



THE OHIO STATE UNIVERSITY
COLLEGE OF ENGINEERING

Ultrafast Laser Materials Processing

MATSCEN 5575

Credit Hours:

3.00

Course Levels:

Undergraduate (1000-5000 level)

Graduate (5000-8000 level)

Course Components:

Lecture

Course Description:

Students are expected to learn basics of laser, non-linear optics, ultrafast lasers, how intense ultrafast lasers interact with materials and ultrafast laser materials processing with a mathematical framework and hands on experience on how an ultrafast laser works, laser safety and how to characterize it and use it to modify materials.

Prerequisites and Co-requisites:

Math 1150 & 1172, Physics 1250 or equivalent, prereq or concurrent Physics 1251 or equivalent

Course Goals / Objectives:

- What and how a laser works
 - What and how an ultrafast laser works
 - Applications of ultrafast lasers in materials engineering
 - Use of Ultrafast lasers for basic non-linear optics and materials modification
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Course Topics:

- Basic optics review: E&M waves, laws of reflection and refraction, lens equation, imaging
 - Basics of what a laser is, how a laser works, simple mathematical formulation of laser amplification
 - Students perform Geometric Optics Experiments at Home with Optics kit, and prepare lab reports.
 - Basics of non-linear optics, harmonic generation, Optical Kerr effect, etc.
 - Basic Fourier transform, concept of ultrashort pulses
 - Ultrashort pulses, how they are generated, mode-locking, how they are characterized
 - Ultrafast Laser safety, eye safety calculations, students take laser safety online course EHS
 - Students study non-linear optics with ultrafast lasers, harmonic generation in various materials
 - Midterm + Introduction to ultrafast laser materials interaction
 - Ultrafast laser damage and ablation I
 - Ultrafast laser damage and ablation II
 - Ultrafast laser surface engineering
 - Ultrafast Laser machining
 - Ultrafast Laser medical applications & surgery (tissue, eye, dental, ear, neuro-)
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Designation:

Elective