

OSE 4520 - LASER ENGINEERING

Required (Suggested) Text: Laser Electronics, Third Edition, J. T. Verdeyen, Publisher: Prentice Hall

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

Reference Materials: Any book on laser physics, e.g., Yariv, Kuhn, Svelto, Siegman
Other Optics Texts: Fowles, Hecht, Klein&Furtak, Pedrotti, Born & Wolf

Topics to be Covered:

I. Ray Tracing in an Optical System: Ray Matrices, Applications to optical cavities, Stability diagrams;

II. Gaussian Beams: TEM₀₀ modes; Physical description of Gaussian beams, (Amplitude, radial and longitudinal phase); higher order modes; ABCD Law for Gaussian beams,

III. Optical Cavities: Gaussian beams in stable resonators; ABCD law applied to optical cavities; mode volume.

----- **TEST**

IV. Resonant Optical Cavities: General concepts; Cavity Q and Finesse; Photon lifetime; Cavities with gain.

V. Atomic Radiation: Simple Harmonic Oscillator; Einstein A&B coefficient approach; Line shape functions; Amplification by an atomic system.

VI. Laser Oscillation and Amplification: Threshold conditions; Laser oscillation/amplification in homogeneous broadened medium; Gain saturation in H.B. medium.

----- **TEST**

VII. General Characteristics of Lasers; Two three, four level lasers; C.W. Lasers(ring, standing wave, optimum output coupling problem); *Laser Dynamics (solving rate equations)??* sub-threshold; c.w. at threshold; small signal a.c. modulation; relaxation oscillations; gain switching; Q switching.

VIII. Semiconductor Lasers (Time Permitting)

-----**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.