EML 5937: Special Topics-Spectroscopy and Laser Diagnostics for Engineers
Syllabus
M, W 10.30-11.45 am BA 216

1. Course Overview

This course will introduce students to basic concepts and applications, including latest research developments in this field. Spectroscopy and laser diagnostics are applied to remote sensing, combustion and gasdynamic diagnostics, process control, energy systems and environmental monitoring. Spectroscopy and laser diagnostics are of increasing utility to engineers. This course will integrate fundamental and applied concepts in this area. The goal of this course is to provide a practical complement (focus on combustion/atmospheric sciences) to courses on quantum mechanics.

What is spectroscopy? Interaction of radiation (light) with matter (in our case, gases)

Motivation: Spectroscopy is of increasing utility to engineers
Provide a practical complement to courses on quantum mechanics.

Example Applications: Remote sensing, combustion and gasdynamic diagnostics, process control, energy systems and environmental monitoring

Common Measurements: Species concentrations, temperature (T), pressure (P), density (ρ), velocity (u), mass flux

2. **Credit Hours** 3 (3 lecture hours per week)
3. **Instructor** Dr. Subith S. Vasu
Room 216, Engr 1, 407-823-3468 (office), subith@ucf.edu
Office hrs: Monday 1-4pm

4. Text (no required text, but following notes will be distributed in class)

"Introduction to Spectroscopy and Laser Diagnostics for Gases", by Prof. R.K. Hanson.

"Combustion Laser Diagnostics" by Prof. Marcus Alden.

Guest seminars and visits from academia and industry researchers will be organized. Additional notes will be distributed in the coming months.

5. Prerequisites

Background in Thermodynamics, Fluids and Heat Transfer is good. Physical Gasdynamics or equivalent background in Statistical Mechanics, (or consent of the teacher) is better. EML6131 Combustion Phenomena experience is desirable but NOT required.

6. **Grading**

Homework = 25%: Mid Term = 15%: Final (25%): Project = 35%

MidTerm on Wednesday **Feb 26** (in class)
Final Exam on Monday, **April 28**, 2014: 10:00 AM – 12:50 PM

Exam will focus on simple concepts. HW submission is individual.

7. **General Topics:**

Planck's Law, Beer's Law, Boltzmann distribution, Diatomic Molecular Spectra: Rotational Spectra (microwaves), Vibration-Rotation Spectra (Infrared), Electronic (Rovibronic) Spectra (UV, visible)
Bond Dissociation Energies: Pre-dissociation, Dissociation Energies, Polyatomic Molecular Spectra: Rotational Spectra (microwaves), Vibrational Bands, Vibrational Spectra, Nuclear Spin
Rayleigh & Raman Spectra: Light Scattering, quantum & classical models, rotational & vibrational spectra, Quantitative Emission/Absorption: Spectral Absorptivity, Equation of Radiative Transfer, Einstein coefficients/theory, radiative lifetime, line strength, Spectral Lineshapes: Doppler, Natural, Collisional and Stark broadening, Voigt profiles, Electronic Spectra of Atoms: Quantum numbers, single-electron atoms, Multi-electron atoms, example spectra, Electronic Spectra of Diatomics: Term symbols, molecular models (rigid rotor, symmetric top, Hund's cases (a) and (b) quantitative absorption, Case studies of Molecular Spectra: Ultraviolet, OH, Infrared CO, Visible/Near-IR, O2, Laser-Induced Fluorescence (LIF): Two-level model, more complex models, diagnostic applications (T, V, species), PLIF Diagnostic Techniques: Absorption (narrow-and broad-band, wavelength modulation), LIF (various models), Rayleigh & Raman scattering, other methods (photothermal deflection, REMPI, cavity ring-down, photoacoustics), Spectroscopy Equipment

International students must register for the live class, as required by SEVIS.

**** Note: The course instructor reserves the right to modify this syllabus.**