

**Course Syllabus for
Industry 4.0 PhD
(years 2022-23 /2023-24)**

Course title	Principles of lasers and their applications in materials processing
Scientific Discipline Sector	FIS/03
Hours of instruction	20 hours
CFU	2 CFU
Semester	Second semester
Goal	After completing the course, the doctoral student shall be able to: <ul style="list-style-type: none"> (i) explain the laser operation principles relating it to atom and molecular physics, (ii) describe how a laser source is built and operates, (iii) give an account of technological issues behind laser construction, (iv) describe the main properties of the most common laser types, (v) know the most important safety issues related to laser utilization.
Syllabus	The course provides an introduction to the physics of lasers. It covers the following topics: <ul style="list-style-type: none"> • atom-light interactions (absorption, spontaneous emission and stimulated emission) • principles of laser resonators and laser action (properties of lasers, three and four level lasers, gain, threshold, laser cavities and modes), • laser pulsing (Q-switching, mode-locking). The course will give also an overview of the most important laser sources (gas lasers, fiber lasers, solid-state lasers, semiconductor lasers) and safety regulations and main applications of lasers in materials processing (welding, cutting, drilling, surface treatments)
Bibliography	- O. Svelto, Principles of Lasers, 4th and 5th Edition. - Elijah Kannatey-Asibu, Jr – Principles of laser materials processing Slides and support material from lecturer.
Examination method	Final examination in class