Course Specification
(Bachelor)

Course Title:	**Solid State Physics**
Course Code:	**PHY 1361**
Program:	**Bachelor of Science in Physics**
Department:	**Physics**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**
Version:	4
Last Revision Date:	***26/09/2024***

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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: (Level 6/ Year 3)					
4. Course General Description:					
This course integrates theory of Solid State Physics with experimental demonstrations in the Research Physics Lab. The course will provide a valuable theoretical introduction and an overview of the fundamental applications of the physics of solids. This course includes theoretical description of crystal and electronic structure, lattice dynamics, and optical properties of different materials (metals, semiconductors, dielectrics, magnetic materials and superconductors, diamagnetism and paramagnetic, ferromagnetism and antiferromagnetic.), based on the classical and quantum physics principles.					
5. Pre-requirements for this course (if any)**:**					
Quantum Mechanics (1), PHY 1312					
6. Co-requisites for this course (if any)**:**					
7. Course Main Objective(s):					
• **Understand basic physical concepts and mathematical tools used to describe solids.** • **Develop knowledge and understanding the fundamental applications of the physics of solid.** • **Describe the theoretical description of crystal and electronic structure, lattice dynamics, and optical properties of different materials.** • **Learn the techniques to solve, through discussion and reading, a wide range of specific theoretical problems including their backgrounds and implications.**					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	75	100%
2	E-learning		
3	Hybrid • Traditional classroom • E-learning		
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	**45**
2.	**Laboratory/Studio**	**0**
3.	**Field**	**0**
4.	**Tutorial**	**30**
5.	**Others (specify)**	**0**
Total		75

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

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	**State the fundamental applications of the physics of solids.**	**K1, K2**	• Lectures. • Tutorials. • Class discussions.	▪ Exams. ▪ Participation. ▪ Discussions.
1.2	**Describe and state the lattice dynamics, phonons and thermal properties.**	**K1, K2**	• Lectures. • Tutorials. • Class discussions.	▪ Exams. ▪ Homework. ▪ Quizzes.
1.3	**Outline the structure and physical properties (mechanical, electrical, optical & thermal) of materials.**	**K1, K2**	• Lectures. • Class discussions. • Tutorials.	▪ Participation. ▪ Exams. ▪ Discussions. ▪ Homework.
2.0	**Skills**			
2.1	**Explain and summarize the basic knowledge gained from studying the course.**	**S1, S2**	▪ Lectures. ▪ Class discussions. ▪ Tutorials.	▪ Exams. ▪ Discussions. ▪ Participation.

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
2.2	**Develop the students ability to solve and analyze problems in physics related the topics covered by the course.**	**S2, S3**	▪ Problem classes and group tutorial. ▪ Homework assignments as well as problems solutions.	▪ Exams. ▪ Discussions. ▪ Homework.
2.3	**Communicate in a clear and concise manner orally, and using IT for acquiring and analyzing information.**	**S4, S5**	• Lectures. • Class discussions. • Tutorials. • Encourage students to use electronic mail and internal network for submitting homework and assignments. • Use digital library.	▪ Exams. ▪ Participation and activities of students in the course community and blackboard. ▪ Homework.
3.0	**Values, autonomy, and responsibility.**			
3.1	**Show the collaboration and inter-professionalism in class discussions or team works, as well as solve problems independently.**	**V1, V2, V3**	• Small team tasks • Open discussion at classroom. Office hours.	▪ Participation. ▪ Homework. Mini-project(s).

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 structures; direct imaging of atomic structure; non-ideal crystal structures.	**12**
2.	**Wave Diffraction and the Reciprocal Lattices:** Diffraction of waves by crystals; scattered wave amplitude; Brillouin zones; Fourier analysis of the basis.	**14**
3.	**Binding in Crystals:** Basic types of binding, examples.	**6**
4.	**Phonons-Crystal Vibrations:** Vibrations of crystals with monoatomic basis; two atoms per primitive basis; quantization of elastic waves; phonon momentum; inelastic scattering by phonons.	**10**
5.	**Phonons-Thermal Properties:** Phonon, heat capacity; an harmonic crystal interactions; thermal conductivity.	**8**
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.	**10**
7.	**Semiconductor crystals:** Band Gap, equations of Motion, intrinsic Carrier Concentration, impurity Conductivity and Thermoelectric Effects.	**6**

8.	**Introduction to superconductivity.**	**4**
9.	**Introduction to magnetism:** Diamagnetism, Paramagnetic, Ferromagnetism and Antiferromagnetic.	**5**
Total		**75**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	**Class Activities (class quizzes, homework, solving problems, etc.....)**	**weekly**	**10 %**
2.	**Midterm Exam 1**	**6thweek**	**25 %**
3.	**Midterm Exam 2**	**12thweek**	**25 %**
4.	**Final Exam**	**16thweek**	**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	- Kittel C., ***Introduction to Solid State Physics***, 8th Edition, John Wiley & Sons, NY (2004).
Supportive References	- Ashcroft N.W. and Mermin N. D., Solid State Physics, Rinehart and Winston, NY (1976).
Electronic Materials	- https://units.imamu.edu.sa/colleges/en/science/Pages/default.aspx
Other Learning Materials	-

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	**- Classrooms.** **- Labs.**
Technology equipment (projector, smart board, software)	- **Classroom equipped with a whiteboard and a projector.**
Other equipment (depending on the nature of the specialty)	

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	- Students - Second examiner	- Indirect (The students complete the evaluation forms at the end of term. Final exam is evaluated by the second examiner)
Effectiveness of Students assessment	- Instructors -	- Direct (exams, HW, project, ...)
Quality of learning resources	- Faculty - Students	- Indirect (surveys)
The extent to which CLOs have been achieved	- Instructors - Program Leaders	- Direct (excel sheet)
Other		

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

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	Quality Unit-Physics Department
REFERENCE NO.	Department council No. 06
DATE	26/09/2024