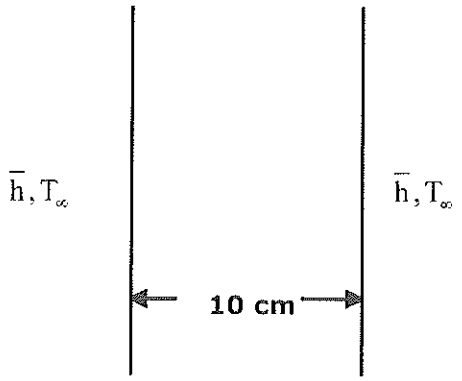
CANKAYA UNIVERSITY
FACULTY OF ENGINEERING
MECHANICAL ENGINEERING DEPARTMENT

ME 313 HEAT TRANSFER

FALL 2016

A large slab of aluminum has a thickness of 10 cm and is initially uniform in temperature at 400 ^{0}C. Suddenly it is exposed to a convection environment at 90 ^{0}C with $\bar{h}$=1400 W/m^2 ^{0}C.



How long does it take the centerline temperature to drop to 180 ^{0}C ?

$2L = 10\ cm \rightarrow L = 5\ cm$ $\quad \bar{h} = 1400\ \frac{W}{m^2 C}$

$T_i = 400^\circ C$ $\quad T_\infty = 90^\circ C$ $\quad k = 204\ \frac{W}{m^\circ C}$

$\alpha = 8.4 \times 10^{-5}\ m^2/s$

$$\frac{1}{Bi} = \frac{k}{\bar{h}L} = \frac{204}{(1400)(0.05)} = 2.91$$

i.e $Bi \cong 0.34 > 0.1$ use charts $\Rightarrow F_o = 4.2$

$$\frac{\theta_o}{\theta_i} = \frac{T_o - T_\infty}{T_i - T_\infty} = \frac{180 - 90}{400 - 90} = 0.29$$

$$F_o = \frac{\alpha t}{L^2} = 4.2 \rightarrow t = \frac{(4.2)(0.05)^2}{8.4 \times 10^{-5}} = 125\ s$$