructed of aluminum. The diameter at the top is 7.5 cm, and the diameter at the bottom is 12.5 cm. The lower surface is maintained at 93 °C; the upper surface, at 540 °C. The other surface is insulated. Assuming one dimensional heat flow, what is the rate of heat transfer in watts?

$q_{total} =$

Hint: Use the attachments for find k, h, other data and calculations, if needed.

Examiner's Name: Ahmed A. Ahmed

UNIVERSITY
Faculty of Engineering
Department: Chemical Engineering
Stage: ٣rd

Midterm Examination
Fall Semester (٢٠٢٤-٢٠٢٥)

Course Title: Heat Transfer
Course Code: KOU٢٠٤٥٢
Time Allowed: ٩٠ minutes
Attached Sheet: Charts and Tables

Answer All Questions

Q1/ An aluminum fin [k=200W/m·°C] 3.0 mm thick and 7.5 cm long protrudes from a wall, as in Figure 1. The base is maintained at 300 °C, and the ambient temperature is 50 °C with h=10 W/m²·°C. Calculate the heat loss from the fin per unit depth of material.

$$m^2 \equiv \frac{hP}{kA_c}$$

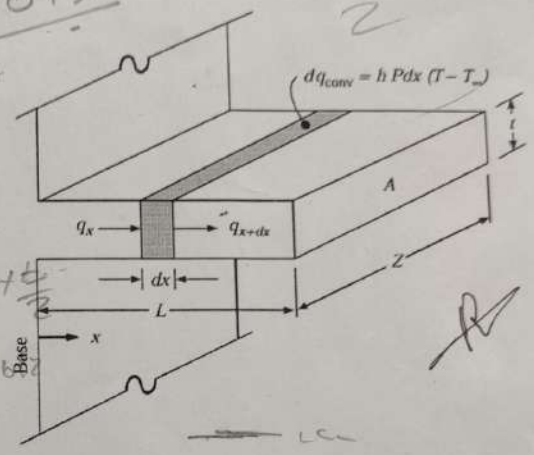

Figure 1

Q2/ A steel tube having k =46 W/m·°C has an inside diameter of 3.0 cm and a tube wall thickness of 2 mm. A fluid flows on the inside of the tube producing a convection coefficient of 1500 W/m²·°C on the inside surface, while a second fluid flows across the outside of the tube producing a convection coefficient of 197 W/m² ·°C on the outside tube surface. The inside fluid temperature is 223 °C while the outside fluid temperature is 57 °C. Calculate the heat lost by the tube per meter of length.

Q3/ A certain insulation has a thermal conductivity of 10 W/m·°C. What thickness is necessary to effect a temperature drop of 500 °C for a heat flow of 400 W/m²?

Q4/ What is heat? What are the modes that heat transferred by? What are the differences between the modes?

Q5/ A 1.0-mm-diameter wire is maintained at a temperature of 400 °C and exposed to a convection environment at 40 °C with h=120 W/m² ·°C. Calculate the thermal conductivity that will just cause an insulation thickness of 0.2 mm to produce a critical radius.

Examiner's Name: Ahmed A. Ahmed