PH503 Laser and Applications

Credit: (3-0-0-3) Approval: Approved in 2nd Senate

Prerequisites: Mechanics of Particles and Waves & Electrodynamics

Students intended for: B.Tech

Elective or Core: elective Semester: Odd/Even

Course objective:

This course will provide knowledge of the basic concepts and applications of laser in all walks of life. It will help to read and understand scientific literature in this field. The course contains basic theory and applications of lasers in research and industry. Various techniques of laser pulse generation and use of short pulses in spectroscopy are discussed. Mechanism of higher harmonic generation will also be addressed.

Course content:

- Radiation: energy density and pressure of radiation, cavity radiation, modes of oscillation. [1 Lectures]
- Interaction of radiation with matter: absorption, spontaneous and stimulated emission, Einstein coefficients, photoexcitation cross-section, amplification of radiation, laser pumping systems: optical pumping, electrical pumping other methods of pumping, spectral lines shapes, different types of broadening mechanism, gain calculation, threshold condition. [7 Lectures]
- Cavity resonator: time constant and quality factor of optical cavity, stability of resonators, g parameters, various types of resonators. [6 Lectures]
- Various Lasers:

  Solid state lasers: Ruby Laser and Nd: YAG laser

  Gas lasers: He-Ne laser, CO2 laser and Nitrogen laser

  Liquid lasers: Dye lasers

  Semiconductor lasers

  Free electron lasers [8 Lectures]
- Laser pulse generation: Q-switching: theory and various methods; mode locking: methods of mode locking, efficiency of mode locking, ultrashort (nanosecond, picosecond and femtosecond) laser pulse generation. [6 Lectures]
- Applications in time-resolved spectroscopy: fluorescence lifetime, various measurement techniques- oscilloscope method, time-correlated single photon counting, Streak Camera, fluorescence up conversion. [4 Lectures]
- Application in optical communication: optical fibre, fibre laser. [2 Lectures]
- Higher harmonic generation: white light continuum generation, optical parametric amplifier, pump-probe spectroscopy. [3 Lectures]
- Holography: Theory, classification and application. [3 Lectures]

Text Books

O. Svelto - Principles of lasers

W. Koechner - Solid State Laser Engineering

References

W. T. Silfvast, Laser and Fundamentals

A. E. Seigman, Lasers.

A. Yariv - Quantum Electronics.

D.R.Hall and P.E.Jackson (ed by) - The Physics and Technology of Laser Resonators.

M.Young. - Optics and Lasers

D. Meschede - Optics, Lights and Lasers

B.A.Lengyel - Lasers