هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

اعتماد NCAAA T4 2020

Course Specifications

Course Title:	**Solid State Physics 1**
Course Code:	**PHY4701**
Program:	**Physics**
Department:	**Physics**
College:	**Applied Sciences**
Institution:	**Umm Al-Qura University**

Table of Contents

A. Course Identification

1. Credit hours:	4
2. Course type	
a.	University ☐ College ☐ Department ☑ Others ☐
b.	Required ☑ Elective ☐
3. Level/year at which this course is offered:	Level 10th / 4th year
4. Pre-requisites for this course (if any):	Quantum Mechanics 2
5. Co-requisites for this course (if any):	

6. Mode of Instruction (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	40	100%
2	Blended		
3	E-learning		
4	Distance learning		
5	Other		

7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	Lecture	40
2	Laboratory/Studio	
3	Tutorial	
4	Others (specify)	
	Total	40

B. Course Objectives and Learning Outcomes

1. Course Description

This course is intended to introduce the physics of the solid state. It begins by investigating crystal structure, reciprocal lattice vector and the Brillouin zone. The interference pattern obtained from X-Ray diffraction by crystals is also, covered to identify the lattice structure of the solid state. Then followed by crystal binding and elastic constants. Next, this course covers crystal vibrations, followed by thermal properties of solids.

2. Course Main Objective

At the end of this course, the student will be able to

- Defined the Miller indices of the direction and the planes within the crystals
- Differentiate between the different types of the crystals structure.
- Differentiate between the different types of bonds in solids.
- Defined the thermal properties of solids

3. Course Learning Outcomes

	CLOs	Aligned PLOs
1	**Knowledge and Understanding**	
1.1	Recognize the atomic structure and the different types of interatomic bonds.	K1
1.2	Recognize how diffraction of X-Rays on solid matter can be used to obtain lattice structure.	K2
1.3	Recognize the concept density of states in one, two and three dimensions.	
2	**Skills :**	
2.1	Differentiate between different Lattice types and explain the concepts of reciprocal lattice and crystal diffraction.	S1
2.2	Explain mechanical, electrical and thermal properties of solids and explain their origin.	S2
2.3	Evaluation of the approximations needed to build models to understand the solid state.	
3	**Values:**	
3.1	Work effectively and responsibly in teamwork.	V2

C. Course Content

No	List of Topics	Contact Hours
1	**Crystal Structure** • Periodic Array of Atoms. • Fundamental Types of Lattices. • Index Systems for Crystal Planes • Simple Crystal Structure • Direct Imagining of Atomic Structure • Nonideal Crystal Structures	8
2	**Wave Diffraction and the Reciprocal Lattice** • Diffraction of Waves by Crystals. • Scattered Wave Amplitude. • Brillouin Zones • Fourier Analysis of the Basis.	8
3	**Crystal Binding and Elastic Constants** • Crystal of Inert Gases. • Ionic Crystals. • Covalent Crystals. • Metals. • Hydrogen Bonds. • Atomic Radii. • Analysis of Elastic Strains. • Elastic Compliance and Stiffness Constants • Elastic Waves in Cubic Crystals.	6
4	**Phonons I. Crystal Vibrations** • Vibrations of Crystals with Monatomic Basis. • Two Atoms per Primitive Basis	6

	• Quantization of Elastic Waves. • Phonon Momentum. • Inelastic Scattering by Phonons.	
5	**Phonons II. Termal Properties** • Phonon Heat Capacity • Anharamonic Crystal Interactions. • Thermal Conductivity.	6
6	**Free Electron Fermi Gas** • Energy Level in One Dimension • Effect of Temperature on the Fermi Dirac Distribution. • Free Electron Gas in Three Dimensions. • Heat Capacity of the Electron Gas. • Electrical Conductivity and Ohm's Law. • Motion in Magnetic Field • Hall Effect • Thermal Conductivity of Metals.	6
Total		40

D. Teaching and Assessment

1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
1.0	**Knowledge and Understanding**		
1.1	Recognize the atomic structure and the different types of interatomic bonds.	1. Demonstrating the basic principles through lectures. 2. Discussing phenomena with illustrating pictures and diagrams. 3. Lecturing method: Board, Power point. 4. Discussions 5. Brain storming 6. Start each chapter by general idea and the benefit of it.	- Solve some examples - Discussions during the lectures - Exams: a) Quizzes. b) Midterm exams. c) Final exam.
1.2	Recognize how diffraction of X-Rays on solid matter can be used to obtain lattice structure.		
	Recognize the concept density of states in one, two and three dimensions.		
2.0	**Skills**		
2.1	Differentiate between different Lattice types and explain the concepts of reciprocal lattice and crystal diffraction.	1. Preparing main outlines for teaching. 2. Following some proofs. 3. Define duties for each chapter	1. Exams: a) Quizzes. b) Midterm exams. c) Final exam 2. Homework.
2.2	Explain mechanical, electrical and thermal properties of solids and explain their origin.		

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
	Evaluation of the approximations needed to build models to understand the solid state.		
3.0	**Values**		
3.1	Work effectively and responsibly in teamwork.	• Organize the students in a small groups (teamwork). • Give students tasks of duties as a small project.	• Evaluate the scientific reports. • Discussing the reports with each teamwork. • Evaluate the efforts of each student in preparing the report.

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	Midterm Exam	7th	30%
2	Homework's & Quizzes& Reports	All weeks	20 %
3	Final Exam	End of the semester	50%

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

E. Student Academic Counseling and Support

Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice:

Each student will be supervised by academic adviser in Physics Department and the time table for academic advice were given to the student each semester. (4 hrs per week)

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	• Introduction to Solid State Physics, 8th Edition, by Charles Kittel, John Wiley, (2005).
Essential References Materials	• Solid State Physics, by R. K. Puri & V. K. Babbar 3rd Edition, Ram Nagar, New Delhi : S. Chand, (2008). • Materials Science and Engineering An Introduction 8th edition, by D. William, Jr. Callister and David G. Rethwisch, John Wiley and Sons, Inc. (2010). • Solid-State Physics: An Introduction to Principles of Materials Science Fourth Edition, by Harald Ibach & Hans Luth, Springer-Verlag Berlin Heidelberg, (2009).
Electronic Materials	

Other Learning Materials	

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	- Classroom
Technology Resources (AV, data show, Smart Board, software, etc.)	- Black Board - Data show
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of teaching Strategies	Students	Questionnaire
Effectiveness of student assessment	Instructor	Exams
Extent of achievement of course learning outcomes	Instructor	Course report
Quality of learning resources	Instructor	Course report

Evaluation areas (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
Evaluators (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
Assessment Methods (Direct, Indirect)

H. Specification Approval Data

Council / Committee	
Reference No.	
Date	