

AE 331 QUIZ 5

BILAL HASSAN

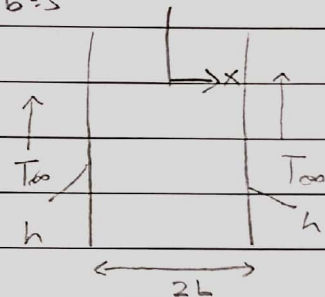
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I affirm that all the work done on this quiz is my own; have obeyed the rules indicated above and I have not given or received any help during this quiz. I understand that any indication of violation of this word of honor may lead to a zero grade on this quiz and to a disciplinary action. Bilal Hassan 2350015

P. Alani
02/12/2020

Q1. $2L = 0.85 \text{ m}$, $T_{\infty} = 715 \text{ K}$ $a=1, b=5$
 $T_i = 315 \text{ K}$, $k = 55 \text{ kW/mK}$

$\rho = 2215 \text{ kg/m}^3$, $c = 1.5 \text{ kJ/kgK}$
 $h = 35 \text{ kW/m}^2\text{K}$, $t = 20 \text{ hours}$.



$$Bi = \frac{hL}{k} = \frac{0.425 \times 35}{55} = 0.27 > 0.1$$

Hence, Lumped Capacitance Method cannot be used.

$$Fo = \frac{\alpha t}{L^2} \quad \text{where } \alpha = \frac{k}{\rho c} = \frac{55 \times 10^3}{2215 \times 1.5 \times 10^3} = 0.01655$$

$$Fo = \frac{0.01655 \times 20 \times 3600}{\left(\frac{0.85}{2}\right)^2} = 6598.6 \gg 0.2$$

Hence, an approximate single-term solution can be obtained.

(a) $T(L, 72000 \text{ s}) = ?$

For $Bi = 0.27$, by interpolation, $\xi_1 = 0.5$, $C_1 = 1.0426$
 (Table 5.1)

$$\theta_o^* = C_1 \exp(-\xi_1^2 Fo) = 0$$

$$T(L, 72000 \text{ s}) = T_{\infty} + (T_i - T_{\infty}) \theta_o^* \cos\left(\frac{\xi_1}{L}\right) = T_{\infty} = 715 \text{ K}$$

(b) $T(0, 72000 \text{ s}) = T_{\infty} + \theta_o^* (T_i - T_{\infty}) = T_{\infty} = 715 \text{ K}$

(c) $q_d''(L, 72000 \text{ s}) = 2h[T(L, 72000) - T_{\infty}] = 0$
 (both sides)

Note: Since my Fourier no. Fo came out to be very large, I had cancellations of terms. Please consider I know how to solve it. Thanks!