Faculty: Faculty of Science	
Department: Physics	**Program: M. Sc. of Physics**
Semester: First	**Academic year:2024/2025**

Course Plan

First: Course Information

Course Name:	Advanced Solid State Physics			***Course No.* 0302771**	
Credit Hours:	***3 hrs***	***Theoretical***	***3***	***Practical***	***0***
Prerequisite:		***Class Number: 1***		***Lecture Time:***	
Level in JNQF	***8***				
Course Nature:	☐ *Mandatory Faculty Requirement* ☐ *Mandatory University Requirement* ☑ *Optional Specialty Requirement* ☐ *Optional University Requirement* ☐ *Ancillary Course* ☐ *Mandatory Specialization requirement*				
Type of Education:	☑ **Fully Direct (Fully Face-to-Face Education)** ☐ **Integrated Education (2 Face-to-Face + 1 Asynchronous)** ☐ **Electronic Education Fully (1 Asynchronous + 2 Synchronous)**				

Second: Instructor's Information

Course coordinator		
***Name:* Said Al Azar**	***Office Number: 342 D***	***Email:* Salazar@zu.edu.jo**
Instructor		
Name: Said Al Azar	***Office Number: 342 D***	***Email: Salazar@zu.edu.jo***
Office Hours:	***To be announced***	

Third: Short Description of the Course

Crystal structure, reciprocal lattice vectors, symmetry and fundamental types of lattice, Brillouin Zone, Miller indices, Determination of crystal structure by using XRD-diffraction, Thermodynamics properties for Fermions and Bosons due to weak interaction, nearly free electron model, wave

function of electron in periodic potential, Bloch theory, construction of Fermi surfaces, Spin-angular coupling, Tight binding method of energy bands.

Fourth: Objectives:

Aims of the course:

- provide the student with a clear and logical presentation of the basic concepts and Principles of solid state physics.
- Strengthen an understanding of the concepts and principles through a broad range of the interesting real world applications.
- Demonstrate and apply knowledge of the crystalline lattice, Drude model, nearly free electrons model, tight binding model.
- Solve problems concerning the definition of the Bravais lattice, crystallography, and phonons.
- Understand and apply the definition of the reciprocal lattice and X-ray diffraction.

Fifth: Learning Source

Designated Book:	**Solid State Physics**	Cengage Learning
N.W. Ashcroft and N.D. Mermin,	***Print: Kindle Edition***	***Year: 2022***
Additional Sources: ***Website:***	• ***J. Dekker, Solids State Physics,1958,*** Macmillan • ***H. Ibach and H. Lutz, Solid-State Physics: An Introduction to Principles of Materials Science 2nd Edition, 1995,*** Springer • ***Omar,*** **Elementary Solid State Physics 1999, PEARSON INDIA** • ***Stevan Simon,*** **The Oxford Solid State Basics ,2013, Oxford University Press** • **Introduction to solid state physics, Kittel, 2004,** John Wiley & Sons Inc	
Teaching Type:	■ ***Classroom*** ***Laboratory*** ***Workshop*** **MS Teams** **Moodle** ☐	

Sixth: Learning Outcomes

Number	***Course learning output***	***Associated PILOs Code*** *Choose one PILO for each CILO**	***Assessment method**** *Choose at least two methods*	***Scores out of 100*** State the total score identified for each CILO	***Minimum acceptable Score/percentage (%)*** *The percentage should not be less than 50% ****
Knowledge					
K1	Explain the significance and value of solid state physics, both scientifically and in the wider community.	PK1	Mid-Exam Quiz Final exam	12	6(50%)
K2	Describe key concepts in crystallography such as material structure and reciprocal space, and how these can be investigated experimentally.	PK2	Mid-Exam Quiz Final exam	12	6(50%)
K3	Integrate knowledge and mathematical techniques from foundational areas of physics to describe the thermal, electrical and magnetic properties of solid systems.	PK3	Mid-Exam Quiz Final exam	10	5(50%)
K4	Understand the role of materials physics in the development of modern technology, and the physical processes on which these technologies are based.	PK4	Mid-Exam Quiz Final exam	8	4(50%)
Skills					
S1	Apply key analysis techniques to typical problems encountered in the field.	PS1	Mid-Exam Quiz Final exam	18	9(50%)
S2	Research and communicate scientific knowledge in the context of a topic related to condensed matter physics, in either a technical or non-specialist format;	PS2	Mid-Exam Quiz Final exam	12	6(50%)
S3	An ability to solve problems in solid states Physics using appropriate mathematical tools. An ability to execute and analyze critically the results of an experimental investigation or theoretical modelling and to draw valid conclusions with an estimate of the uncertainty in the result. An ability to compare	PS3	Mid-Exam Quiz Final exam	18	9(50%)

