10110PHYS332000 Optics I

Lecture Hours: 10:10 – 11:00, Tuesdays, 10:10 – 12:00, Thursdays
Location: Room Phys 313
Instructor: Prof. Ci-Ling Pan (潘犀靈教授)
Room 231, Physics Building
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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 and a preview of selected topics of modern optics.
- A student who have successfully completed this course is expected to have a solid foundation in optics so that
    - He can pursue optics and photonics as a career.
    - Use optics as a tool for advanced studies in science and engineering or tackling industrial problems.

Text Book

Eugene Hecht, Optics, 4th Ed., Addison Wesley, 2002.

Reading Materials:

Several important references have been put on reserve, available in the Physics Library, 3rd floor, the Physics Building.

- Lipson, S.G. Lipson, and H. Lipson, **Optical Physics**, Cambridge University Press, 4th Ed., 2011.
- 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://phweb.physics.gatech.edu/frog/lectures/index.html/

Course topics and lectures in order of presentation:

- Introduction and Remarks on History of Optics.
- Review of Wave Motion, Electromagnetic Theory, Maxwell's equations, E-M waves, Energy, Momentum, Poynting vector, light in bulk matter, index of refraction, dispersion relation $n(\omega)$.
- Propagation of light, Rayleigh scattering, reflection, refraction, Fermat's principle, the Fresnel equations, total internal reflection, optical properties of metals.
- Geometric optics, lenses, mirrors, fiberoptics, optical systems, thick lenses, analytical ray tracing, aberrations, GRIN systems.
- Superposition of waves, same and different frequencies, anharmonic periodic waves.
- Polarization, polarizers, dichroism, birefringence, polarization by reflection, circular polarizers, optical modulation, liquid crystals.
- Interference, interferometers, multiple beam approaches.
- Diffraction, Fraunhofer diffraction, Fresnel Diffraction.
- Topics in modern optics, e.g., lasers, nonlinar optics, etc.

Pre-requisites:

Familiarity with optics at the level of general physics course and electromagnetism at the level of an undergraduate electromagnetism course is assumed. 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 examination. The formula that will be used to calculate your final grade is as follows:

Problem Sets and Midterms: 60%
Final Exam: 40%