هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

اعتماد NCAAA T4 2020

# Course Specifications

| | |
|---|---|
| **Course Title:** | **Solid State Physics 2** |
| **Course Code:** | **PHY4702** |
| **Program:** | **Physics** |
| **Department:** | **Physics** |
| **College:** | **Applied Science** |
| **Institution:** | **Umm Al-Qura University** |

## Table of Contents

## A. Course Identification

| |
|---|
| 1. Credit hours: 4 |
| 2. Course type<br>a. University ☐ College ☐ Department ☑ Others ☐<br>b. Required ☑ Elective ☐ |
| 3. Level/year at which this course is offered: Level 11th / 4rd year |
| 4. Pre-requisites for this course (if any):<br>Solid State Physics 1 + Co-requisite: Semiconductor Physics |
| 5. Co-requisites for this course (if any): Semiconductor Physics |

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 covers the magnetic properties of solids, dielectric properties of solids, superconducting properties of the solids, optical properties of solids.

2. Course Main Objective

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

- Define the magnetic properties of the solids.
- Differentiate between the different types of the magnetic materials.
- Define the dielectric properties of the solids.
- Differentiate between the different types of dielectric materials.
- Differentiate between the different types of superconducting materials.

### 3. Course Learning Outcomes

| | CLOs | Aligned PLOs |
|---|---|---|
| 1 | **Knowledge and Understanding** | |
| 1.1 | Define the physical quantities related to magnetic, dielectric, and superconducting properties of solids. | K1 |
| 1.2 | Describe the physical quantities and physical laws related to magnetic, dielectric, and superconducting properties using mathematical formula. | K2 |
| **2** | **Skills :** | |
| 2.1 | Solve some problems related to solid state using suitable laws of physics | S1 |
| 2.2 | Explain the physical phenomena related to the magnetic, dielectric, and superconducting properties of solids. | S2 |
| **3** | **Values:** | |
| 3.1 | Work effectively and responsibly in teamwork. | V2 |
| | | |

## C. Course Content

| No | List of Topics | Contact Hours |
|---|---|---|
| 1 | **Fermi Surface and Metals**<br>• Construction of Fermi Surfaces.<br>• Electron Orbits, Hole Orbits, and Open Orbits.<br>• Calculation of Energy Bands | 6 |
| 2 | **Superconductivity**<br>• Experimental Survey.<br>• Theoretical Survey.<br>• High Temperature Superconductors | 6 |
| 3 | **Diamagnetism and Paramagnetism**<br>• Langevin Diamagnetism Equations<br>• Quantum Theory of Diamagnetism of Mononuclear Systems.<br>• Paramagnetism.<br>• Quantum Theory of Paramagnetism.<br>• Paramagnetic Susceptibility of Conduction Electrons. | 6 |
| 4 | **Ferromagnetism and Antiferromagnetism**<br>• Ferromagnetic Order.<br>• Magnons<br>• Neutron Magnetic Scattering.<br>• Ferrimagnetic Order.<br>• Antiferromagnetic Order.<br>• Ferromagnetic Domains.<br>• Single Domain Particles. | 6 |
| 5 | **Plasmons, Polaritons, and Polarons**<br>• Dielectric Function of Electron Gas.<br>• Plasmons.<br>• Electrostatic Screening. | 6 |

| | | |
|---|---|---|
| | • Polaritons<br>• Electron-Electron Interaction.<br>• Electron-Phonon Interaction.<br>• Polarons. | |
| 6 | **Optical process and Excitons**<br>• Optical Reflectance.<br>• Excitons<br>• Raman Effect in Crystals<br>• Energy Loss of Fast Particles in a Solid | 5 |
| 7 | **Dielectric and Ferroelectrics**<br>• Macroscopic Electric Field.<br>• Local Electric Field at an Atom.<br>• Dielectric Constant and Polarizability<br>• Structural Phase Transitions.<br>• Ferroelectric Crystals.<br>• Displacive Transitions. | 5 |
| **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 | Define the physical quantities related to magnetic, dielectric, and superconducting properties of solids. | 1. Demonstrating the basic principles through lectures.<br>2. Discussing phenomena with illustrating pictures and diagrams.<br>3. Lecturing method: Board, Power point.<br>4. Discussions<br>5. Brain storming<br>6. Start each chapter by general idea and the benefit of it. | - Solve some examples<br>- Discussions during the lectures<br>- Exams:<br>a) Quizzes.<br>b) Midterm exams.<br>c) Final exam. |
| 1.2 | Describe the physical quantities and physical laws related to magnetic, dielectric, and superconducting properties using mathematical formula. | | |
| **2.0** | **Skills** | | |
| 2.1 | Solve some problems related to solid state using suitable laws of physics | 1. Preparing main outlines for teaching.<br>2. Following some proofs.<br>3. Define duties for each chapter | 1. Exams:<br>a) Quizzes.<br>b) Midterm exams.<br>c) Final exam<br>d) Practical exam.<br>2. Homework. |
| 2.2 | Explain the physical phenomena related to the magnetic, dielectric, and superconducting properties of solids. | | |
| **3.0** | **Values** | | |

| Code | Course Learning Outcomes | Teaching Strategies | Assessment Methods |
|---|---|---|---|
| 3.1 | Work effectively and responsibly in teamwork. | • Organize the students in a small groups (teamwork).<br>• Give students tasks of duties as a small project. | • Evaluate the scientific reports.<br>• Discussing the reports with each teamwork.<br>• 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 | 8th | 20% |
| 2 | Practical Part | | 20% |
| 3 | Homework's & Quizzes | All weeks | 10 % |
| 4 | 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).<br>• Materials Science and Engineering An Introduction 8th edition, by D. William, Jr. Callister and David G. Rethwisch, John Wiley and Sons, Inc. (2010).<br>• 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**<br>(Classrooms, laboratories, demonstration rooms/labs, etc.) | - Classroom |
| **Technology Resources**<br>(AV, data show, Smart Board, software, etc.) | - Black Board<br>- Data show |
| **Other Resources**<br>(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** | |