Course Title	Course Code	Number of Study Hours				Year	Level	Prerequisites
		Theo.	Lab.	Credit	ECTS			
Solid State Physics	PHYS640	3	-	3	9	1st/ 2nd	2nd/ 3rd	-

Student's workload			
In-class activities	Contact Hours	Self-learning/study	Hours
Lectures	45	Preparation for classes	120
Laboratory	-	Case studies	-
Exams and quizzes	5	Working on lab experiment	-
Lab demo	-	HW/Assignments	22
		Study for exam	48
Total	50	Total	190
Total Learning Hours = 240		Equivalent ECTS points = Total LH/28 = 9	

BRIEF COURSE DESCRIPTION

- This course is designed to provide a framework for graduate students to understand at an "advanced" level some of the important aspects of solid-state physics and is designed to introduce crystal structures and symmetries, electron levels in periodic, weak periodic and tight binding potential, classification of solids, dielectric properties of insulators, homogeneous semiconductors and inhomogeneous semiconductors.

COURSE OBJECTIVES

The main objectives of this course are focused on the following:

1. Review the crystal structure and crystal symmetries.
2. Explore Electron Levels in periodic potential.
3. Analyze the electrons in a weak periodic potential and tight binding potential.
4. Discuss the classification of solids.
5. Explain the dielectric properties of insulators.
6. Discuss the homogeneous and inhomogeneous semiconductors.

COURSE CONTENTS

- Crystal Structure and Crystal Symmetries: Review of crystal lattices, the reciprocal lattice, Brillouin zone, Miller indices, and symmetry operations, classification of lattices, crystallographic point groups and space groups.
- Electron Levels in a Periodic Potential: Review of Sommerfeld theory of metals, the periodic potential and Bloch's theorem, Boundary condition, Fermi surface, Density of levels.
- Electrons in a Weak Periodic Potential and the Tight-binding method: Energy levels near a single Bragg plane, extended and repeated zone schemes in one dimension, Fermi surface and Brillouin zone, general features of tight binding levels.
- Classification of Solids: The spatial distribution of valance electrons, ionic crystals, covalent crystals, molecular crystals, metals and hydrogen–bonded solids.
- Dielectric Properties of Insulators: Review of Macroscopic electrostatic Maxwell's equation, theory of local field, theory of polarizability, optical properties of ionic crystal, covalent insulators. Pyroelectricity and Ferroelectricity.
- Homogeneous Semiconductors: Review of general properties of semiconductors, Band structure, carrier statistics in thermale equilibrium, intrinsic and extrinsic semiconductors, and statistics of impurity levels in thermal equilibrium, carrier densities, impurity band conduction, and transport in nondegenerate semiconductors.
- Inhomogeneous Semiconductors: Fields and carrier densities in the equilibrium p-n junction, drift and diffusion currents, collision and recombination times, carrier densities and currents in the nonequilibrium p-n junction.

ASSESSMENT CRITERIA

- Mid Term exam and Quizzes: 30 %
- Assignments and classroom activities: 20 %
- Final Exam: 50%

COURSE TEACHING STRATEGIES

- Lectures, Tutorials, Seminars, Interactive Discussions, Expository and Discovery, and Interactive Discussions.

TEXT BOOK

- N. Ashcroft and N. Mermin, Solid State Physics, (Brooks / Cole Publishing 1976)

REFERENCE BOOKS

- C. Kittel, Introduction to Solid State Physics, 8th edition, (Wiley Charles 2005).
- D. A. Neamen, Semiconductor physics and devices, (McGraw-Hill, 2011).
- S. M. Sze and M. K. Lee, Semiconductor Devices-Physics and Technology, 3rd Edition, John Wiley.