NAVAL POSTGRADUATE SCHOOL
Monterey, California

EC 3550/EO 3911 FINAL EXAM 12/01 Prof. Powers

- This exam is closed book and notes; 3 sheets of 8-1/2 x 11 paper (both sides) are allowed.
- There are four problems; each is equally weighted.
- Partial credit will be given; be sure to do some work on each problem.
- Be sure to include units in your answers.
- Please circle or underline your answers.
- Show *ALL* work.
- Write only your name on this sheet.
- I will send out an email when the exams and course grades are available. They will be located outside the Optical Electronics Laboratory (Bu 224) door on the landng at the top of the stairs.
- If you want me to email your exam and course grades to you, send me an email request. (Grades are privacy protected otherwise and cannot be sent without a request.)
- Happy holidays and enjoy your break!

Course grade: _____

1		3	
2		4	
TOTAL			

Name: _____

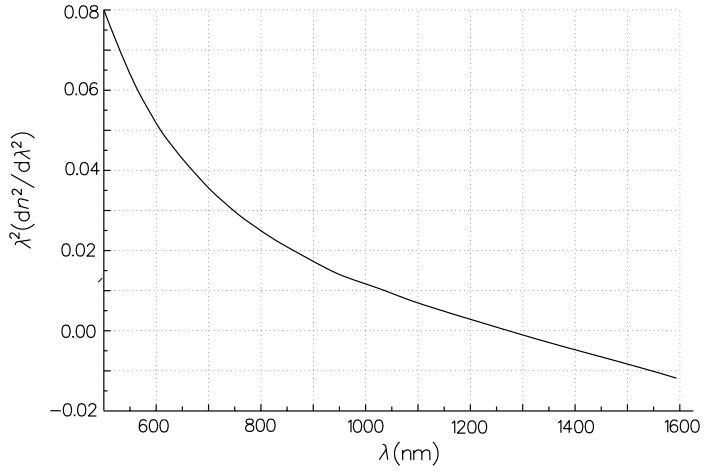

Figure 1: Fig. 3.8 of text

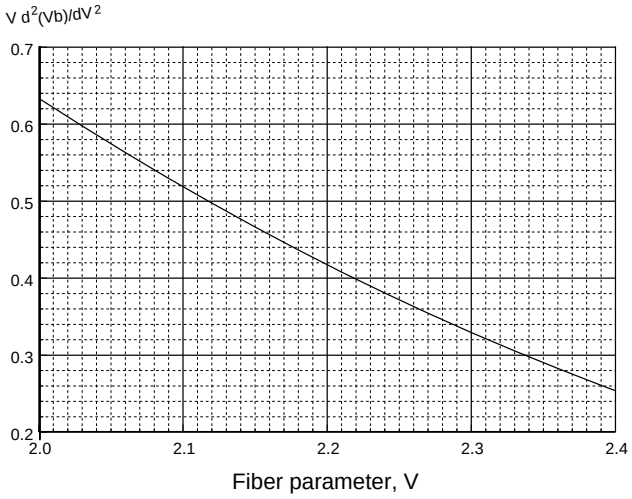

Figure 2: Fig. 3.10 of text

1. Please provide brief, concise answers to the following questions.

   (a) List the primary advantage of a graded-index multimode fiber compared to a step-index multimode fiber.

   (b) List three disadvantages of an APD detector compared to a pin-diode detector.

   (c) Draw a block diagram of an erbium-doped fiber amplifier. (Identify all of the components.)

   (d) In a lab discussion, a student asserts the measured loss across a pair of connectors was "−1.5 dBm". What is your response?

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2. Short problems.

   (a) An optical filter used in an optical amplifier has a frequency linewidth of 150 GHz. What is its spectral linewidth if its center wavelength is 1550 nm?

   (b) An optical-fiber amplifier has an usaturated gain of 30 dB. If the measured gain is 20 dB when the input power is −10 dBm, calculate the saturation power of the amplifier.

   (c) A fiber amplifier has an unsaturated gain of 32 dB. If a link/amplifier combination has an LG_0 product of 3, find the maximum distance between amplifiers if the fiber loss is 0.4 dB at the operating wavelenth.

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3. A fiber link operating at 1300 nm consists of six 10-km long fibers that are spliced together with each splice having a loss of 0.5 dB. The fiber loss at 1300 nm is 0.5 dB/km. The transmitter power (in the fiber pigtail) is 1.0 mW.

   (a) Using the "dB method", calculate the power at the receiver in dBm *and* μW.

   (b) The receiver consists of a pin diode (quantum efficiency of 80%), a load 100-kΩ load resistor with a noise temperature of 320K, and a voltage amplifier with a voltage gain of 20 dB, a noise figure of 3.5 dB, and an input resistance of 100 kΩ. Find the signal-to-noise ratio of the receiver. (You may assume that the thermal noise of the load resistor and the preamplifier are the dominant noise sources.)

   (c) Find the BER of this link.

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4. A single-mode fiber link, operating at 500 Mb/s at 1550 nm, is desired to have a dispersion-limited distance of 50 km when operating with a source with a spectral width of 1 nm. The coding of the data is nonreturn-to-zero.

   (a) Calculate the maximum total dispersion, D, with units of ps·nm^{-1}·km^{-1} that is allowed.

   (b) If an 8/125 singlemode fiber is used with a core index of 1.47 and a fractional difference in the index of refraction of 0.45%, calculate the dispersion, D, of this fiber in units of ps·nm^{-1}·km^{-1}.

   (c) Can this fiber achieve the desired dispersion-limited distance? (Show your reason.)