AME 517, Fall 2009
Problem set #6
Assigned: 11/25/2009
"Due" 12/4/2009, 4:30 pm (but no late penalty until after 12/7/09, 4:30 pm)

Homework may be submitted by email (ronney@usc.edu), by fax (213-740-8071) or put in my mailbox (down the hall from my office in the OHE 430 suites, in the small room with the copy machine). DEN students should submit through the usual channels.

Note: the special symbols seem to work only on Internet Explorer, not Netscape or Safari. Click here for a pdf version of the assignment.

Chapter 10:

10.30 (answer: 37 $m^{-1}atm^{-1}$)

Chapter 11:

11.2 (answer: C = 1.9 $cm^{-3}\mu m^{-1}$ (wonderful units…), $N_T = 770/cm^3$)

11.7 (answers: $\beta_\lambda = 0.75\ cm^{-1}$, $\kappa_\lambda = 0.22\ cm^{-1}$, $\sigma_{s\lambda} = 0.52\ cm^{-1}$.)

13.7 Answers:

(a)

$$q(0) = \sigma T_1^4 - 2\sigma T_2^4 E_3(\tau_L),$$
$$q(L) = -\left[\sigma T_2^4 - 2\sigma T_1^4 E_3(\tau_L)\right]$$

$$\dot{Q}'' = -\left[1 - 2E_3(\tau_L)\right]\sigma(T_1^4 + T_2^4)$$

(b)

$$q(0) = -q(L) = \frac{1}{2}\dot{Q}'' = \frac{\left[1 - 2E_3(\tau_L)\right]\sigma T_w^4}{1 + (1/\epsilon - 1)\left[1 - 2E_3(\tau_L)\right]}$$

14.10 Answer: $T_{max} = 2113K$, $q_{wall} = 5 \times 10^5\ W/m^2$.

Hints: (i) using symmetry, show that

$$\Psi = \frac{q}{\dot{Q}'''/\kappa} = \tau - \tfrac{1}{2}\tau_L$$

(ii) boundary condition from Eq. 14.25.
(iii) radiosity (J) can be eliminated using Eq. 13.44

14.11 Answer: $T_{max} = 2172K$, $q_{wall} = 5 \times 10^5$ W/m^2

14.12 Answer: $T_{max} = 2101K$, $q_{wall} = 5 \times 10^5$ W/m^2