	experimental results with the predictions of relevant theories.				
S4	Master different problem-solving strategies	PS4	Mid-Exam Quiz Final exam	10	5(50%)
Competences					
C1	Know the role of solid state physics in important technological developments	PC1			
C2	Demonstrate effective oral and written communication skills and be able to research and explain scientific concepts.	PC2			
C3	- Increase the cooperative behavior between the different research groups of different applications. - To work in stressful environment and within constraints.				

Seventh: Course Structure

Lecturer Date	Teaching Outcome	Topics	Teaching Procedures	Teaching Methods	References
4/3	PK1, PK3, PS1, PC1,	What is condensed matter?	Direct	Lecturing, Whiteboard, Data Show	Text Book
11/3	PK1, PK3, PS1, PC1,	The Drude theory of metals	**Direct**	Short videos Assignment	
18/3	PK1, PK3, PS1, PC1,	a. Drude model b. Conductivity c. Hall effect d. Thermal conductivity	Direct	Lecturing, Whiteboard, Data Show	Text Book
25/3	PK1, PK3, PS1, PC1,	The Sommerfeld theory of electrons	**Direct**	Short videos Quiz	Text Book
1/4	PK3, PK4, PS1, PS4, PC2	a. Ground state energy of electrons	Direct	Lecturing, Whiteboard, Data Show	Text Book
8/4	PK3, PK4, PS1, PS4, PC2	b. Thermal properties of electron gas	**Direct**	Short videos Assignment	Text Book
15/4	PK3, PK4, PS1, PS4, PC2	5. Crystal lattice a. Bravais lattice, lattice vector	Direct	Lecturing, Whiteboard, Data Show	Text Book
22/4	PK3, PK4, PS1, PS4, PC2	b. Primitive cell, Wigner-Seitz cell and conventional cell c. Common crystal structures	**Direct**	Short videos Quiz	Text Book
29/4	PK2, PK3, PS1, PS3, PC1, PC2	6. Reciprocal lattice and Brilliouin zone, Miller notation	Direct	Lecturing, Whiteboard, Data Show	Text Book
6/5	PK2, PK3, PS1, PS3, PC1, PC2	7. X-ray diffraction	**Direct**	Short videos Assignment	Text Book

13/5	PK2, PK3, PS1, PS3, PC1, PC2	a. Bragg and von Laue formulations	Direct	Lecturing, Whiteboard, Data Show	Text Book
20/5	PK2, PK3, PS1, PS3, PC1, PC2	b. Structure factor and atomic form factor	**Direct**	Short videos Quiz	Text Book
27/5	PK2, PK3, PS1, PS3, PC1, PC2	8. General theory of electrons in a periodic potential a. Bloch theorem b. Born von Karman boundary condition c. Band structure of real solids	Direct	Lecturing, Whiteboard, Data Show	Text Book
3/6	PK2, PK3, PS1, PS3, PC1, PC2	9. Optical properties of dielectrics and metals	**Direct**	Short videos Quiz	Text Book
9-27/6	PK1, PK2, PS1, PS2, PC1, PC2	10. Theory of phonons a. General theory of phonon vibrations b. 1D lattice vibrations			
		Final exam			

Education procedures: (Direct, synchronous, Direct). * * Teaching methods: Lecture, video….. * * Reference: Pages of the book, recorded lecture, video

Eighth: Assessment methods

Methods	Fully Electronic Education	Integrated Teaching	Direct Teaching	K1	K2	K3	K4	S1	S2	S3	S4
Mid-Exam			30	6		4	2	4	6		8
Quizzes and assignment			20	2	4	4	2	2	2	4	
Final			50	4	8	2	4	12	4	14	2
Total out of 100			100	12	12	10	8	18	12	18	10

Ninth: Course Polices

- Meeting the deadline for the lecture.
- Commitment to interaction and participation.
- Interactive lectures will be given through a platform (MS Teams).
- Duties and tests will be given through a platform(Moodle).
- Commitment to the right appearance in front of the camera with the proper background.
- University regulations for attendance and absence from lectures and examinations are in force.
- Academic Integrity: Fraud or moral impersonation are unacceptable and are punishable according to university regulations and instructions.

Approval	Name	Date	Signature
Head of Department			
Faculty Dean			