
Physics 464/564

http://www.physics.pdx.edu/~larosaa/Applied_Optics_464-564/Applied_Optics_464_564.html

Spring-2008

Room CH 158

T & Th 14:00-15:50

<http://www.physics.pdx.edu/~larosaa/>

Dr. Andres La Rosa

Office: SB-2-Room 418

Ph:725-8397 andres@pdx.edu

Office Hours: Th: 16:00 – 17:00 PM

Syllabus will be updated as the course progresses. Please check updates online

Text*: Optics, 4th Edition, by Eugene Hecht

Grading:

Homework	25%
1 st Exam	25% (Tentatively May 1st)
Project	25% (Presentation + Write up) Due May 12th
Final exam	25%

About the project Building an optical device, or working out a scientific paper
To be presented in front of the class (15 minutes)

Lecture Notes Available in the Online

LECTURE 1 LIGHT: WAVE or PARTICLE

1.A Evolution of the concepts about the nature of light from century to century

Particle nature of light (Newton). Light as a wave (Huygens, Maxwell)

1.B Photons and quantum mechanics

The ultraviolet catastrophe

Thermal equilibrium of radiation

Classical Theory of Cavity Radiation

Planck's Theory of Radiation

LECTURE 2 DESCRIPTION of WAVES: The WAVE EQUATION, FOURIER EXPANSION, COHERENCE LENGTH

2.A Wave Motion

Longitudinal, transverse waves, traveling waves, the Wave Equation

2.B Synthesizing Periodic Waves: The Fourier Series

Periodic waves, harmonic waves, anharmonic periodic waves

Fourier Theorem: Expressing anharmonic periodic waves in terms of harmonic waves

Wave packet: Fourier components of one pulse. The concept of wave-packet (or frequency bandwidth)

Relationship between pulse duration and frequency bandwidth.

2.C Synthesizing non-periodic waves The Fourier Integral

The Fourier components are called "Fourier transform."

The Fourier transform of the Cosine Wavetrain

2.D Coherence

Predictability, correlation, Concept of Coherence time and coherence length

LECTURE 3 ADDITION of WAVES (PHASORS) and LIGHT-MATTER INTERACTION

3.A Description of waves in complex variables

Complex numbers

Addition, multiplication, reciprocal number

Euler's representation

3.B Representation of a traveling harmonic wave in complex variable: Phasors

The concept of phasors

Phasors are complex numbers (they are not vectors)

Addition of (real) waves using phasors

Wave as the real component of a phasor. Graphic interpretation

Adding waves of the same frequency and wavelength

Example: Addition of two waves. Calculation of magnitude and phase

Generalization for the addition of many waves.

3.C Light-matter interaction

Resonant Absorption

Short-lived excited states. Return to equilibrium by re-emission of light or by thermal energy dissipation.

Line spectra from gases

The Doppler Effect and spectral line broadening

The Doppler effect and laser cooling (optical molasses)

Analogy between "electronic excitations in an atom" and the motion of a mechanically forced oscillator"

LECTURE 4 INTERFERENCE of SEVERAL COHERENT OSCILLATORS

4A. Plane Waves

4.B Interference of coherent oscillator

4.C Diffraction Grating

4.D Resolving Power of a grating, Raleigh's criterion for resolution

LECTURE 5 MAXWELL's EQUATION

5A. Vector algebra

Line integral, surface integral Gauss's and Stoke's Theorems

5.B Maxwell's Equations in Integral Form

Gauss' Law, absence of magnetic monopoles, Faraday's law, and Ampere's Law + displacement current

5.C Maxwell's Equations in Differential Form

The "Gradient," "divergence," and "rotational" operators

The Gauss Theorem. First and Second Maxwell's Equation

The Stokes Theorem. Third and Fourth Maxwell's Equation

LECTURE 6 GENERATION, PROPAGATION and DETECTION of EM WAVES

LECTURE 7 MICROSCOPIC VIEW of the INDEX of REFRACTION

The Origin of the Refractive Index

GEOMETRICAL OPTICS

LECTURE 8 PROPAGATION of LIGHT Huygens' Principle

LECTURE 9 FERMAT'S PRINCIPLE

LECTURE 10 REFRACTION at ASPHERICAL SURFACES

*** Other References**

- 1. Frank L. Pedroti, Leno S. Pedroti, Introduction to Optics, 2nd Ed. , Prentice Hall (1993).**
 - 2. R. Feynman, R. Leighton, M. Sands; "The Feynman Lectures On Physics"; Vol-I and II; Addison-Wesley; QC21.2.F49 1989.**
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