SYLLABUS PHYS 45200: ADVANCED OPTICS 2022

Instructor: Professor R.R. Alfano

Class Section: T Th 11:00 AM – 12:15 PM (**Hybrid**)

Required Text: Introduction to Modern Optics by G. Fowles (Publisher: Dover),2nd ed.

Optional Text: Nonlinear Optics, Geoffrey New (Publisher : Cambridge , Abe Books)

Prerequisites: Phys 20700, 20800;

Exams:

- Test on major topics (announced)
- Midterm (paper problem or test)
- Final Exam

Course Grades:

- Homework 30%
- Midterm or paper 10%
- Test 30%
- Final Exam 30%

TOPICS

Topic 1: First day Basic Vectors Analysis and Electromagnetism (E&M)

Second day Introduction to Singular Optics

Topic 2: Third day

- Overview of optics
- Basic Equations
- E&M waves and pulses
- Spectrum – color – x-ray to THz
- E&M pulse shapes and relationships
- Key equations in optics

Fourth day

- Maxwell Equations, Nonlinear wave Eqs

- Wave equations, paraxial approximation
- Spectral width and pulse duration relation for different pulses shapes
- Rect., gaussian, exp.
- Dispersion curves ($\omega(k) and\ n(\lambda)$
- Group and phase velocity
- Self-phase modulation and SC, SHG, parametric three waves

Topic 3:

- Poynting Vector, $\bar{S}$
- $\bar{E}, \bar{B}, \bar{k}, \bar{S}$ relationship
- Polarization states
- Algebra and matrix forms of polarized E&M waves
- Jones matrix for optical elements and beams
- Optical vortex beam

Topic4:

- Reflection from dielectric for polarized beam
- Fresnel equations amplitude and phase
- Phase and amplitude vs. angle of incidence
- Multi-beam reflection
- Etalons, time delay

Topic 5: Coherence (space and temporal)

Topic 6: Interference

Topic 7:

- Diffraction
- Fraunhofer
- Fresnel

Topic 8:

- Crystal optics (*e* and *o* waves)
- Optics of condensed matter

Class diversity statement:

I consider this classroom to be a place where you will be treated with respect, and I welcome individuals of all ages, backgrounds, beliefs, ethnicities, genders, gender identities, gender expressions, national origins, religious affiliations, sexual orientations, ability – and other visible and nonvisible differences. All members of this class are expected to contribute to a respectful, welcoming and inclusive environment for every other member of the class.

In general, anybody who is willing to have a solid background is Optics is more than welcome to take this subject.