EE136: Introduction to nanophotonics and nanostructures *(Fall 2008)*

Instructor: Jelena Vuckovic

Tentative syllabus

1. Basic concepts *(~1 week)*
- Electromagnetic waves; light; Maxwell equations; Wave equation; Modes.

2. How to confine light? (Introduction to various types of mirrors) *(~3-4 weeks)*
- Metallic mirrors
- Total internal reflection (TIR)
- Distributed Bragg reflection (DBR)
- Photonic crystals (1D, 2D, 3D)
- Optical waveguides: fibers, ridge waveguides, photonic crystal fibers, photonic crystal waveguides
- Optical microresonators (microcavities): microspheres, microdisks, microposts, photonic crystal cavities
- Plasmonics: suface plasmons; metallic nanoparticles; particle chains and arrays.

3. Basic concepts – continued *(~1 week)*
- Introduction to quantum mechanics.
- Semiconductors

4. How to confine a quantum mechanical wave? (*~1 week)*
- Infinite quantum well and quantum box
- Tunneling
- Semiconductor quantum wells
- Quantum wires
- Quantum dots
- Carbon nanotubes, fullerenes

5. How to generate light in a semiconductor? *(~1/2 week)*
- Basic introduction to spontaneous and stimulated emission (lasers)
- Modification of spontaneous emission.

6. Devices incorporating confinement of both electromagnetic and quantum mechanical waves *(~1/2week)*
- Resonant cavity quantum well lasers and light-emitting diodes
- Microcavity-based single photon sources
- Cavity QED

7. System-level applications *(~1/2 week)*
- Optical communications
- Biochemical sensing
- Quantum cryptography

8. Final presentations *(1 week)*