EE 530 Fall 2012 – Optical Materials, Instruments & Devices

THE PREREQUISITE WILL BE WAIVED (by the Professor).

Instructor:	Professor Robert W. Hellwarth
Office Hours:	1:30-4:00 MW
	SSC 329
E-mail:	hellwart@usc.edu
Telephone:	(213)740-4380
Class Time:	11-12:20 a.m. MW
Course URL:	TBA
Classroom:	TBA

Course Description:

Laser beams do not focus according to the famous "lens law" that you learned as an undergraduate. Perhaps you have derived this lens law in EE529 from the "geometrical optics" approximation to Maxwell's equations. However, in EE530, we will study devices and materials that are used in processing "coherent" optical beams and which require the Full Maxwell equations to analyze. These devices will include both present and future devices for fiberoptic and free space communications, liquid-crystal flat-panel and projective displays, scanning optical microscopes, optics-on-a-chip and optical modulators. Although we assume the student is familiar with Maxwell's equations, with elementary integral calculus and with vector analysis, we will devote the first two weeks to a review of a) the wave equation for optical fields, b) complex-number representations for monochromatic vector field amplitudes, and c) optical energy flows written in terms of these complex-vector amplitudes. We then proceed to analyze 1) plane wave solutions of Maxwell's equations in a homogeneous medium having arbitrary complex dielectric tensor, 2) teraherz optical modulators, 3) propagation in magnetic media, 4) propagation in optical fibers, fiber lenses, fiber gratings, fiber junctions and fiber resonators, 5) propagation in twisted birefringent media: liquid crystal displays, 6) the focusing of a Gaussian beam to deliver maximum intensity on a near or distant target, and 7) the optical waves that can exist at metal and dielectric interfaces (plasmonics). We will demonstrate a number of mathematical tricks that greatly simplify the above analyses and that have not yet found their way into published texts.

Prerequisites: None. The prerequisite "EE529" listed in the catalogue is in the process of being removed; EE529 and EE530 are now complimentary and can be taken together.

Student wishing to enroll in EE530 can get this prerequisite waved in PHE 100 or though an email to Professor.

Homework and Grading

Homework papers are assigned each Monday and due the next Monday in class with exceptions to accommodate School holidays. Each assignment will be graded and returned promptly with solutions. The lowest homework grade will be omitted from calculating the overall homework grade, which will be assigned on the basis of the class curve (from 0 to 4.2).

Midterm and final exam grades (from 0 to 4.2) will also be assigned using the class curve. The final course grade G will be computed using the formula:

$$G = \frac{[\text{homework}]}{4} + \frac{[\text{midterm}]}{4} + \frac{[\text{final}]}{2}.$$

The University grade sheet requires a letter grade, which will be calculated using the usual number-to-letter conversion.

Textbook:

There will be no required text. Class notes will be supplied by the lecturer. The book "Optical Waves in Crystals", by A. Yariv and P.Yeh, (Wiley 1984), will be kept on reserve in Seaver Library; it contains much useful data on materials. The lecturer will attempt to relate his lectures and class notes to material in books familiar to the students from other courses and sources.

Calendar 2012

First Class:	Monday, August 27
Last Class:	Wednesday, December 3
Class Holidays:	Monday, September 3 and November 21 to 24.
Midterm Exam:	Monday, October 17 (during class period)
Final Exam:	Wednesday, December 12 (11am to 1pm)