

EE16N: From Science Fiction to Science and Engineering

Instructor: Jelena Vuckovic

Fall 2005

Syllabus (*tentative*)

Part 1 (~2-3 weeks)

Intro

- Motivation for the class.
- What is the difference and relation between science fiction, science and engineering?

Nanotechnology

- What is nanotechnology? Historical overview (including Richard Feynman's talk from 1959 "There's Plenty of Room at the Bottom" *An Invitation to Enter a New Field of Physics*)
- Wave-particle duality. Why quantum mechanical properties of objects become important on nano-scales?
- Tools for viewing or making nanoscale objects:
 - Optical microscope => photolithography. Why photolithography is not good enough for nanofabrication?
 - Scanning Electron Microscope (SEM) => electron beam lithography.
 - Scanning Tunneling Microscope (STM) => tool for rearranging atoms.
- Nano-imprinting.
- Self-assembly: quantum dots – artificial atoms, buckyballs, carbon nanotubes.
- Nanophotonics.
- Miniaturization of computer chips.
- Miniaturized machines, nanorobots.
- Molecular manufacturing.

Part 2 (~2 weeks)

Light, lasers

- Electromagnetic waves. Light.
- Wave-particle duality for light. Photons.
- Light sources.
- Lasers and their applications.
- Radiation pressure. Solar sails

Part 3 (~2 weeks)

Communications, computers

- Satellite communications.
- Wireless communications tools.

- Tricorders
- Super-computers.
- Artificial intelligence and androids.
- Internet, cyberspace, virtual reality.

Part 4 (~1-2 weeks)

Quantum technologies

- A super-brief intro into quantum mechanics.
- Quantum mechanical entanglement.
- Quantum key distribution (quantum cryptography), quantum communication.
- Quantum computation.
- Quantum teleportation experiments vs. teleportation in science fiction.

Part 5: (last 2 weeks)

Student presentations