OSE 4520 - LASER ENGINEERING


**Instructor:** Dr. Peter J. Delfyett, CREOL 272; 823-6812; delfyett@creol.ucf.edu

**Prerequisites:** Calculus, Differential Equations, Vector Calculus, Electromagnetic Theory, Wave Propagation, Interference, Diffraction & Coherence,

**Topics to be Covered:**

I. **Laser Fundamentals:** Overview, Energy states in atoms, Basic stimulated emission, Power and energy, Monochromaticity, coherency and linewidth, spatial coherence, longitudinal and transverse modes, gain profile;

II. **Energy States and Gain:** Laser states, multiple-state laser systems, linewidth and the uncertainty principle, broadening of fundamental linewidths; basics of gain, blackbody radiation, gain.

III. **The Fabry Perot Etalon:** Longitudinal modes in the laser resonator cavity, quantitative analysis of a Fabry Perot etalon, illustrative Fabry Perot etalon calculations.

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IV. **Transverse Mode Properties:** TEM transverse modes, Gaussian beam propagation, ray matrices, Gaussian beams in resonant cavities, ABCD Law

V. **Gain Saturation:** Saturation of the exponential gain process, homogeneous and inhomogeneous gain saturation, Rate equations, Laser output power characteristics

VI. **Transient Processes:** Relaxation oscillations, Q-switching; Mode-locking

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VII. **Introduction to Nonlinear Optics:** The nonlinear polarizability, Second harmonic generation, Optical parametric oscillation, Raman scattering.

VIII. **Conventional Solid State, Transition-Metal Solid State and Semiconductor Lasers:** Laser materials, Laser transition in Nd:YAG & Ti:Sapphire, Pump technologies,

---------------------------------- FINAL (Cumulative)

There will be two in class exams and an in class final exam. There may also be short “quizzes” that can serve as ‘extra-credit’. The role of the quizzes will be to assist in the determination of final grades. Homework’s will be “assigned” to provide guidance as to how to do problems.

Approximate weighting: Homework: 10%; 2 Exams: 25% each; Final: 40 %; Total: 100%.

Grading Policy: The +/- system will be used.