

## Homework #6

- 1) 6.4 & 6.5 (counts as one)
- 2) 6.6 (sunlight pumped laser!)
- 3) 6.7
- 4) A homogeneously broadened laser transition at  $\lambda = 10.6 \mu\text{m}$  ( $\text{CO}_2$ ) has the following characteristics:  $A_{21} = 0.34 \text{ s}^{-1}$ ,  $g_2 = 43$ ,  $g_1 = 41$ ,  $\Delta\nu = 1.0 \text{ GHz}$ ,  $\tau_1 = 0.1 \mu\text{s}$  and  $\tau_2 = 10 \mu\text{s}$ .  
**(a)** In general, are  $A_{21}$ ,  $\Delta\nu$ ,  $\tau_1$ ,  $\tau_2$  effectively independent quantities or can one of them be derived from the other three? **(b)** What must be the population inversion density ( $N_2 - g_2/g_1 N_1$ ) to obtain a gain coefficient of  $0.05/\text{cm}$ ? **(c)** What is  $I_{\text{sat}}$ ? (You can simply add the lifetimes to get an effective lifetime for the transition here.)
- 5) 7.3