ECE182 – Electromagnetic Optics, Guided-wave and Fiber Optics

Webpage: http://cem01.ucsd.edu/~vitaliy/courses/ece182/

Lectures: Tu, Th 2-3:20pm; EBU1, 2315

Instructor: Prof. Vitaliy Lomakin

Office hours: Tu, Th, 3:30-4:30pm or by appointment

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Text book:

Fundamentals of Photonics, B.E.A. Saleh , Wiley, 1991 or 2007.

Grade Distribution:

- Homework: 15%
- Experiments: 25%
- Midterm: 25%
- Final Exam: 35%

Detailed outline:

1. Electromagnetic optics
    - Electromagnetic theory of light: Maxwell's equations in free space and dielectric, boundary conditions
    - Dielectric media: Linear/nonlinear, dispersive/nondispersive, homogeneous/inhomogeneous, isotropic/anisotropic
    - Monochromatic electromagnetic waves: Phasor representation, Maxwell's equation in the frequency domain
    - Elementary electromagnetic waves: Plane waves, spherical waves, Gaussian beams
    - Absorption and dispersion: absorption, dispersion, resonant media
    - Pulse propagation in dispersive media
2. Polarization optics and crystal optics
    - Polarization of light: Linear/elliptical/circular polarization, matrix representation
    - Reflection and refraction: Fresnel coefficients, TM and TE polarization
    - Optics in anisotropic media: Refractive indices, propagation along the principle and arbitrary axis, rays and energy transport, double refraction
    - Optical activity and Faraday effect
    - Optics of liquid crystals
    - Polarization devices: Polarizers, wave retarders, polarization rotators
3. Guided wave optics
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    - Planar mirror waveguides: waveguide modes, field distribution, propagation constant and velocity
    - Planar dielectric waveguides: waveguide modes, field distribution, propagation constant and velocity
    - Two-dimensional waveguides: Rectangular mirror and dielectric waveguides, geometries of channel waveguides

- Optical coupling in waveguides: Input couplers, coupling between waveguides

4. Fiber optics
    - Step index fibers: Guided rays, guided waves, single mode fibers
    - Graded index fibers: Guided rays, guided waves, quisi-plane waves, modes, propagation constant and velocity
    - Attenuation and dispersion
5. Resonator Optics
    - Planar mirror resonators: Resonator modes, resonator as a spectrum analyzer, two and three dimensional resonators
    - Spherical Mirror resonators: ray confinement, Gaussian modes, resonance frequencies, modal structure