

ENEE 408E Design Problem Set 5

A guide for studying for the final. Optional for handing in.

A problem very much like (1), (2), (3), or (4) will be on the final examination

(1) A point source of light that emits 1W of light at 600nm is placed on axis 50mm from the end face of a single mode fiber with core diameter $5\mu\text{m}$, $n_1 = 1.46$, $n_2 = 1.45$. Calculate:

- (a) The N.A. of the fiber.
- (b) Is the fiber single mode at this wavelength?
- (c) If the fiber is not single mode, what wavelength would be needed to ensure this?
- (d) Use a simple ray model to calculate the power that is guided in the fiber.

(2) A photomultiplier (PMT) has a dark noise level of 100 pulses per second. Calculate the minimum optical power ($S/N=1$) at 500nm that can be detected with a 10 second integration time. Assume that the quantum efficiency of the PMT is 0.2 at 500nm.

(3) A p-i-n photodiode has responsivity 0.8A/W at $1.55\mu\text{m}$. The effective resistance of the detector circuit is 50ohm. The photodiode dark current is $1\text{pA}/\sqrt{\text{Hz}}$. Calculate the NEP at 300K of the detector. Include both shot noise and Johnson noise in your calculation. If the area of the detector is 1mm^2 what is its detectivity?

(4) In a uniaxial crystal $n_o=2$, $n_e=1.5$. What is the refractive index for a wave traveling at 30° to the optic axis. What is the angle between wave vector and ray for this wave?