EEC 289K – Spring 2020

Ultrafast Photonics

Science, Technology, and Applications

Course Description:

Ultrafast lasers are rapidly finding their way into laboratories all over the world. In this course, we will explore what makes these short-pulse lasers useful for applications ranging from bio-imaging to x-ray generation. Specifically, we will cover the *essentials* of ultrafast photonics, including the basic science of ultrashort laser pulses, the technology to generate and manipulate these pulses, and a few of the numerous applications of ultrafast photonic systems.

Course Goals:

This course will prepare students for experimental or theoretical work that involves the use of ultrafast lasers, and it will provide a taste of some of the exciting developments in the application of such ultrafast systems.

Schedule:

Time: TR 2:10-4pm
Location: Olson 159
Instructor: William Putnam

Course requirements:

The course will have seven problem sets and one final project. The problem sets will cover ultrafast science and technology, and in the last few weeks of the course, students will complete a small final project on an ultrafast optical application of their choosing.

Prerequisites:

Basic background in electromagnetic waves and optics. (Ask instructor for further details.)

Expanded Course Description:

The course consists of three sections: ultrafast science, ultrafast technology, and ultrafast applications. Each section will cover a collection of topics. Below is an approximate breakdown of the topics that will be covered each week. (The numbers refer to week number.)

I. Ultrafast Optical Science

1. Laser pulse propagation through linear media and dispersion
2. Second-order nonlinear optical processes
3. Third-order processes, solitons, and the nonlinear Schrödinger equation

II. Ultrafast Optical Technology

4. Laser Basics
5. Active modelocking
6. Passive and Kerr-lens modelocking
7. Laser pulse measurement techniques

III. Ultrafast Optical Applications

8. Frequency combs
9. Ultrafast, nonlinear spectroscopy (multi-dimensional spectroscopy)
10. Extreme, non-perturbative nonlinear optics