NAVAL POSTGRADUATE SCHOOL
Monterey, California

EC 3550 MIDTERM EXAM II 5/02 Prof. Powers

- This exam is closed book and notes; notes on four sides of 8-1/2 x 11 paper are allowed.
- There is a 50 minute time limit.
- There are three 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.
- Do *NOT* do any work on this sheet.
- Show *ALL* work.

1	
2	
3	
Total	

Name: _____

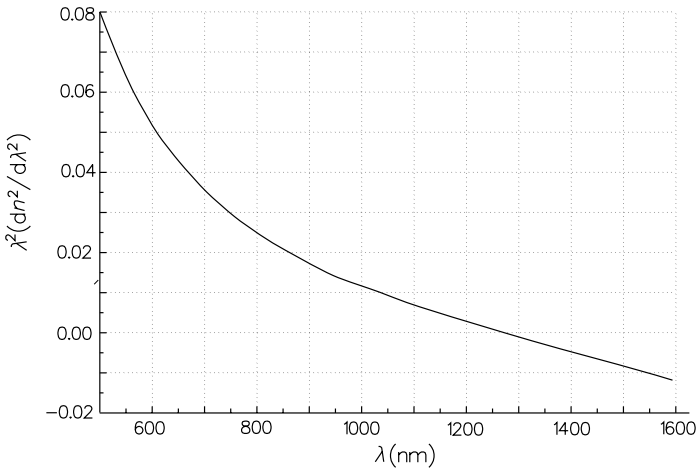

Figure 1: Fig. 3.8 of text

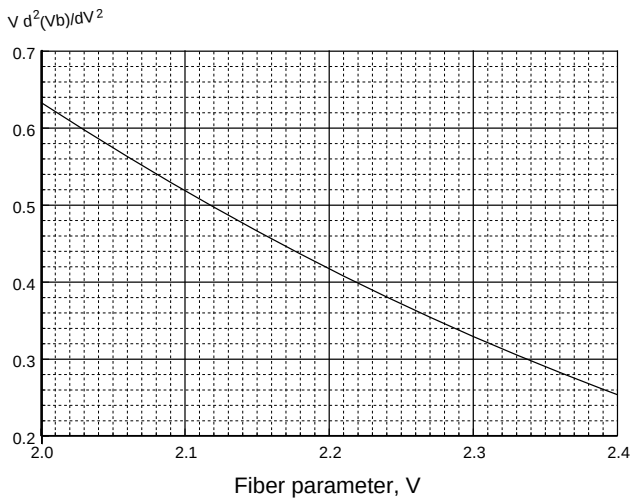

Figure 2: Fig. 3.10 of text

1. Consider a splice made between two identical pieces of 50/125 step-index multimode fiber. When the longitudinal separation is 3 μm, the losses due to this separation are 0.1 dB. Calculate the NA of the fiber.

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2. Consider a VCSEL, operating at 1300 nm, with a diameter of 10 μm that produces 80 mW. When measured as a function of angle, the power is reduced to 86% of its value at an angle of $\theta = 10$ degrees.

   The power out of the VCSEL reduces to 99% of its original value after one year of operation.

   Find the power (in watts) expected to be coupled into a 10/125 single-mode fiber pigtail with an NA of 0.09 after twenty years of operation. The core index of the fiber is 1.460 and there is a small air-gap between the source and the fiber.

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3. Consider the data link shown in Fig. 3. The laser source produces 850 μW in the fiber (point "A") at 1550 nm. The parameters for the components are shown in the tables below. (Unless specified, all other losses [e.g., losses in fiber pigtails] are negligible.)

   Using the "dB method", calculate the power that is reflected by the splice at point "B" back to the receiver (point "A") in both dBμ *and* watts.

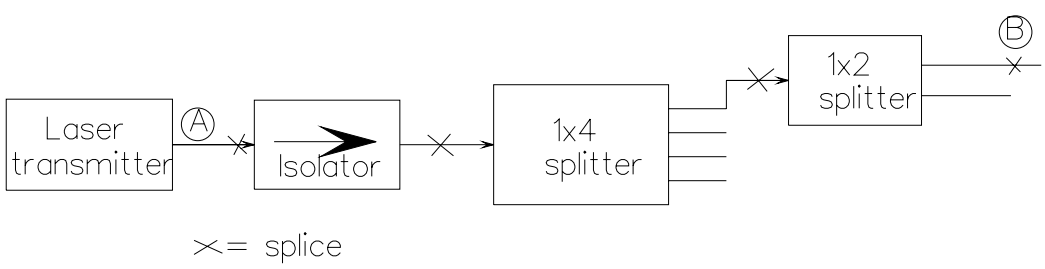

Figure 3: Fiber Link of Prob. 3.

Splice parameters		**Isolator parameters**		**Splitter parameters**	
Parameter	Value	Parameter	Value	Parameter	Value
Insertion loss	0.15 dB	Insertion losses	2.2 dB	Excess loss	0.7 dB
Return loss	25 dB	Isolation	25 dB		
		Return loss	30 dB		