

## **PH 551: LIGHT-MATTER INTERACTION (4-0-0: 4)**

### **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, Rabi-oscillations, density matrix formulation, energy and phase relaxation.

### **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.

### **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.

### **Nano-photonics and Metamaterials**

Metal optics, propagating and localized surface plasmons, effective medium theories, transformation optics, recent experiments in linear and nonlinear metamaterials.

### **Text Books and References:**

1. C. C. Tannoudji, J. D. Roc and G. Grynberg, "Atom-Photon Interactions: Basic Processes and Applications", Wiley-VCH
2. P. E. Powers, "Fundamentals of Nonlinear Optics", CRC Press.
3. A. Weiner, "Ultrafast Optics", John Wiley & Sons
4. B. E. A. Saleh and M. C. Teich, "Fundamentals of Photonics", John Wiley & Sons
5. R. W. Boyd, " Nonlinear Optics", Academic Press