# Physics 108 Introduction to Optics (Spring, 2014)

Instructor: Xiangdong Zhu
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Lecture: 2:10 PM – 3: 00 PM, MWF, 140 Physics Building

Office hours: Drop-in, Rm. 237 Physics/Geology Building

Textbook: **Optics Introduction to Optics**, 3rd Edition, Pedrotti's (Prentice Hall, 2007)
**Lecture notes** on www.physics.ucdavis.edu/xdzhu

Homework: There are 9 assignments. Each will be posted on Monday on my Web page: www.physics.ucdavis.edu/xdzhu/course2014_Spring.html. The assignment is due on the following Monday at the time of the lecture. The assignments are graded based on the number of problems that are attempted. The solution to an assignment will be posted on the Web page after the assignment is collected.

Midterm Exam: 2:10 PM – 3 PM, **Monday, May 5, 2014**

Final Exam: 3:30 PM – 5:30 PM, **Wednesday, June 11, 2014**

Grading rules:

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|---|---|
| Homework: | 25% |
| Midterm exam: | 30% |
| Final exam: | 45% |

References: **Principles of Optics**, Born and Wolf (Pergamon Press)
**Introduction of Modern Optics**, Grant R. Fowles (Dover Publications)

Prerequisites: Physics 9 series and Math 21 sequence, preferably Physics 110 series

108 Lab: **Lab begins on 4/14/2014 (the third week of Instruction)**
3:10 – 5:30 PM, Mondays, 156A Roessler Hall

[1] *Measurement of light mean-free path in highly scattering media*
[2] *Michelson interferometer*
[3] *Measurement of refractive indices of transparent materials using Brewster angle and critical angle*

T.A.: Dan Hernandez

**SCHEDULE:**

**I. Geometric Optics:**

i. Snell's law of refraction and reflection

ii. Refraction and reflection at spherical surfaces and Paraxial approximation
Thin lens equation
Mirror equation
Microscope and Telescope
Beyond paraxial approximation: correction with lens systems

iii. $(2 \times 2)$-Matrix description for paraxial rays
Thick lens
Lens systems

**II. Wave Optics:**

i. Two-beam interference
Young's fringes
Stokes relations
Single reflections from two parallel surfaces
Michelson interferometer and Mach-Zender interferometer

ii. Multiple reflections from two parallel surfaces
Fabry-Perot Interferometer

iii. Diffraction
Fraunhofer diffraction from a single slit
Fraunhofer diffraction from multiple slits
Reflection gratings and blaze angles (optional)

**III. Maxwell's Theory of Optics**

i. Maxwell's equations and boundary conditions

ii. Snell's law of reflection and refraction (revisit)

iii. Fresnel equations of reflection and transmission

iii. Brewster angle

iv. Critical angle and evanescence wave

**IV. Optical Dielectric Constant**

i. Induced dipole moments of electrons

ii. Optical constants of metals, semiconductors, and insulators

iii. Optical constants in anisotropic optical media (liquid crystals)

iv. Optical constant in magnetic/optically active materials

**V. Polarized Light and its propagation in anisotropic Media**

i. Polarization of light

ii. Jones vector representation of polarization

iii. Jones $(2 \times 2)$-Matrix representation of polarizing optical components

ii. Light propagation in uniaxial crystals and double refraction

iii. Production of polarized light with polarizing optical components

iv. Optical activity