ECE 476/576

HW #6

8.1

$$\sigma = A_{21}\frac{\lambda_0^2}{8\pi}\left[g(\nu_0) = \frac{2}{\pi\Delta\nu_h}\right] = 9.68\times10^{-18}\ \text{cm}^2;\ \gamma_0 = 0.05\ \text{cm}^{-1} = \sigma\cdot\Delta N;$$

$$\Delta N = 5.17\times10^{+15}\ \text{cm}^{-3};\ I_s = h\nu/\sigma\tau_2 = 193.5\ \text{W/cm}^2$$

8.7

$$\sigma = A_{21}\frac{\lambda^2}{8\pi}\left[g(\nu_0) = \frac{2}{\pi\Delta\nu_h}\right] = 4.4\times10^{-14}\ \text{cm}^2;$$

$h\nu/e = 2.3$ eV; $\quad \bar{\nu} = 18{,}552\ \text{cm}^{-1}$; $\quad \lambda = 0.539\ \mu\text{m}$

$N_2\sigma = 0.01\ \text{cm}^{-1}$; $\therefore \quad N_2 = 2.26\times10^{+11}\ \text{cm}^{-3}$;

$$\frac{dN_2}{dt} = R_2 - N_2\left(\frac{1}{\tau_{20}} + \frac{1}{\tau_{21}}\right) = 0$$

$$\therefore R_2 = 3.4\times10^{+18}\ \text{cm}^{-3}/\text{sec};\ \frac{1}{\tau_2} = \frac{1}{\tau_{20}} + \frac{1}{\tau_{21}} = 1.5\times10^{+7}\ \text{sec}^{-1};$$

$I_s = (h\nu/\sigma\tau_2) = 125.4\ \text{W/cm}^2$ and the Pump power $= R_2\cdot5.5\times16\times10^{-19} = 2.99\ \text{W/cm}^3$;

$\Delta\nu/\nu = \Delta\lambda/\lambda$; $\therefore \Delta\lambda = 0.0968$ Å; $\Delta\bar{\nu} = (10^{10}\text{sec}^{-1})\div(3\times10^{+10}\text{cm/sec}) = 0.33\underline{3}\ \text{cm}^{-1}$

8.9

$$\frac{B_{12}}{B_{21}} = \frac{g_2}{g_1} = \frac{3}{5};\ \gamma_0 = A_{21}\frac{\lambda^2}{8\pi}g(\nu)\left[N_2 - \frac{g_2}{g_1}N_1\right];\ \int g(\nu)d\nu = 1 = \frac{1}{2}3^{+9}\ \text{Hz}\cdot g(\nu_0)$$

$$\therefore g(\nu_0) = \frac{2}{3}\times10^{-9}\ \text{sec};\ \text{If } N_2 = N_1 = 10^{12}\ \text{cm}^{-3}\ \text{(error in printing in 2nd Ed)}$$

$$\therefore N_2 - \frac{g_2}{g_1}N_1 = \frac{2}{5}\times10^{12}\ \text{cm}^{-3};\ \gamma_0(\nu_0) = 4.35\times10^{-2}\ \text{cm}^{-1}$$

8.13

$$\tau_p = \frac{2d/c}{1-R_1R_2T^4} = 13.1\ \text{nsec};\ \text{Is } R_1R_2T^4\exp[\gamma_0 2l_g] \overset{?}{>} 1\ \text{ or}$$

$$\text{Is } \gamma_0 \overset{?}{>} \frac{1}{R_1R_2T^4} = 4.9\times10^{-3}\ \text{cm}^{-1}$$

$\therefore \gamma_0 < \alpha$; No, it will not oscillate; $\mathbf{E} = E_0\hat{a}_x$