10010PHYS332000 Optics I

Lecture Hours: 11:10 – 12:00, Tuesdays, 10:10 – 12:00, Thursdays
Location: Room Phys 313
Instructor: Prof. Ci-Ling Pan (潘犀靈教授)
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Office Hours: by appointment
Teaching Assistant: to be assigned.

Course Objective:

This course is intended to provide broad, introductory to intermediate-level coverage of the field of classical optics, establishing a solid foundation for further work or study. It covers propagation of light, basic geometric optics, superposition of waves, polarization of light and its properties, interference and coherence, diffraction and imaging. Selected topics of modern optics, e.g., lasers, nonlinear optics quantum optics will be covered, time permitting

Text Book and Reading Materials:

There are no required textbooks. Course slides will be made available. Several important references have been put on reserve, available in the Physics Library, 3rd floor, the Physics Building. You are strongly urged to study the reading materials. Most of the materials are covered in:

1. A. Lipson, S.G. Lipson, and H. Lipson, **Optical Physics**, Cambridge University Press, 4th Ed., 2011.
2. Eugene Hecht, Optics, 4th Ed., Addison Wesley, 2002.

Other optics books you might be interested in consulting:

- Bahaa E. A. Saleh, Malvin Carl Teich, **Fundamentals of Photonics**, 2nd Ed., Wiley-Interscience, 2007. (First edition of the book is available as an E-book from the library).
- Frank L.Pedrotti, Leno M. Pedrotti, Leno S. Pedrotti, **Introduction to Optics**, 3rd Ed., Pearson Prentice Hall, 2007.
- Grant R. Fowles, **Introduction to Modern Optics**, Holt, Rinehart and Winston, 1968.
- Francis A. Jenkins, Harvey E. White, **Fundamentals of Optics**, McGraw-Hill, 1981.
- Karl Dieter Moller, **Optics**, University Science Books, 1988.

- Miles V. Klein, **Optics**, Wiley, 1986.
- Max Born, Emil Wolf, **Principles of optics**: electromagnetic theory of propagation, interference and diffraction of light, Pergamon Press, 1980

We use heavily slides adapted from those of Prof. Trebino's course website (Georgia Tech): http://www.physics.gatech.edu/gcuo/UltrafastOptics/

Course topics and lectures in order of presentation:

1. Review of Electromagnetic Theory, Maxwell's equations, E-M waves, Energy, Momentum, Poynting vector, light in bulk matter, index of refraction, dispersion relation $n(\omega)$.
2. Propagation of light, Rayleigh scattering, reflection, refraction, Fermat's principle, the Fresnel equations, total internal reflection, optical properties of metals.
3. Geometric optics, lenses, mirrors, fiberoptics, optical systems, thick lenses, analytical ray tracing, aberrations, GRIN systems.
4. Superposition of waves, same and different frequencies, anharmonic periodic waves.
5. Polarization, polarizers, dichroism, birefringence, polarization by reflection, circular polarizers, optical modulation, liquid crystals.
6. Interference, interferometers, multiple beam approaches.
7. Diffraction, Fraunhofer diffraction, Fresnel Diffraction

Pre-requisites:

Familiarity with optics and electromagnetism is expected, at the level of an introductory electromagnetism course. Facility with basic vector calculus and matrix operations is required. Also, we will be using complex numbers and Fourier transform techniques.

Grading

Grades will be determined by problem sets, midterm exams and a final exm. The formula that will be used to calculate your final grade is as follows:

Problem Sets and Midterms: 50%
Final Exam: 50%

Resources on the Web:

http://www.lightandmatter.com/area1book5.html#contents

http://acept.la.asu.edu/PiN/rdg/readings.shtml
http://www.physics.gatech.edu/gcuo/UltrafastOptics/index.html