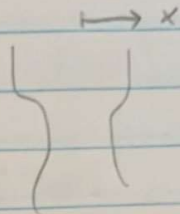


Mod D4 Problem

Steel & copper



Assume:

1-D heat trans.

Conduction in x dir

k, α const

Analysis:

Use MATLAB for plots

$$\frac{T(x,t) - T_i}{T_{\infty} - T_i} = \text{erfc}\left(\frac{x}{2\sqrt{\alpha t}}\right) - \exp\left[\frac{hx}{k} + \frac{h^2 \alpha t}{k^2}\right] \text{erfc}\left[\frac{x}{2\sqrt{\alpha t}} + \frac{h\sqrt{\alpha t}}{k}\right]$$

$$x = (0, 3), \quad t = 2, 5, 10, 15$$

↳ Assume inches. I convert to m

Steel: $h = 10000$, $k = 60.5$, $\alpha = 17.7 \times 10^{-6}$, $T_{\text{melt}} = 1643\text{K}$

b) t when melting point reached

used MATLAB plots

this happens at $t = 2$ when $x = 0$

c) Plot copper profile

d) t when copper melts

Copper ex. will melt at 18 sec at $x = 0$

e) copper is more conductive (higher k) which means heat is drawn away faster than in steel