هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

2023
TP-153

Course Specification

(Bachelor)

Course Title:	Solid State Physics 1
Course Code:	2033201 - 4
Program:	Bachelor in Physics
Department:	Physics Department
College:	College of Science
Institution:	Taif University
Version:	1
Last Revision Date:	2020

Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours: (4)					
2. Course type					
A.	☐University	☐College	☒ Department	☐Track	☐Others
B.	☒ Required		☐Elective		
3. Level/year at which this course is offered: (6th Level / 3rd Year)					
4. Course general Description:					
The course introduces the basic solid state physics elements, including: Bravais lattices and crystal systems, miller indices for planes and directions, crystal defects, inter-atomic forces and bonds, X-ray diffraction methods, reciprocal lattice and Brillouin zones, lattice vibrations, Einstein and Debye models for heat capacity, thermal conductivity, free electron classic and quantum models, Fermi level and Fermi surfaces and the density of electronic states.					
5. Pre-requirements for this course (if any):					
Modern Physics 2033105-4					
6. Co-requisites for this course (if any):					
None					
7. Course Main Objective(s):					
- Classify crystalline solids according to their crystalline structures. - Introduce the x-ray diffraction techniques used to characterize the crystalline structure of solids. - Explain the relation between lattice vibrations and thermal properties in solids. - Introduce the free electron classic and quantum theories in solids.					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	90 (6h per week)	100%
2	E-learning		
3	Hybrid • Traditional classroom		

No	Mode of Instruction	Contact Hours	Percentage
	• E-learning		
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	Lectures	45
2.	Laboratory/Studio	45
3.	Field	
4.	Tutorial	
5.	Others (specify)	
Total		90

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
1.0	Knowledge and understanding			
1.1	Outline the different crystalline systems and the different X-ray diffraction methods used to analyze them.	K1	Lectures Discussions	Written exams Assignments
1.2	Recognize the main theories and laws of solid state physics relative to lattice dynamics and free electron phenomena.	K3	Lectures Discussions	Written exams Assignments
2.0	Skills			
2.1	Develop skill versatility in solving problems related to solid state physics.	S2	Problem solving	Written exams Assignments
2.2	Measure solid state quantities in laboratory and analyze qualitatively and quantitatively the associated experimental data.	S4	Lab work	Lab reports Lab exam
3.0	Values, autonomy, and responsibility			
3.1	Work efficiently within a group frame to perform class and	V2	Lab work	Lab reports Lab exam

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	laboratory activities in solid state physics.		Discussions	Essay evaluation
3.2	Act responsibly and be able to prepare a written scientific report.	V3	Lab work Discussions	Lab reports Lab exam

C. Course Content

No	List of Topics	Contact Hours
	Lectures	
1.	Unit1: **Crystal structure** ▪ The crystalline state ▪ The fourteen Bravais lattices and the seven crystal systems ▪ Crystal directions and crystal planes ▪ Miller indices ▪ Examples of crystalline structures (sodium chloride, cesium chloride, diamond, mercury)	12
2.	Unit2: **Crystal defects** ▪ Point defects ▪ Line defects ▪ Surface defects ▪ Volume defects	3
3.	Unit3: **Diffraction of X-rays in crystals** ▪ Generation and absorption of X-ray ▪ Bragg's law ▪ Scattering from a crystal ▪ The reciprocal lattice and Brillouin zones ▪ X-ray diffraction methods	9
4.	Unit4: **Lattice vibrations and thermal properties** ▪ The Continuous Elastic Solid ▪ Vibration of monoatomic lattice in one dimension ▪ Specific heat (classical, Einstein and Debye models) ▪ Electronic specific heat (conduction electrons) ▪ Thermal expansion and Thermal conductivity.	12
5.	Unit5: **Free electron model and introduction to band theory** ▪ Classical theory of free electrons, Drude Model ▪ Ohm's law; Electrical conductivity, temperature dependence ▪ Quantum treatment of free electrons ▪ Density of state and Fermi level, Summerfield Model ▪ Introduction to band theory.	9
	Total	**45**

	Laboratory	
1.	Introduction	3
2.	Models of the 14 Bravais lattices	3
3.	Calibration of induced magnetic field for Hall effect experiment	3
4.	Hall effect experiment for conductors (W, Ag)	6
5.	Hall effect experiment for semiconductors (n-type Ge and p-type Ge)	6
6.	Temperature dependence of electrical conductivity in conductors (W, Ag).	3
7.	Temperature dependence of electrical conductivity in semiconductors (n-Ge, p-Ge).	6
8.	Four-Probe experiment for sheet resistance	3
9.	Dielectric constant experiment	3
10.	Revision	6
11.	Practical exam	3
Total		45

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Midterm exam I	7th	20%
2.	Midterm exam II	11th	10%
3.	Activities	Periodically	10%
4.	Lab reports	Weekly/ 14th	15%
5.	Final Lab Exam	15th	5%
6.	Final exam	16th	40%

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	• Introduction to Solid State Physics, Charles Kittle, John Wiley & Sons, Inc, New York USA (1996). • Solid State Physics, J. S. Blakemore, 2nd edition, Cambridge university press 1985.
Supportive References	
Electronic Materials	http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html http://www.crystallography.net/cod/result.php https://en.wikipedia.org/wiki/Main_Page
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Classroom Solid State laboratory
Technology equipment (projector, smart board, software)	Data show
Other equipment (depending on the nature of the specialty)	

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	Indirect
Effectiveness of Students assessment	Faculty Program coordinator Departmental council	Indirect
Quality of learning resources	Students Faculty	Indirect
The extent to which CLOs have been achieved	Program leaders Faculty	Direct
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	PHYSICS DEPARTMENT COUNCIL
REFERENCE NO.	NO. 4-45
DATE	27/09/2023 (12/03/1445)

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Physics Department
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