THE OHIO STATE UNIVERSITY
COLLEGE OF ENGINEERING

Ultrafast Laser Materials Processing

MATSCEN 7575

Credit Hours:
3.00

Course Levels:
Graduate (5000-8000 level)

Course Components:
Lecture

Course Description:
Advanced study of lasers, non-linear optics, ultrafast lasers, and ultrafast laser materials processing. Modeling of non-linear optics, as well as a study of the interaction of materials and ultrafast lasers. Includes hands-on experience of how an ultrafast laser works, laser safety, how to characterize, and use of ultrafast lasers to modify materials.

Prerequisites and Co-requisites:
Graduate standing in Engineering, Physics, Chemistry, or Mathematics

Course Goals / Objectives:
- Students will have a working knowledge of what a laser is and how it works
- What an ultrafast laser (UFL) is, how it works, and its engineering applications
- How to perform realistic modeling in lasers and non-linear optics: design a laser amplifier and an optical parametric amplification system using equations derived in class, and using SNLO software, introduced in class.
- Basic mechanisms of UFL-materials interaction: strong field ionization, free electron interaction with laser, electron lattice collision and energy transfer, two temperature model, learn how to perform model of laser damage and ablation
- How to use an ultrafast laser for basic non-linear optics and materials modification

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-)

Designation:

Elective