UNIVERSITÀ DI PAVIA

Anno Accademico 2019/2020

INDUSTRIAL LASER DESIGN	
Enrollment year	2018/2019
Academic year	2019/2020
Regulations	DM270
Academic discipline	ING-INF/01 (ELECTRONICS)
Department	DEPARTMENT OF ELECTRICAL,COMPUTER AND BIOMEDICAL ENGINEERING
Course	ELECTRONIC ENGINEERING
Curriculum	Photonics
Year of study	2°
Period	1st semester (30/09/2019 - 20/01/2020)
ECTS	6
Lesson hours	45 lesson hours
Language	English
Activity type	WRITTEN AND ORAL TEST
Teacher	AGNESI ANTONIANGELO (titolare) - 6 ECTS
Prerequisites	Principles of electromagnetic theory, geometric and wave optics, optical and optoelectronic components.
Learning outcomes	Laser operating principles are discussed in relation to specific laser systems and materials. The aim is to provide the student with the working knowledge to understand the most used laser systems and their tecnological evolution, as well as how to choose the most appropriate laser for a given application. In particular, the approach to solid-state laser design will be explained with some practical examples. Solid-state laser engineering involves today most of the professionals designing laser sources or optimizing specific industrial applications of lasers. Lastly, the main applications of industrial lasers are presented, as well as those of the rapidly emerging ultrafast laser family.
Course contents	·Continuous-wave laser oscillators: 4 levels and quasi 3 levels systems.

	Factors determining threshold and efficiency. · Optical resonators: Gaussian beams and ABCD techniques. Stable resonators. Beam quality. Unstable resonators. · Techniques for controlling the emission spectrum. · Most important industrial lasers: Solid-state lasers. Fiber lasers. Semiconductor lasers, electrically and optically pumped. Other lasers of practical interest. · Nanosecond and sub-nanosecond pulsed operating regimes: Q-switching at low and high frequency. Gain-switching. Cavity dumping. Switching devices. Mode locking: techniques and devices. Stability condition for passive mode-locking. Propagation in dispersing media with Kerr nonlinearity. Technology of ultrafast lasers (ps/fs). · Techniques for measurement of ultrafast pulses. · Example of design of a solid-state laser working in cw and in Q-switching mode. · Pulsed and cw laser amplifiers. · Solid-state sources with nonlinear frequency conversion: harmonic, parametric and Raman generation. · Industrial applications of high power lasers: marking, cutting, soldering, drilling, trimming, surface processing. · Industrial and biomedical applications of ultrafast lasers: micromachining, nonlinear microscopy.
Teaching methods	Lectures (hours/year in lecture theatre): 45 Practical class (hours/year in lecture theatre): 0 Practicals / Workshops (hours/year in lecture theatre): 0
Reccomended or required readings	Lectures notes (A. Agnesi)?. Further readings: ?O. Svelto: Principles of Lasers, Springer, New York, 2010
Assessment methods	The exam consists in a (typically) 30-min discussion of a laser project assignment (different for each student), developed by the student as a “homework” during 2-3 weeks period before the agreed exam date. Such discussion might offer the opportunity for general questions on concepts related to the specific project task, presented in the course.
Further information	The exam consists in a (typically) 30-min discussion of a laser project assignment (different for each student), developed by the student as a “homework” during 2-3 weeks period before the agreed exam date. Such discussion might offer the opportunity for general questions on concepts related to the specific project task, presented in the course.
Sustainable development goals - Agenda 2030	$lbl_legenda_sviluppo_sostenibile