UNIVERSITÀ DI PAVIA

Anno Accademico 2020/2021

QUANTUM ELECTRONICS	
Enrollment year	2020/2021
Academic year	2020/2021
Regulations	DM270
Academic discipline	FIS/03 (MATERIAL PHYSICS)
Department	DEPARTMENT OF ELECTRICAL,COMPUTER AND BIOMEDICAL ENGINEERING
Course	ELECTRONIC ENGINEERING
Curriculum	Space Communication and Sensing
Year of study	1°
Period	1st semester (28/09/2020 - 22/01/2021)
ECTS	6
Lesson hours	46 lesson hours
Language	English
Activity type	WRITTEN AND ORAL TEST
Teacher	PIRZIO FEDERICO (titolare) - 6 ECTS
Prerequisites	The Mathematical and Physical concepts given by the 1st Level Degree (Mechanics and Electromagnetism, Geometry and Algebra, Mathematical Methods courses). The concepts illustrated in the course of “Fotonica” (Photonics) are important but not essential
Learning outcomes	The aim of the course is to give a correct quantum-mechanical description of the radiation-matter interaction and provide the physical tool necessary to understand the functioning of LASERs. At the end of the course, the students should possess the basic concepts of Quantum Mechanics, the main aspects of the radiaton-matter interaction and should be able to qualitatively and quantitatively describe the functioning of a LASER oscillator.
Course contents	Wave-particle duality, experimental facts Quantum Mechanics Postulates, Schrödinger Equation

	Eigenvalue problems, some examples of representative potentials Angular momentum, Hydrogen Atom and Periodic Table of Elements Identical Particles, Spin, Fermions and Bosons Statistics Time Independent Perturbation Theory Time Dependent Potentials, Perturbative method Electric Dipole interaction Fermi Golden Rule Absorption, Spontaneous and Stimulated Emission, Einstein’s A and B coefficients Density Matrix, radiation-matter interaction 3- and 4-levels systems, rate equations Optical resonators Free running laser operation Q-Switching and Mode-Locking regimes Some representative example of lasers (Gas lasers, Solid-state lasers, Fiber Lasers, Semiconductor Lasers)
Teaching methods	Lectures (hours/year in lecture theatre, blackboard + slides): 44 Practical class (hours/year in lecture theatre): 2 Practicals / Workshops (hours/year in lab): 2
Reccomended or required readings	There are many wonderful books about the topics we will cover in this Course. A lot of them are available at the Faculty Library. I will not follow a specific textbook, but students can refer to: A. Yariv. Quantum Electronics. Wiley. D. J. Griffiths. Introduction to Quantum Mechanics (2nd Edition). Pearson Prentice Hall. C.L. Tang. Fundamentals of quantum mechanics, for solid state electronics and optics. Cambridge University Press. W. Koechner. Solid.State Laser Engineering (6th Edition). Springer. This book can be considered the "Holy Bible" of solid-state lasers Engineers.
Assessment methods	The final exam will consist of an oral discussion about the topics introduced during the course. The student will select a specific topic to start from among those presented during classes. During the exam, the Teacher will evaluate the general knowledge of the matter and will verify the effective level of understanding of the main topics covered in the course. The final mark will be depending also on the ability of the student present the concepts and to make use of a correct scientific language.
Further information	Please visit the web-page of the course on KIRO platform for further informations about the course
Sustainable development goals - Agenda 2030	$lbl_legenda_sviluppo_sostenibile