AAU

KING ABDULAZIZ UNIVERSITY

ACADEMIC ASSESSMENT UNIT

COURSE PORTFOLIO

FACULTY OF SCIENCE

PHYSICS DEPARTMENT

COURSE NAME: *Solid State Physics*

COURSE NUMBER: *Phys 471*

SEMESTER/YEAR: *2nd / 1436 H*

DATE: *Rabia Althani -1437 H*

Instructor Information

- ✍ **Name of the instructor:** Dr. Hala A Al-Jawhari
- ✍ **Office location:** Faculty of Science, 3rd floor, Room No. (108).
- ✍ **Office hours:**

Sunday	Monday	Tuesday	Wednesday	Thursdays
10-11, 12-1	-	10-11, 12-1	-	10-11, 11-2

- ✍ **Contact number(s): Tel :** 6400000 **Ext.** 26904
- ✍ **E-mail address:** haljawhari@kau.edu.sa

Course Information

- ✍ **Course name and number:** Solid State Physics - Phys (471)
- ✍ **Course meeting times & places:**

	Time	Room
Lectures	9-10 **Sun, Tus & Thru.**	104A

- ✍ **Course prerequisites and requirements: Quantum Mechanics Phys (354)**
- ✍ **Description of the course :**

This course is an introduction to the: crystal structures, properties of periodic lattices, electrons in metals, band structure, transport properties, semiconductors, and superconductivity.

Course Objectives

By the end of this course student must be able to:

- Define the lattice planes & directions.
- Establish a reciprocal lattice from a real lattice.
- Determine *the structure factor* for all cubic lattices.
- Define phonons in crystals and distinguish between their different modes.
- Choose the right formulas to calculate *specific heat* of the lattice.
- Recognize the main drawbacks of the *free electron model* in metals.
- Identify: Bloch's theorem, Brillouin zones & Fermi surface in metals.
- Classify different types of solid according to *The Band Theory*.
- Recognize the main factors affect *the conductivity in metals*.
- Distinguish between *intrinsic & extrinsic Semiconductors* and know their properties and applications.
- Recognize the idea behind the Superconductivity phenomenon and be aware of its applications.

Learning Resources

- ✍ The primary textbook for the course is
  1- Elementary Solid State Physics by M. Ali Omar, 1997.
- ✍ Additional references that may be helpful to students in this course:

2- ***Solid State Physics*** , by J. Hook & H. Hall , 2nd ed (2010).
3- ***Materials Science & Engineering,*** by W. Callister & D. Rethwisch, 8th ed (2011).
4- ***The Physics of Solid***, by R. Turton, (2000).
5- ***Introduction to Solid State Physics***, by C. Kittel, 6th ed .
6- http://www.doitpoms.ac.uk/tlplib/index.php
7- http://ocw.mit.edu/courses/materials-science-and-engineering/3-091sc-introduction-to-solid-state-chemistry-fall-2010/index.htm

Course Requirements and Grading

✍ **Student assessment:**

H.W	**10%**	**-**
Quiz	**10%**	**The 2nd lecture of each week**
1st EXAM	**20%**	**21-5-1437 H**
2nd EXAM	**20%**	**5-7-1437 H**
Final Exam	**40%**	**After week 14**

✍ **Expectations from students:**

- Students are expected to attend lectures and labs on time.
- Students may discuss a homework assignment to clarify what is required. However, students may NOT share or copy each other work.
- Students are expected to prepare them self for each exam or quiz, and bring their own pens and calculator.

✍ **Student responsibilities to the course:**

The student responsibilities are to:

- Attend all lectures and labs, since the absence of 25% of the total lectures will prevent the student from attending the final exam.
- Perform all lab experiments and submit their required reports.
- Submit each problem set on its defined date. .
- Work hard on each given exam or quiz. **Eight** quizzes will be given, but only the best **five** of them will be encountered.

Detailed Course Schedule

	Topic	***Readings***	***Due***
1 (14/4/37)	***STRUCTURE & BONDING*** *Periodic Structures & main definitions.*	*Ch 1, Sec 1-3*	
	Crystal Planes & directions	*Ch 1, Sec 4-6*	*+Ch 3* -Ref(3)

	Common Structures 1	*Ch 1, Sec 7*	
2	*Common Structures 2*	*Ch 1, Sec 7*	
	Interatomic Forces	*Ch 1, Sec 9*	
	Types of Bonding	*Ch 1, Sec* 10	
3	***DIFFRACTION IN CRYSTALS*** *X-Ray (Nature & Generation) &Bragg's Law.*	*Ch 2, Sec 1-4*	
	Diffraction by a Crystal	*Ch 2, Sec 5*	
	Reciprocal Lattice & Diffraction	*Ch 2, Sec 6-7*	
4	*The structure factor.*	*Ch 2, Sec 9-11*	
	Neutron and Electron Diffraction.	*Ch 2, Sec 12*	
	Tutorial *session 1*		***Problem set (1)***
5	***ACCOUSTIC PROPERTIES OF SOLIDS*** *The Continuum Model(1D) & Discrete Lattice*	*Ch 3, Sec 1-2 & 6*	
	Dispersion Relation for a 2D Lattice & Phonons	*Ch 3, Sec 5-6*	
	Density of States for a 1D &3D Lattice	*Ch 3, Sec 3,7*	
***** 1st EXAM *** 21-5-1437**			
6	*Specific Heat*	*Ch 3, Sec 4,8*	
	Specific Heat & Thermal Conductivity	*Ch 3, Sec 4,8 &9*	
	THE FREE ELECTRON MODEL *Drude Model of metals*	*Ch 4, Sec 1-4*	
7	*Electrical conductivity vs temperature*	*Ch 4, Sec 5*	
	The Quantum Model & the Fermi Sphere	*Ch 4, Sec 6-8*	
	Thermal conductivity & Hall Effect	*Ch 4, Sec 9-10*	
Mid Term Holiday			
8 **(11/6/37)**	***Tutorial*** *session 2*		***Problem set (2)***
	BAND THEORY OF SOLIDS *Formation of Energy Bands: Bloch Theorem*	*Ch 5, Sec 1-3*	
	The crystal potential	*Ch 5, Sec 5*	
9	*No. of states in a band*	*Ch 5, Sec 5*	
	The Nearly Free Electron Model	*Ch 5, Sec 6-7*	
	Metals, Insulators, & Semiconductors- DOS	*Ch 5, Sec 10 -11*	
***** 2nd EXAM *** 5-7-1437**			
10	*Fermi surface & velocity*	*Ch 5, Sec 12-13*	
	The electron effective mass	*Ch 5, Sec 14-16*	
	The Hole, Electrical conductivity & Hall Effect	*Ch 5, Sec 17-19*	
11	***SEMICONDUCTORS*** *Intrinsic semiconductors*	*Ch 6, Sec 1-4*	
	Doped semiconductors	*Ch 6, Sec 5-6*	
	Cont.		
12	*Mobility & The Semiconductor Hall Effect*	*Ch 6, Sec 7-8*	
	The hot electrons & Gunn Effect	*Ch 6, Sec 10-11*	
	Optical Absorption	*Ch 6, Sec 12*	
13	***Tutorial*** *session 3*		***Problem set (3)***

	SUPERCONDUCTIVITY *Types I &II Superconductors & The BCS Theory*	*given Handout*	
	High Tc Superconductors & their applications	*given Handout*	
14	****** FINAL EXAM ******		