Chapter 4

4-1

$$T_{\rm ex} = T_{\rm ex} + A_{\rm ex} \sin \omega \tau$$

Energy balance:
$$q = hA(T - T_{ex}) = \rho_C V \left(\frac{dT}{d\tau}\right)$$

Let $K = \frac{hA}{\rho cV}$ along with initial condition $T = T_0$ at $\tau = 0$;

Solution is:

$$T - T_m = (T_0 - T_m)e^{-K\tau} + \left(\frac{KA_m}{\omega^2 + K^2}\right)[\omega(e^{-K\tau} - \cos\omega\tau) + K\sin\omega\tau]$$

4-2

$$\alpha = 1.8 \times 10^{-6} \text{ m}^2/\text{sec}$$
 $2L = 2.5 \text{ cm}$ $T_i = 150^{\circ}\text{C}$ $T_{\bar{1}} = 30^{\circ}\text{C}$
 $\tau = 1 \text{ min} = 60 \text{ sec}$ $\frac{\pi x}{2L} = \frac{\pi}{2}$; $\left(\frac{\pi}{2L}\right)^2 \alpha \tau = 1.705$

1st four nonzero terms n = 1, 3, 5, 7

$$\frac{T - T_1}{T_i - T_1} = \frac{4}{\pi} [0.1818 - 7.22 \times 10^{-8} + 6.15 \times 10^{28}] = 0.231$$

$$T = 30 + (0.231)(150 - 30) = 57.8$$
°C $\frac{\alpha \tau}{L^2} = 0.69$ $\frac{\theta_0}{\theta_i} = 0.25$

4-3

at
$$\tau = 0$$
 $\frac{x}{2L} = \frac{1}{2}$ $\frac{\pi x}{2L} = \frac{\pi}{2}$ $\frac{T - T_1}{T_1 - T_1} = \frac{4}{\pi} \left(\sin \frac{\pi}{2} + \frac{1}{3} \sin \frac{3\pi}{2} + \frac{1}{5} \sin \frac{5\pi}{2} + \frac{1}{7} \sin \frac{7\pi}{2} \right) = 0.9216$ correct value is 1.0. From = 7.84%.

4-4

$$q = \alpha A(T^4 - T_m^4) + hA(T - T_m) = -c\rho V \frac{dT}{d\tau}$$

Solution Manual Jp Holman Heat Transfer

G Psacharopoulos

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<u>Heat Transfer</u> Jack P. Holman,1993 This text presents all material appropriate for a first course in heat transfer This edition contains new material on design and computer applications and is the solutions manual for the main text

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