TECNOLOGIE DELL'INFORMAZIONE QUANTISTICA

FIS/03 - 9 CFU - 1° Semester

Teaching Staff

ALESSANDRO RIDOLFO
Email: alessandro.ridolfo@ct.infn.it
Office: Dipartimento di Fisica e Astronomia, stanza 109 (primo piano)
Office Hours: Mercoledì dalle 11:00 alle 13:00. Gli studenti sono cordialmente invitati a contattare il docente via email al fine di garantire una migliore organizzazione

GIUSEPPE FALCI
Email: gfalci@dmfci.unict.it
Office: Dipartimento di Fisica e Astronomia, Città Universitaria, Ufficio 212
Phone: 0953785337
Office Hours: Lunedi 18:00-20:00 (ex DMFCI), Mercoledi 10:30-11:30 (DFA)

LEARNING OBJECTIVES

The course will provide basic notions, from quantum mechanics to elements of the theory of solids and quantum transport, necessary to the understanding of modern quantum technologies. Phenomena and principles at the basis of Quantum Technologies will be reviewed as well as applications. The goal is to provide the student with skills and competencies complementing the the basic microelectronics curriculum, as: (a) familiarity with the emerging opportunities that nanoelectronics and quantum technologies offer; (b) ability of using quantum mechanics in different contexts of ICT and Nanotechnologies and judging the state of the art and relative progress in different technologies involving nanosystems; (c) acquiring a basis to come up with their own idea of new interesting project.

The present course addresses the multidisciplinary need of the diverse industrial sectors embracing nowadays nanotechnology, and the recent growth of interest in quantum technologies, which may offer new opportunities for employment and specialization to our graduates.

The student must have elements of the language, as a good knowledge of classical physics and some grasp of introductory device physics.

COURSE STRUCTURE

The course is divided in three parts, namely (1) basic quantum mechanics and solid state physics, (2) applications to nanophysics and (3) to quantum technologies

DETAILED COURSE CONTENT

PART I: Quantum Mechanics

1. Wave-particle duality: phenomenology [2,5,6]
2. Wave mechanics [3,5,6]
3. Some stationary problem [3,5]
4. Quantum Mechanincs and illustrative applications [3,5,6]
5. Approximation methods [3,5]
6. Elements of statitical mechanics [5,6]
7. Crystalline solids and semiclassical transport [1,5]

PART II: Nanostructures

1. Tunneling and charging effects [5,6]
2. Low-dimensional systems [5,6]
3. Quantum transport [4,5]

PART III: Quantum Technologies

1. Quantum Computation [7]
2. Quantum Comunication [7]

TEXTBOOK INFORMATION

[1] Neil W. Ashcroft and N. David Mermin. Solid State Physics. Holt Saunders, 1976.
[2] P. Mazzoldi, M. Nigro, C. Voci, Elementi di Fisica: Elettromagnetismo e Onde, Edises 2008.
[3] C. Cohen-Tannoudji, B. Diu, and F. Lalo¨e. Quantum Mechanics - vol 1, volume 1. Wiley-Interscience Publication, 1977.
[4] Datta. Electronic Transport in Mesoscopic Systems. University Press, 1995. Cambridge
[5] G. Falci. Appunti del corso di fisica dei nanosistemi. 2018.
[6] G.W. Hanson. Fundamentals of Nanoelectronics. Prentice Hall, 2007.
[7] G. Benenti, G. Casati, G. Strini, Principles of Quantum Computation and Information, voll. 1 e 2, World Scientific, 2004