OPTI 500D- Photonic Communications Engineering II D

Course Description:

Photonic Communications Engineering (PCE) consists of two parts (I and II). PCE I covers optical fiber light guiding and wave propagation characteristics, materials properties, optical transmitters, receivers and amplifiers, communications systems and fiber optics networks and the Internet. PCE II builds upon this knowledge with advanced subjects in system modeling, device integration, and systems-level engineering. Reference material for the course is in a digital platform to allow dense hyper-linking between topics so that students from various disciplines can customize the reading material to their individual background knowledge. Prerequisites: OPTI 500A, B and C

Grading Policy:

Section D Exam (covering Modules 1-5) will determine the Course Grade in 500 II D.

Each Module will have 3 exam questions of which students select 2 questions to answer (or complete all questions and 2 highest scores are chosen by the instructor). All questions are weighted equally towards the Course Grade.

The grade will be determined according to the percentage earned such that 90-100% = A, 80-89% = B, 70-79% = C, 60-69% = D, below 60% = E.

See Office of the Registrar website for courses within a semester with different start and end dates.

Outline

Module 1: Electromagnetic Wave Propagation

- Planar solutions to the Wave Equation
- Reflection and transmission at material interfaces
- Maxwell's Equations in Cylindrical Coordinates
- Modal propagation

Module 2: Linear fiber propagation

- Linearly polarized (LP) fiber modes.
- Chromatic dispersion and fiber losses.
- Group velocity, group velocity dispersion (GVD), higher-order dispersion.
- Pulse propagation in fibers
- Slowly-varying envelope equation.
- Gaussian pulse propagation with GVD and loss.

- Pulse broadening and chirp.

Module 3: Numerical pulse propagation in fibers

- Fourier representation of pulses and pulse spectra.
- Linear pulse propagation using Fourier methods.
- Numerical propagation using MATLAB.

Module 4: Nonlinear fiber properties

- Nonlinear refractive-index and self-phase modulation (SPM).
- Slowly varying envelope equation.
- Numerical simulation of SPM in fibers.
- Examples of pulse spectra and spectral broadening.
- Nonlinear chirping model for spectral broadening.
- Intuitive model for temporal solitons in fibers.

Module 5: Solitons in optical fibers

- Slowly varying envelope equation for fibers with GVD and SPM.
- The fundamental bright soliton solution in fibers.
- Soliton stability and higher-order solitons.
- Numerical simulations.
- Fiber losses and soliton amplification, “the path-average soliton".
- Dispersion-managed solitons.
- Cross-phase modulation and solitons in the presence of polarization mode dispersion.
- Modulational instability and the generation of soliton trains.

Exam