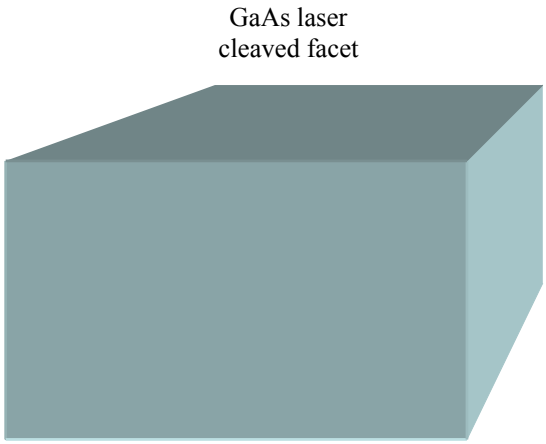
ECE 278
Final exam
Take-home, open notes, open book
Pick up at 4 pm on Monday, March 18, 2002 in EG2232
Due by 4 pm on Tuesday, March 19, 2002 in EG2232

1) (40 pts.) Verdeyen 11. 1.
2) A) (25 pts.) Use the parameters from problem 1. Consider an edge-emitting GaAs laser. The mirror is the cleaved facet, n=3.5. At T=0, plot the gain coefficient (γ) vs. photon frequency (or energy). Label your axis. I want units on both axis, or no credit. You may use whatever units you want. However, it is common practice to use cm^{-1} as the gain units, and eV as the photon energy units. (It is not necessary to go out any further than 2 eV on the x-axis.) Use the gain equation (11.4.15d) in Verdeyen. Assume T=0. Assume A=1/(1 ns). Be sure to read about the factor of h on the bottom of page 456, and use equation 11.4.10. (For this one, use $m_r=0.0597m_0$.) Also be careful about the definition of the symbol "n". In equation 11.4.15d, the symbol "n" means the index of refraction. You can just sketch the result by hand; it is not necessary to use a computer to plot.

   B) (30 pts.) The answer to this question is just a number, so I will not be giving much or any partial credit. If the only loss is due to the finite reflectivity of the end of the laser, what is the shortest length that can lase? The ends reflect because of the index of refraction mismatch between the GaAs and vacuum. (Aside: The answer to this question will tell you why it is not possible for a VCSEL to oscillate with a reflector that is only the index of refraction mismatch between air and GaAs.)

   C) (5 pts.) If the temperature is non-zero, will that increase or decrease the required minimum length to achieve lasing?



You will make the professor's life easier if you staple this sheet to the front of or back of your solutions.

1a	1b	1c	1d	2a	2b	2c	Total
/10	/10	/10	/10	/25	/30	/5	/100

A note about the course grades:
I have already posted the average HW grade and midterm grade for each student on the eee.uci.edu website. I will post the final exam grade, and the "course" numeric grade on the eee.uci.edu website as soon as I grade the exam (probably by Wednesday.) PLEASE CHECK to make sure the grades on the website agree with what I wrote on your papers. Let me know of any errors by Monday morning after finals week.