Major Unit: Laser Physics (5 ECTS) RADMEP/ UJM semester 3

Course instructor: Prof. Youcef Ouerdane, Prof. Sylvain Girard /Language of instruction: English

Overview:

Nowadays the laser plays a key role in multiple domains such as: optical telecommunications, information storage (CD, DVD), instrumentation, metrology, bio-medical, materials processing, … In fact, it opens up new fields to probe and/or functionalize the matter in its ultimate entrenchments.

The scientific and technological advances of the last decades position the laser as an essential equipment in several industries with high added value.

The objective of this course is to understand how a laser works. We will present some typical illustrations related to different types of configurations, including fiber-based lasers.

Content:

- Fundamental mechanisms - focus on the stimulated emission;
  - Population inversion - amplification conditions;
  - Pumping methods,
- Optical pumping and different configurations,
- Diagram with 3 levels: optical pumping of a Hertzian transition;
- Optical pumping in a 4-levels configuration;
- Role of a resonant cavity;
  - Gain, threshold of oscillation, stability;
  - Coefficient of quality – cavity damping time;
  - Operating regimes: multimode single mode;
- Coherence of light waves;
- Frequency enlargement: causes;
- Properties of Gaussian beams
- Fiber-based lasers
  - introduction to guided optics, fiber optics
  - Principles of operation: from materials to systems
  - Examples of application

Teaching methods:

- Lectures: 19 hours
- Tutorials: 19 hours.
- Practical work: 6 hours.

Assumed Knowledge

Bachelor Degree in Physics or Physics/Chemistry.

Evaluation criteria

- Written exam: 80%
- Written assignments / Labs: 20%