



QUANTUM ELECTRONICS

Anno immatricolazione	2020/2021
Anno offerta	2021/2022
Normativa	DM270
SSD	FIS/03 (FISICA DELLA MATERIA)
Dipartimento	DIPARTIMENTO DI INGEGNERIA INDUSTRIALE E DELL'INFORMAZIONE
Corso di studio	ELECTRONIC ENGINEERING
Curriculum	Microelectronics
Anno di corso	2°
Periodo didattico	Primo Semestre (27/09/2021 - 21/01/2022)
Crediti	6
Ore	46 ore di attività frontale
Lingua insegnamento	English
Tipo esame	ORALE
Docente	PIRZIO FEDERICO (titolare) - 6 CFU
Prerequisiti	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
Obiettivi formativi	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.
Programma e contenuti	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

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](#)