### 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

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

# Jp Holman Heat Transfer 10th Edition Solutions Manual

**TD Snyder** 

#### Jp Holman Heat Transfer 10th Edition Solutions Manual:

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