Department of Physical and Chemical Sciences

BACHELOR DEGREE IN CHEMICAL AND MATERIALS SCIENCES AND TECHNOLOGIES

**PROGRAMME OF "PHYSICS OF SEMICONDUCTORS AND DEVICES AND LABORATORY"**

**A.A. 2014-2015**

***Teachers***: Prof. S. Santucci - L. Lozzi; ***ECTF***: 9

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This course introduces semiconductor device operation based on energy bands and carrier statistics. It describes operation of p-n junctions and metal-semiconductor junctions. It extends this knowledge to descriptions of bipolar and field effect transistors, and other microelectronic basic devices. This course is intended for undergraduate students who plan to study in the area of microelectronics or just have an interest in that area. This course emphasizes the fundamentals of materials and device operation. In this course, we will study semiconductor devices from a fundamental point of view emphasizing a thorough understanding of the mechanisms of device operation. It is expected that students who successfully complete the course will have an understanding of basic semiconductor devices sufficient to design transistors and diodes to particular specifications. While the course will provide a 'top-down' view of traditional electronic devices, it should serve as a suitable lead-in to more advanced courses such as (Physics of Nanosterures and devices), which provides a 'bottom-up' view of current and future devices.

**Prerequisites:**

Undergraduate introduction to solid-state devices or electronic materials or some background in classical mechanics, E&M, QM + Motivation.

**Class Topics:**

- Crystals and Semiconductor Materials
- Introduction to Quantum Mechanics
- Application to Semiconductor Crystals – Energy Bands
- Carriers and Statistics
- Recombination-Generation Processes
- Carrier Transport Mechanisms
- P-N Junctions
- Non-Ideal Diodes
- Metal-Semiconductor Contacts – Schottky Diodes
- Metal-Oxide-Semiconductor Transistor (MOSFET)

- Photonic Devices
- MOSFET Operation and Scaling
- Bipolar Junction Transistors (BJT)
- Optoelectronic devices

**Laboratory sessions:**

- X-ray diffraction (XRD) characterization of semiconductors
- Temperature dependence of the electrical conductivity of metals and semiconductors
- The Hall effect
- Current-voltage characterization of diode
- Diode circuits
- Preparation and characterization of a metal-semiconductor junction
- Preparation of semiconductor powders and thin films by sol-gel technique
- Characterization by XRD and UV-VIS techniques of semiconductor powders and thin films

Reading list:

"Solid State Electronic Devices", B.G. Streetman:

Material provided by the teacher

Assessment methods: oral examination