

14:332:466 Optoelectronic Devices Fall 2010

Instructor: Prof. Wei Jiang

Time & Place: T.Th 6:40pm-8:00pm; EE 240

Office Hours: T.Th 4-5pm (or by appointment), EE 215

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Course Catalog Description: 14:332:466 Optoelectronic Devices (3)

Pre-Requisite Courses: 14:332:361 Electronic Devices, 14:332:382 Electromagnetic Fields;
(please contact the instructor if you are not sure).

Course Description: Waveguides and optical fibers, optical resonators, principles of laser action, light emitting diodes, semiconductor lasers, other lasers, optical amplifiers, optical modulators and switches, photodetectors, wavelength-division-multiplexing (brief), solar cell (brief), and other optical devices. A mini-lab session is designed to offer hands-on experience.

Homework: Homework and exams will be based on class notes, which will be available in pdf version on the class web site. Note: this course is collocated with 16:332:591. However, homework and exam problems will be different for undergraduate and graduate sections of this course.

Textbook & Materials:

- All teaching materials will be covered in lectures notes and will be posted on the course website at <http://sakai.rutgers.edu>

References:

- B. E. A. Saleh & M. C. Teich, *Fundamentals of Photonics*, Wiley-Interscience, 2nd edition (2007), ISBN 0471358320
- S. O. Kasap, *Optoelectronics and photonics: principles and practices*, Prentice-Hall, (2001), ISBN 0201610876.
- Pallab Bhattacharya, *Semiconductor Optoelectronic Devices*, Prentice Hall; 2nd edition (1996), ISBN 0134956567.

Overall Educational Objective: To introduce the students to basics of optoelectronic devices, which are appearing everywhere in our daily life, including lasers, LEDs, optical fibers and fiber-optic communication devices, LCDs, photodetectors (including CCD image sensors), and solar cells. The emphasis is placed on the basic device structures, operating principles, and real-world application (Blu-ray discs, Fiber-To-The-Home, LED lighting, etc.). One mini-lab will be included for undergraduates to gain hands-on experiences.

Week-by-Week Syllabus

Week 1: Introduction and Applications of Optoelectronics

Week 2: Basics of EM waves

Week 3: Waveguides, optical fibers and their applications: Fiber-to-the-home (FTTH)

Week 4: Basics of quantum mechanics; semiconductor physics and materials

Week 5: Fundamentals of optical transitions. Optical Amplifiers

Week 6: Optical Resonators & Lasers: Threshold conditions

Week 7: LED designs and applications: lighting and display. Other display: LCD, etc. (brief)

Week 8: Semiconductor lasers: fundamental device structures and characteristics

Week 9: Various types of lasers;

Week 10: Applications of Lasers: Blu-ray discs & medicine, etc., Mini-lab: laser measurements;

Week 11: Modulators: Internal modulation; external modulators (Mach-Zehnder etc)

Week 12: Electroabsorption modulators; optical switches;

Week 13: Photo-detectors: basic physics, noise; Various types; CCD cameras.

Week 14: Other devices (e.g. Wavelength-division-multiplexing)

Week 15: Solar cell; Review for final exam

Computer Usage: Simulations using MATLAB.

Laboratory Experiences: There is a laboratory session.

Independent Learning Experiences: 1. Home-Work, 2. Laboratory, 3.Exams