Course Title	Course Code	Number of Study Hours				Year	Level	Prerequisites
		Theo.	Lab.	Credit	ECTS			
Magnetism and Super conductivity	PHYS642	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	32
		Study for exam	60
Total	50	Total	212
Total Learning Hours = 262		Equivalent ECTS points = Total LH/28 = 9	

BRIEF COURSE DESCRIPTION

- This course covers the principles of magnetism and superconductivity. The first part gives a general overview of magnetism of materials. The second part discusses superconductivity, the Meissner effect, type I and II superconductors, and the superconducting transition. London equations, as well as the details of the BCS theory will be given. Unconventional high TC superconductivity and super fluidity phenomena and their gap symmetry are illustrated.

COURSE OBJECTIVES

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

1. Discuss the basics of magnetism and superconductivity
2. Distinguish between Para magnetism, ant magnetism and ferromagnetism
3. Solve problems related to Spin orbit coupling, Para magnetism, diamagnetism, ferromagnetism, direct, indirect and super exchange,
4. Analyze the phase transitions that cause unusual physical phenomena.
5. Explain other unconventional phenomena of advanced materials.

COURSE CONTENTS

- General introduction to magnetism: Magnetism of electrons in solids, Magnetic moments, Spin, and orbital moments.
- Spin orbit coupling, Paramagnetism, Diamagnetism, Ferromagnetism, Direct, indirect and super exchange,
- Magnetic structures: ferro-, antiferro-, ferromagnetic, Heisenberg model and magnetic excitations, Magnetic phase transitions.
- Introduction to properties of superconductors: thermodynamics, and electrodynamics of superconductors, Meissner effect, type I and II superconductors
- Flux lattice, Superconducting phase transitions, London equations, Isotope effect, Cooper pairs, BCS theory, High Tc superfluidity.
- Applications for Superconductivity, Josephson and its Applications

ASSESSMENT CRITERIA

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

COURSE TEACHING STRATEGIES

- Lectures , blackboard and diagram illustration, Case study, interactive demonstration, guided discussion, Interactive and Group discussion expository and discovery teaching.

TEXT BOOK

- L. P. Levy, Magnetism and superconductivity, (Springer Verlag,2000) (English Version).

REFERENCE BOOKS

- S. Blundell, Magnetism in Condensed Matter (Oxford University Press 2001).
- W. Buckel, R. Kleiner Superconductivity: Fundamentals and Applications, 2nd edition, by Wiley-VCH 2004 .
- C. Timm, Theory of Superconductivity, Wintersemester 2011/2012 (Technische Universität Dresden, Germany.