**EE 383V topic 2 – “Nonlinear Optics”**

**Description:**
This course describes the principles of nonlinear optics and discusses the operation of photonic devices and systems that utilize various nonlinear optical effects. The topics will include: nonlinear optical susceptibility of materials, origin of optical nonlinearities, symmetry properties of nonlinear susceptibility tensors, coupled-wave equations, second harmonic, sum-, and difference-frequency generation, phase-matching condition and techniques to achieve phase matching, parametric amplification, electro-optic effect, multi-photon absorption, self-focusing and self-phase modulation, optical solitons, Raman amplification, and acousto-optic effect. Examples of nonlinear optical devices discussed in class will include optical parametric oscillators, harmonic generation systems, mid-infrared and THz sources based on difference-frequency generation, optical switches, Raman lasers, self-mode-locked femtosecond lasers, acousto-optic modulators, etc.

**Class hours:** Tuesday, Thursday 2-3:30pm; ENS 109

**Instructor:**
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Office Hours: Tuesday, Thursday 3:30-4:30pm in ENS 311 or by appointment in MER 2.606A  
Teaching Assistant: none

**Prerequisites:**
**Required:**  
- Electromagnetic engineering (EE 325 or equivalent)  
- Quantum mechanics and/or solid-state physics course  
- Basic Optics and/or Optoelectronics course

**Text:**
**Required:**
- *Nonlinear Optics*, 3rd or 2nd Ed., by Robert W. Boyd  
- Lecture notes and/or relevant papers (to be distributed as necessary)

**Planned Topics:**
- Nonlinear susceptibility and origin of optical nonlinearities  
- Classical and quantum mechanical models for optical nonlinearities  
- Symmetry properties of nonlinear susceptibility tensors  
- Coupled-wave equations, phase matching conditions, quasi-phasematching  
  \( \chi^{(2)} \) phenomena:  
  - Second-harmonic generation  
  - Sum- and difference-frequency generation  
  - Parametric amplification  
  - Electro-optic effect  
- \( \chi^{(3)} \) phenomena:  
  - Self-focusing
Self-phase modulation
Spontaneous and stimulated Raman scattering
Raman laser
Multi-photon absorption
Spatial and temporal optical solitons
Acousto-optic effect
Brillouin scattering
Nonlinear optical effects in fiber optics systems

Examinations and Grading:
- Homeworks (1/3 of the grade), take-home midterm at the end of October (1/3), in-class presentation + paper (1/3)
- There is no final exam
- Late homework will be accepted at instructor’s discretion

College Drop/Add Policy:
An engineering student must have Dean's approval to add/drop after the fourth class day of the semester.

Students with Disabilities:
The University of Texas at Austin provides upon request appropriate academic accommodations for qualified students with disabilities. For more information, contact the Office of the Dean of Students at 471-6259, 471-4641 TTY or the College of Engineering Director of Students with Disabilities at 471-4382.

Course Website and Student Privacy:
Web-based, password-protected class sites are associated with all academic courses taught at The University. Syllabi, handouts, assignments and other resources are types of information that may be available within these sites. Site activities could include exchanging e-mail, engaging in class discussions and chats, and exchanging files. In addition, electronic class rosters will be a component of the sites. Students who do not want their names included in these electronic class rosters must restrict their directory information in the Office of the Registrar, Main Building, Room 1.

Academic Integrity:
Plagiarism or any form of academic dishonesty is a violation of University rules and will be penalized. For University policies see: http://www.utexas.edu/news/2004/04/29/nr_honor/