



### QUANTUM ELECTRONICS

<b>Anno immatricolazione</b>	2020/2021
<b>Anno offerta</b>	2020/2021
<b>Normativa</b>	DM270
<b>SSD</b>	FIS/03 (FISICA DELLA MATERIA)
<b>Dipartimento</b>	DIPARTIMENTO DI INGEGNERIA INDUSTRIALE E DELL'INFORMAZIONE
<b>Corso di studio</b>	ELECTRONIC ENGINEERING
<b>Curriculum</b>	Photonics
<b>Anno di corso</b>	1°
<b>Periodo didattico</b>	Primo Semestre (28/09/2020 - 22/01/2021)
<b>Crediti</b>	6
<b>Ore</b>	46 ore di attività frontale
<b>Lingua insegnamento</b>	English
<b>Tipo esame</b>	SCRITTO E ORALE CONGIUNTI
<b>Docente</b>	PIRZIO FEDERICO (titolare) - 6 CFU
<b>Prerequisiti</b>	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
<b>Obiettivi formativi</b>	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 radiation-matter interaction and should be able to qualitatively and quantitatively describe the functioning of a LASER oscillator.
<b>Programma e contenuti</b>	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)

#### Metodi didattici

Lectures (hours/year in lecture theatre, blackboard + slides): 44  
Practical class (hours/year in lecture theatre): 2  
Practicals / Workshops (hours/year in lab): 2

#### Testi di riferimento

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.

#### Modalità verifica apprendimento

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.

#### Altre informazioni

Please visit the web-page of the course on KIRO platform for further informations about the course

#### Obiettivi Agenda 2030 per lo sviluppo sostenibile

[Gli obiettivi](#)