Electrical Engineering 5385 "Nonlinear Optics"

MW 5:30 pm – 6:50 pm, Rm. WH 404

Instructor: Michael Vasilyev, Professor, EE Dept.
Phone: (817) 272-1224, e-mail: vasilyev@uta.edu

Course Description: When a strong beam of light (e.g. from a laser) propagates in an optical medium, it changes the properties of the medium, leading to nonlinear optical response. The resulting effects are the subject of nonlinear optics, with applications in many fields, such as

laser industry	(e.g., conversion of laser light to other frequencies)
ultrafast optics	(e.g., measurement of pico- and femtosecond pulses)
quantum security	(e.g., generation of entangled photons for quantum cryptography and quantum computing)
telecommunications	(e.g., Raman optical amplifiers, all-optical regenerators and frequency converters),
high-speed signal processing	(e.g., 1000 GSample/s A/D conversion; 1 Tb/s time-division multiplexing / de-multiplexing),
materials characterization	(e.g., Raman spectroscopy), etc.

In many fields, the good knowledge of nonlinear optics has become imperative to success (e.g., mitigation of nonlinear optical effects arising due to large number of channels propagating in optical fiber has become one of the central problems in the design of long-haul DWDM transmission systems).

The course considers nonlinear optical processes and their applications in crystals, optical fibers and waveguides. Origin of second- and third-order nonlinear susceptibility, symmetry properties, coupled-wave propagation, phase-matching techniques, sum- and difference-frequency generation, parametric amplification, four-wave mixing, self- and cross-phase modulation, soliton propagation, and Raman scattering are covered in detail.

Textbook: R. W. Boyd, "Nonlinear Optics," 3rd edition, Academic Press, 2008.
Additional materials will be distributed in class.

For more information, see the instructor's web page: **http://www.uta.edu/faculty/vasilyev**

Grading: term paper related to one of real-world applications of nonlinear optics (40%) and 2 tests (30% each).

Other information: among other things, this is a required course for anyone who wants to work in Dr. Vasilyev's group (see his lab photos below: on the left–10 Gb/s WDM testbed for studies of novel nonlinear-optical devices for optical fiber communication and all-optical information processing; on the right–alignment of a free-space optical parametric amplifier). ***This course is offered every other year: if you miss it this year, your next chance will be only in Fall 2020!***