14/07/2019

Modern Optics and Lasers

86-365-01

Lecturer: Prof. Patrick Sebbah

Course type: Lecture + practice

Date: 2019-2020 **semester:** A **weekly hours:** 4

A written version of the course in English as well as in Hebrew will be available on the Moodle.

Aim of course:

Laser physics is the most suitable gateway to introduce linear and nonlinear light matter interaction phenomena. By introducing laser theory and laser principles, we will cover a large panel of topics in modern optics, including geometrical and physical optics, optical cavities; Interference, diffraction, and polarization; Coherence and holography; Light emission and absorption, atomic physics, amplification; … Treatment of laser physics is purely classical and no quantum mechanical background is required.

Syllabus:

About 12 courses in English
On white board +powerpoint presentations
About 12 exercise sessions in parallel

Theory of laser: basic concepts; amplification; losses; oscillations; rate equations.

1. Lorenz Model of light-matter interaction.
2. Stable and dynamic states of the laser - CW, relaxation oscillations, Q-switching.
3. Longitudinal and transverse resonant modes in an optical cavity.
4. Cavity design (ABCD matrices).
5. Linear propagation of pulses in dispersive media - group velocity and group velocity dispersion. Dispersion compensation for short pulses.
6. Introduction to Nonlinear Optics in lasers - amplifier nonlinearity, saturable absorption, Kerr effect.

7. Generation of short pulses - Mode locking - Active and passive.
8. Coherent dynamics of lasers - Field equations, Rabi oscillations.

Prerequirements:

Mathematics for Physicists.
Waves.
Optics.

Course Requirements:

Assignment: 12 exercises will be proposed as homework. 10 will be mandatory and submitted the following week.

(the instructor will check at least one question and grade the assignment)

Grading:

Final exam: 80%; Homework: 20%

Bibliography:

Textbooks:

A. E. Siegman
“Lasers”
University Science Books, 1986, revised.