EE524.	T R 9:45 AM – 11:00AM	105 E E WEST

Lasers and Optical Electronics

Instructor: Dr. I. C. Khoo, *W. E. Leonhard* Professor of Electrical Engineering
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Office hours: Tues & Wed.: 4:00 – 5:00 PM

References [optional]:

"**Photonics - Optical Electronics in Modern Communications**" by Pochi Yeh & A. Yariv [Oxford University Press]; ***Lasers*** by P. W. Milonni and J. H. Eberly [Wiley]

Grading Policy: 2 mid-term exam.(66 %) and biweekly reports/homework (10%); Final exam. (33%)

Course Contents:

- Reviews of Lasers Principles and Applications

1. Electromagnetic theory of light/laser [chapter 1]- up to section 1.5
   Basic definitions - intensity, power, energy, refractive index, susceptibility.
2. Propagation of laser beams [chapter 2] -
   Rays and ray matrix, Gaussian beams descriptions; Fundamental and higher order modes;
   Pulse broadening [modal and chromatic dispersions]
3. Laser cavity and resonators [chapter 4]- section 4.1, 4.2, 4.7
   Fabry-Perot interferometer, resolution, cavity lifetime, modes.

----------Mid-term I ----------

4. Interaction of laser with atomic medium [chapter 5] - sections 5.1 -5.7
   Spontaneous and induced emissions, gain, amplification and absorption
   Rate equations,

5. Laser amplification, oscillations , pulsed high power lasers [chapter 6 section 6.1-6.7]
   Oscillation conditions, power and energy considerations, output couplings, multimode and singlemode lasers, mode-locking for ultra-short laser pulse, Q-switching for high power laser pulse generation;

----------Mid-term II ----------

- Advanced theories of laser interaction with matter; quantum optics and nonlinear optics

- Quantum theories of light/materials
  - Basic quantum mechanics of atoms, molecules, and semiconductors
  - Electromagnetic theories revisited – photons and harmonic oscillators
  - Time dependent perturbation theory
    - Spontaneous and induced emissions
    - Atomic susceptibilities and refractive index; nonlinear susceptibilities
- Resonant interaction of laser with materials – Semiclassical theories
  - Density matrix formalism
  - Coherent and incoherent laser-material interaction

----------Final [mid-term III] ----------

- Laser laboratory demonstration [1 week]

Nanosecponds and picosecond pulsed laser [1.06 μm and its harmonics at 0.53 μm]; Near-infrared [750 nm, 1550 nm] and infrared [10.6 μm] lasers.
Experimental demonstration of laser generation, mode-locking and q-switching for short intense laser pulse, harmonic generation, gas laser discharge and infrared optics.