

Physics 530 Modern Optics and Laser Spectroscopy

PROFESSOR YODH (DRL – 2N6)

Tentative Course Outline

1. Electromagnetic Wave Phenomena
 - Wave equations and formal solutions (including sample polarization)
 - Gaussian Beams (connection to diffraction, and resolution limits)
 - Resonators
 - Guided Waves
 - Photonic Crystals

2. Light-Matter (primarily quantum mechanical) Interactions
 - Semiclassical theory of light-matter interactions (density matrix)
 - Linear Spectroscopy (cross-sections, matrix elements, lifetimes)
 - Two-level atoms (I): Saturation
 - Theory of Lasers (Simple theory, Coupled Cavity Equations)
 - Two-level Atoms (II): Bloch Equations; Coherent Transient Spectroscopies
 - Nonlinear Optics: Formal Theory, Harmonic generation, Wave mixing processes
 - Nonlinear Spectroscopy: Two-photon absorption, Raman spectroscopy

3. Light Scattering (primarily from classical fluctuations)
 - Scattering from particles
 - Light forces: Optical Tweezers
 - Brief review of coherence properties of light and photon statistics
 - Fluctuation spectroscopies: Photon correlation effects in single scattering
 - Photon diffusion
 - Diffusing-wave spectroscopy: Photon correlations in turbid systems
 - Microscopy