Università degli Studi di L'Aquila - Dipartimento di Ingegneria e Scienze dell'Informazione e Matematica

Course catalogue

Page compiled on 18/11/2019

Programme of Course "Electronic Devices"

- Code: I0565
- Type of course unit: Elective (Master Degree in Mathematical Engineering curriculum Comune)
- Level of course unit: Postgraduate Degrees
- Semester: 1

Number of ects credits: (Master Degree in Mathematical Engineering) 9 (workload 225 hours)

Teachers: Pasquale Carelli, Vincenzo Stornelli

1	**Course objectives**	The goal of this course is to provide the main concepts on crystallography, electronic and phonon transport theory, techniques of solid state physics of semiconductor junctions between semiconductors, main solid state devices. The main electron device types are described, together with the relevant equivalent model CAD. On successful completion of this module, the student should understand the advanced knowledge about the properties of the main solid state devices with a strong insight into the physical basis of their operation.
2	**Course content and learning outcomes (dublin descriptors)**	Topics of the module include: • Outline of the basic atomic structure of matter: classification of solids, Perfect crystals and Bravais lattice, Crystalline defects • Elements of classical statistics: the classical Drude model of the electron, limitations of the model Quantum statistics: bosons and fermions, the application of quantum mechanics to phonons, boundary conditions, the Sommerfield model for electrons, transport properties in quantum mechanics, the band structure, metals, semiconductors and insulators, the Fermi surface, effective mass, electron dynamics in quantum mechanics • Semiconductor physics: semiconductor real simplified model, occupation of the states, holes and electrons, doped semiconductors, measurement of doping, transport in semiconductors, measuring characteristics of semiconductor pn junction, depletion region, current-voltage characteristic. Heterojunction. Metal semiconductor junction. The structure of metal oxide semiconductor. The equivalent circuit of the junction diode (omojunction). Modelling the current-voltage characteristics and charge-voltage, under low and high injection. Transient beahavior. SPICE model • The SPICE model of the MOSFET. Flash Memory: physical structure, behavior and modeling. Heterojunctions and compound semiconductors, Super-lattices • Heterojunction electronic devices: the bipolar transistor (HBT) and field effect transistors (HEMT), Light Emitting Diodes, pn junctions and heterojunctions • Simulation-based physics: Boltzmann transport equation, models and algorithms. Coupling with the electromagnetic field. Laboratory: Measurement of the junction diode (Gummel plot). Simple circuits with LEDs and photodiodes
3	**Course prerequisites**	The student must have basic notions in electronics and physics, contained in the exams of Physics I and Elettronica I.
4	**Teaching methodsand language**	Lectures and exercises **Language**: English **Reference textbooks** • S.M. Sze, ***Semiconductor devices: physics and technology***. J. Wiley & Sons. 2002.
5	**Assessment methods**	Written and Oral exam