UNIVERSITY of NICOSIA

Course Syllabus

Course Code	Course Title	ECTS Credits
ECE-305	Solid-State Electronic Devices	6
Prerequisites	**Department**	**Semester**
PHYS-160, MATH-191	Engineering	Fall/Spring
Type of Course	**Field**	**Language of Instruction**
Elective	Physics	English
Level of Course	**Lecturer(s)**	**Year of Study**
1st Cycle	Dr Marios Nestoros	3rd
Mode of Delivery	**Work Placement**	**Corequisites**
Face to face	N/A	None

Course Objectives:

The main objectives of the course are to:

- Present the technology behind semiconductor devices fabrication.
- Introduce students to the basic concepts of quantum mechanics and present its implications in the solid state.
- Develop an understanding of the processes taking place in a p-n junction.
- Develop an understanding of the p-n junction as a power source and a detector.

Learning Outcomes:

After completion of the course students are expected to be able to:

- Describe in brief the technology of growth of semiconductor materials as well as the processes of doping and annealing.
- Solve Schrödinger's equation for square potential barriers, calculate the tunneling probability and explain qualitatively the Kronig-Penney Model and its implications (band gap).
- Calculate carrier concentration and Fermi level position in semiconductors
- Explain the effects of temperature, impurities and defects on carrier transport parameters.
- Explain the generation and recombination processes in semiconductors, develop and solve the carrier transport equation in simple cases.
- Describe the basic steps/technology of fabrication of a p-n junction.

- Explain and deduce: the depletion region, the build in voltage under zero, positive and negative bias, the junction breakdown phenomenon
- Explain and deduce the ideal I-V characteristic of a p-n junction as well as the effect of the generation and recombination currents
- Calculate the free carrier generation rate under optical excitation, and explain the operation of solar cells and photo-detectors.

Course Content:

Lectures

1. Atoms Molecules and Solids: types of bonds, basic crystallography, types of defects, crystal growth, doping, annealing.
2. Wave-particle duality: Heisenberg's Principle, Schrödinger's equation in one dimension, potential barriers and tunneling.
3. The Kronig Penney Model: forbidden and allowed energy bands, extension in three dimensions.
4. Equilibrium carrier statistics: electrons, holes, effective mass, energy gap, density of states, Fermi energy, intrinsic carrier concentration, statistics of donors and acceptors.
5. Carrier Transport: diffusion, mobility effects, conductivity, drift currents, total current density, Einstein relation
6. Non-equilibrium Excess Carriers in Semiconductors: carrier generation and recombination statistics, continuity equation, ambipolar transport.
7. The p-n junction: basic fabrication processes, depletion region and build in potential barrier, charge flow under forward and reverse polarization, junction breakdown, ideal p-n junction current, generation recombination currents, charge storage and diode transients, the tunnel diode.
8. Optical Properties and Devices: radiative transitions, optical absorption coefficient, solar cells, photodiodes.

Learning Activities and Teaching Methods:

Lectures, Tutorials, Simulations

Assessment Methods:

Midterm Test, Homework, Lab Work, Final Examination

Required Textbooks / Readings:

Title	Author(s)	Publisher	Year	ISBN
Semiconductor Physics and Devices	D. A. Neamen	Mc Graw Hill	2011	978-0073529585

Recommended Textbooks / Readings:

Title	Author(s)	Publisher	Year	ISBN
Semiconductor Device Physics and Design	U. K. Mishra and J. Singh	Springer	2008	978-94-007-9778-9