Physics 532 – Fundamentals of Photonics Spring 2004
Physics 822 – Lasers and Nonlinear Optics

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Phys 532/822 is intended to explain how lasers work and to describe some of the optical techniques used with laser beams. This material is important for many disciplines, and we may have students from Physics, Engineering, Chemistry, Astronomy, or other departments, at both the graduate and undergraduate level. It will help for everyone to be aware of the range of backgrounds present, and to ask questions about unfamiliar material when necessary.

The division between 532 and 822 is also meant to help handle the variation in background preparation. Physics graduate students should enroll in 822, and other students should enroll in 532. Exceptions to this policy should be cleared with me. Students in 822 will be graded on a separate curve and will also be given some additional homework problems that rely on physical and mathematical topics outside of those covered in class.

Class Hours: MWF 10:00 AM, in Physics 210
Office Hours: Wednesday, Thursday 3-4 PM. I'm usually available at other times in my office or lab (Phys 156) as well, and you are welcome to drop in.

Homework will be due weekly on Fridays.

Webpage: http://galileo.phys.virginia.edu/classes/532.cas8m.spring04
Assignments and solution sets will be posted on the web page.

Text: Saleh and Teich, *Fundamentals of Photonics*

Supplemental texts: (on reserve in Physics Library)
Yariv – *Quantum Electronics* (general photonics, more advanced)
Milonni and Eberly – *Lasers* (more detailed)
Seigman – *Lasers* (good physical explanations, also advanced topics)
Hecht – *Optics* (optics fundamentals)
Boyd – *Nonlinear Optics* (more detailed)

Prerequisites:
Nominally, Phys 531 Optics is a prereq for this class. Nonetheless, students who have not taken optics should be able to succeed in Phys 532, since we will review results from optics as required. However, all students will need to be familiar with Maxwell's equations, complex algebra, and basic Fourier transform theory.

Topics (book chapters):

Laser Beams – ray matrices, Gaussian beams, optical resonators (1, 3, 9)
Laser Theory – light and matter, optical amplification, laser oscillation (12, 13, 14)
Lasers Survey – solid, liquid, gas, diode, free electron lasers (14)
Modulation Techniques – electro-optic, acousto-optic (18, 20)
Nonlinear Optics – second and third order, phase matching techniques (19)
Fiber optics – fiber modes, fiber communication techniques (8, 22)

Grading:

Homework 50%
Your lowest homework score will be dropped.
Midterm and final exam 50%
Your better exam will be weighted 35%, and your worse one 15%.

Exams:

There will be a midterm and a final exam. The midterm will be take-home, and will be held over the week of March 1-5. The final will be open book, and held in class on Friday, April 30 from 9 AM to noon.