Course Title	Course Code	Number of Study Hours				Year	Level	Prerequisites
		Theo.	Lab.	Credit	ECTS			
Materials Science	PHYS641	3	-	3	9	1st/ 2nd	2nd/ 3rd	-

Student's workload			
In-class activities	Contact Hours	Self-learning/study	Hours
Lectures	45	Preparation for classes	135
Laboratory	-	Case studies	-
Exams and quizzes	5	Working on lab experiment	-
Lab demo	-	HW/Assignments	24
		Study for exam	52
Total	50	Total	211
Total Learning Hours = 261		Equivalent ECTS points = Total LH/28 = 9	

BRIEF COURSE DESCRIPTION

- This course covers basic knowledge about crystalline and amorphous materials, polymer, ceramics, metals and alloys, glasses, semiconductors, luminescent and optoelectronic materials. It also covers topics including synthesis, processing, characterization and properties of the different materials.

COURSE OBJECTIVES

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

1. Discuss the importance of materials physics in determining the properties of materials according to its structure, composition and performance.
2. Explore the different techniques used for materials characterization to deduce the suitable technique for each type of materials.
3. Correlate between structure, processing and properties for a given material.
4. Differentiate between different materials in terms of their microstructures, characteristics and properties.
5. Investigate the relations between composition, temperature and phase fractions applied to the equilibrium phase diagrams for a given material system.

COURSE CONTENTS

STRUCTURE OF MATERIALS:

- Structure of Crystals: Introduction to Lattices, Local Atomic Bonding Units and Crystal Structures
- Bonding in Solids: Bonding in Elemental Solids, Bonding in Multi element Crystals, Some Atomic Properties and Parameters
- Order and Disorder in Solids: Order and Disorder, Defects in Solids

2.PHYSICAL PROPERTIES OF MATERIALS

- Phonons: Excitations of the Lattice: Phonons, Lattice Specific Heat of Solids, Anharmonic Effects.
- Electrons in Solids: Electrical and Thermal Properties, Classical Theory of Electrical Conduction, Free-Electron Gases, Transport Theory, Conduction in Insulators, Metal– Insulator Transition, Conductivity of Reduced-Dimensional Systems,
- Optical Properties of Materials: AC Conductivity of Metals, Optical Properties of Semiconductors, Excitons
- Magnetic Properties of Materials: Origins of Magnetism in Solids, Types of Magnetism and Magnetic Behavior in Materials,
- Mechanical Properties of Materials: Stress, Strain, and Elastic Constants, Elastic Properties of Materials, Anelastic Properties of Materials.

3.CLASSES OF MATERIALS:

- Semiconductors: Properties of Semiconductors, Macroscopic Properties, Applications of Semiconductors,
- Metals and Alloys: Three Classes of Metals, Examples and Applications of Metallic Alloys
- Polymers: Structure of Polymers, Mechanical Properties, Thermal Properties, Applications
- Magnetic Materials: Characteristic Propertiesof Magnetic Materials, Effects in Magnetic Materials, Applications of Magnetic Materials
- Optical Materials : Propagation of Light, Generation of Light, Recording of Light.

4.SURFACES, THIN FILMS, INTERFACES, AND MULTILAYERS

- Surfaces: Real Surfaces, Electronic Properties of Surfaces, Surface Modification.
- Thin Films, Interfaces, and Multilayers: Thin Films, Interfaces, Multilayers

5. SYNTHESIS AND PROCESSING OF MATERIALS

- Synthesis and Processing of Materials: Synthesis and Processing of Semiconductors, Metals, Ceramics, Glasses and Polymers.

6.CHARACTERIZATION OF MATERIALS

- Diffraction Techniques, Optical Spectroscopy, Electron Microscopy, Transport Measurements, Magnetic Measurements, Resonance Techniques, Elementary Particles.

ASSESSMENT CRITERIA	COURSE TEACHING STRATEGIES
• Mid-Term exam and Quizzes: 30 % • Assignments and classroom activities: 20 % • Final Exam: 50%	• Lectures, Discussion, presentation, Group activities.

TEXT BOOK	REFERENCE BOOKS
• J. Gersten, F. W. Smith, The Physics and Chemistry of Materials, John Wiley & Sons, Inc., 2000.	• W. D. Callister, Materials Science and Engineering Introduction, John Wiley & Sons, 2007