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PH2501 -- Photonics
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Study Guide 6

Weeks 7 & 8 12/3 - 12/10	Homework due 12/11 (Tues)

READINGS: Quimby, Chapters 13 and 14. Due to limited time, we will focus on only the sections of the book indicated:

Ch. 13: Read the discussion of *photon detectors* (such as the photodiode) on pp. 228-234. We will also discuss the two main sources of noise in photonics circuits, *shot noise* and *Johnson* (thermal) *noise*. Read the discussion on pp. 241-246, and make note of the key results for each type of noise in Eq.(13-29) and Eq.(13-33)

Ch. 14: In this chapter we focus attention on the most important type of optical detector for photonics applications, the *photodiode detector*. Methods of biasing the photodetector are discussed in terms of the *load line analysis*. The two operating regimes for a photodiode detector, the *photovoltaic* and *photoconductive modes*, are compared in terms of sensitivity and time response. Read pp. 249-258, with special attention to figs. 14-2, 14-3, and 14-8. Of the various photodiode detector types, we will consider in detail only the *PIN photodiode* on pp. 264-267. The discussion of noise in detectors is considered further in this chapter, with an emphasis on the concept of *signal-to-noise ratio* (SNR). Read pp. 273-274 on the SNR for different situations.

PROBLEMS: Ch. 13: problems 6 (assume constant quantum efficiency), 7
Ch. 14: problems 1, 2, 16 [new problem below]

14.16 For the photodiode circuit described in problem 14.1,
(a) Determine the separate contributions to the rms noise voltage due to Johnson (thermal) noise, and shot noise, and also the total combined noise voltage. Assume an incident optical power of 20 μW, room temperature (20° C), and system bandwidth of 100 kHz.