**PH 521: Light-Matter Interaction (3-0-0: 3)**

**Classical and Semi-classical Treatment of Light-Matter Interaction**

Lorentz oscillator, Drude model, susceptibility and complex refractive index, Kramer Kronig relation, Sellmeier equations, anisotropic media, polarization optics, electronic transitions in atoms, two-level interactions. Relaxation oscillators in Lasers, Rabi-oscillations, density matrix formulation, energy and phase relaxation. **[9L]**

**Nonlinear Optics**

Nonlinear perturbation theory and coupled mode equations, anharmonic classical oscillator model, second order & third order effects, phase-matching mechanisms, vibrational transitions in molecules and Raman nonlinearity, Kerr nonlinearity. **[9L]**

**Ultrafast Optics**

Definition of ultrashort pulses, propagation of ultrashort optical pulses through dispersive optical elements, femto-second lasers and their applications, characterization of ultrashort pulses, temporal-lens, introduction to coherent control. **[9L]**

**Nano-photonics and Metamaterials**

Metal optics, propagating and localized surface plasmons, effective medium theories, transformation optics, recent experiments in linear and nonlinear metamaterials. **[9L]**

**Text Books and References**

1. C. C. Tannoudji, J. D. Roc, and G. Grynberg, “Atom-Photon Interactions: Basic Processes and Applications”, Wiley-VCH.

# P. E. Powers, “Fundamentals of Nonlinear Optics”, CRC Press.

1. A. Weiner, “Ultrafast Optics”, John Wiley & Sons.
2. B. E. A. Saleh and M. C. Teich, “Fundamentals of Photonics”, John Wiley & Sons.
3. R. W. Boyd, “Nonlinear Optics", Academic Press.
4. P. Meystre and M. Sargent, “Elements of Quantum Optics”, Springer.