

## EE 424 – Principles and Applications of Lasers

**Designation:** EE elective course for electrical engineering majors.

**University Bulletin Description:** EE 424: (3) Introduction to principles of laser amplifiers and oscillators; generation, propagation, detection and modulation; applications of lasers to communications and holography.

Prerequisite: EE 330.

### Prerequisites by Topics:

1. Understanding of basic principles in calculus, differential equations, linear algebra, and complex variables.
2. Understanding of basic electricity and magnetism concepts: electric and magnetic fields, Maxwell's equations, energy and power associated with electromagnetic fields, and wave propagation in material media.

### Textbook/Required Materials:

*Photonics: Optical Electronics in Modern Communications*, 6<sup>th</sup> Ed. by Amnon Yariv and Pochi Yeh. Oxford University Press, 2007, ISBN 978-0-19-517946-0.

### Learning Outcomes:

Upon the completion of this course the student will be able to:

1. describe the propagation of laser beams in homogeneous media and through an optical system
2. understand the interaction of light with an atomic medium, and state the conditions under which absorption or amplification of light may occur
3. describe the mechanisms for generation of laser pulses
4. describe different types of laser systems

### Topics:

1. Electromagnetic theory (Chapter 1)
2. Propagation of optical beams in homogenous and guiding media (Chapter 2)
3. Optical resonators (Chapter 4)
4. Quantum theory of atomic system (Extra Lecture Notes)
5. Interaction of radiation with atomic system (Chapter 5)
6. Theory of laser oscillation and amplification (Chapter 6)
7. Laser systems: theory and applications (Chapter 6 and extra lecture notes)
8. Electro-optic modulation of light (Chapter 9)
9. Acousto-optical laser modulation (Chapter 12)

**Class/laboratory schedule:** Two 75-minute lectures lectures per week. Laser laboratory demonstration and tour.

**Computer usage:** Some of the homework needs computer solutions.

### Laboratory Projects/Assignments:

#### Contribution to Meeting the Requirements of Criterion 5. Curriculum:

This course contributes to both the engineering topics and design components.

The course provides students with the basic principles of lasers and related optical and photonic devices and a working knowledge of these modern optical devices in current technologies. It also serves to broaden the students' knowledge and prepare them for graduate research.

**Relationship to Program Outcomes:**

- O.1.1. Graduates will possess mathematics skills necessary for electrical engineering.
- O.1.2. Graduates will have a theoretical and practical background in both physics and chemistry.
- O.1.3. Graduates will have attained computer proficiency.
- O.2.4. Graduates will understand fundamental electricity and magnetism concepts and be able to use them in applications.
- O.3.1. Graduates will have in-depth technical knowledge in one or more areas of specialization.
- O.3.2. Graduates will have practical understanding of the major electrical engineering concepts and demonstrate application of their theoretical knowledge of the concepts.
- O.4.2. Graduates will develop an appreciation of continuing educational and professional development.

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