due 10/4/17

HW 3

1. a) Derive Eqs. (5.5-23) and (5.5-24) from Eq. (5.5-19) (on page 177 of the textbook). (5 points)
   b) In a laser, its gain spectrum is determined by the Lorentzian line shape function:

$$g(\nu) = \frac{\Delta\nu}{2\pi[(\nu_0 - \nu)^2 + (\Delta\nu/2)^2]}$$

   Find the full width at half maximum (FWHM) of $g(\nu)$ when $\nu_0 = 0$ and sketch $g(\nu)$ by examining various important points (maximum point, half height point, ∞ tendency). (do not use calculator or computer) (10 points)

2. a) Problem 1.16(c) in Chapter 1 of the Laser Engineering (not the textbook) (5 points).
   b) Problem 1.18(b) in Chapter 1 of the Laser Engineering (not the textbook) (5 points).

3. a) At what incident angle θ_i so that $r_{\parallel} = \frac{-n_2 \cos\theta_i + n_1 \cos\theta_t}{n_2 \cos\theta_i + n_1 \cos\theta_t}$ equals to $r_{\perp} = \frac{-n_2 \cos\theta_t + n_1 \cos\theta_i}{n_2 \cos\theta_t + n_1 \cos\theta_i}$? Find the expression for power reflectance under this θ_i. (5 points)
   b) Use the result from a) to solve Problem 1.19(a) in Chapter 1 of the Laser Engineering. (not the textbook) (5 points)

Bonus problem for undergraduate but required for graduate students

4. a) Derive the expression for $r_{\parallel}$ in problem 3a) by completing calculation in http://scylla.ceas.uwm.edu/890/summary/pdf/pcalc.pdf
   Note: θ_1 is θ_i and θ_2 is θ_t in the pdf file. (5 points)
   b) Convert expressions for amplitude reflectance in problem 3a) in terms of tan for $r_{\parallel}$ and sin for $r_{\perp}$ similar to those in the Summary of Sept. 19. (5 points)

Extra-credit

5. Problem 1.22 in Chapter 1 of the Laser Engineering (not the textbook) (10 points).