

# Integrated Optics I: Silicon Photonics

## Course Syllabus:

- Introduction
- Integrated Optical (photonic) Waveguides
  - Basic Electromagnetics Theory
  - Planar, Rib, Strip and Novel Integrated Optical Waveguides
  - Losses in Optical Waveguides
  - Light Coupling into / out of Optical Waveguides
- Review of Passive Integrated Optical Devices
  - Waveguide Bends and Directional Couplers
  - Multimode Interferometer
  - Y-junction and Mach-Zehnder Interferometer
  - Integrated Optical Gratings
  - Resonators
- Photonic Crystals (PhCs) and Photonic Crystal Based Devices
  - Band Gap Formation in 1D, 2D and 3D Periodic Structures
  - Applications of PhCs
    - PhC Waveguides and Resonators
- Silicon Based Integrated Optical Modulators
  - Optical Modulation Mechanisms
  - Electro-Optical Modulators
    - Review of Different Structures
- Review of Silicon Based Light Sources and Detectors
  - Hybrid Silicon Laser
  - Silicon-Germanium Detectors
- Integration of Optics (Silicon Photonics) with Electronics

- Motivations
  - CMOS Integration of Integrated Optical Elements
  - Fundamentals of Integrated Optics Packaging
  - Applications of Integrated Optics
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### **Grading System:**

- Homework            15%
  - Term Project        25%
  - Midterm Exam      25%
  - Final Exam         35%
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### **References:**

- G. T. Reed, *Silicon Photonics: The State of the Art*, 2008.
- R. G. Hunsperger, *Integrated Optics: Theory and Technology*, 6<sup>th</sup> Edition, 2009.
- L. Vivien and L. Pavesi, *Handbook of Silicon Photonics*, 2013.
- S. Fathpour and B. Jalali, *Silicon Photonics for Telecommunications and Biomedicine*, 2011.
- Selected Research Papers