FDIT215uj Fundamentals of light-matter interaction

Description:

This course provides a theoretical framework for understanding the interaction between (laser) light and matter, combining classical electrodynamics and quantum mechanics.

Topics:

Topics of the course include optical wave propagation in media, the macroscopic Maxwell equations, quasi-monochromatic fields, and the slowly varying envelope approximation (SVEA). It also course covers linear and nonlinear dipole oscillators, three- and four-wave mixing, and the role of polarization and susceptibility. The quantum mechanical part addresses charged particles in external fields, time-dependent perturbation theory, resonant excitation of two-level systems, Rabi oscillations, the density matrix formalism, and coherent transient phenomena such as free induction decay, photon echoes, and self-induced transparency. Additional topics include semiclassical laser theory, line broadening mechanisms in spectroscopy, and the role of the Maxwell–Bloch equations in describing nonequilibrium dynamics of laser–matter interactions.

Literature:

Pierre Meystre and Murray Sargent: *Elements of Quantum Optics*, 4th edition, Springer, 2007, ISBN 978-3-540-74211-1.

Benedict Mihály: *Theoretical foundations of laser matter interactions* (egyetemi jegyzet, SZTE)