ECE 228B
Spring 2011
Homework #4

➢**Yariv and Yeh**
  ➢**Problems 10.7, 10.11, 11.2, 11.8 (copy pages from book in 2221F ESB)**

Additional Problems:

➢A p-i-n photodiode is able to convert a pulse of light with 8 x 10^{12} photons into 3 x 10^{12} electrons that contribute to the output photocurrent.

  (a) Calculate the quantum efficiency η and the responsivity R at $\lambda_0 = 0.83$ mm, 1.3 mm and 1.55 mm.
  (b) Now assume that the photodiode is composed of $In_{0.70}Ga_{0.30}As_{0.64}P_{0.36}$ and that the intrinsic region perpendicular to the incident photons is 1 mm thick. Use Figure 11.15 for absorption as a function of wavelength for different material systems/compositions to estimate the quantum efficiency and responsivity at $\lambda_0 = 1.3$ mm.

➢A silicon p-i-n photodiode operating with 0dBm input at 0.8 mm has 20MHz bandwidth, 65% quantum efficiency, 1nA dark current and 8pf junction capacitance.

  (a) Determine the RMS current noise due to shot noise.
  (b) Determine the SNR due to shot noise.
  (c) If we require and SNR of 20dB, calculate the minimum received optical power when shot noise is the only noise source.