

# 16:332:592 Optoelectronics II

## Contemporary Topics in Optoelectronics/Photonics

### Spring 2008

**Instructor:** Dr. Wei Jiang

**Time:** MW 5:00-6:20 PM

**Classroom:** ARC-205

**Office Hours:** MW 4-5pm (or by appointment), EE 215

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**Prerequisites:** Electromagnetic waves, and semiconductor physics or solid state electronics or optoelectronics I (please contact the instructor if you are not sure).

**Course Description:** This course is intended to introduce current research topics in optoelectronics and photonics. Three topics for this year: (1) Photonic crystals: basic physics, fabrication (including nanoimprint), and integrated devices (cavities, waveguides, lasers, modulators, demultiplexers, sensors, negative index materials); (2) Selected topics in plasmonics; (3) Selected topics in silicon photonics.

**Grading:** Some of the research papers and reports will be given as "supplemental reading". About five assignments: 2 regular homework assignments and 2~3 two-page summaries of research papers, and a term paper and presentation.

#### Week-by-Week Syllabus

**Week 1:** Photonic bands and bandgaps

**Week 2-3:** Photonic crystal slabs and waveguides and cavities

**Week 4:** Photonic crystal surfaces: transmission/coupling,

**Week 5:** Fabrication of photonic crystals: Electron beam lithography, etching, nanoimprint

**Week 6:** Holography, two-photon absorption(direct write), DUV, colloidal assembly & templating

**Week 7:** Photonic crystal lasers and LEDs

**Week 8:** Photonic crystal modulators

**Week 9:** Spring break, no class.

**Week 10:** Photonic crystal superprism based demultiplexers and sensors

**Week 11:** Photonic crystal cavities and optical filters

**Week 12:** Surface plasmon excitations: basic physics, waveguiding.

**Week 13:** Negative index materials (photonic crystals or metamaterials), and subwavelength imaging or superlensing; Plasmonic nano-antenna; surface-plasmon enhanced Raman scattering

**Week 14:** Silicon photonics: overview. High-speed silicon modulators, and silicon lasers

**Week 15:** Silicon Raman amplifiers. **Term paper presentation**

**Textbooks** (just for references, all materials will be covered in lectures notes and posted on the course website <http://sakai.rutgers.edu>)

- W. Jiang and M. L. Povinelli, "Photonic crystals: physics, fabrication and devices," book chapter for Springer *Nanostructure Science and Technology Series*. To appear in 2008.
- D. L. Lockwood and L. Pavesi (ed.), "Silicon Photonics," Springer Topics in Applied Physics, vol. 94, 2004. ISBN: 3-540-21022-9.
- A list of reference books and research papers will be given throughout the lectures.