POINT 19 02 LOMA NAZARENE UNIVERSITY	**Department/School Name: Physics and Engineering** **Course Number and Name:** **PHY/EGR 4063 – Solid State Physics** **Number of Units: 3**
Spring 2023	

Meeting Days: **(Lecture) MWF**	**Professor: Dr. Anthony Cortez**
Meeting Times: **(Lecture) 8:30am – 9:25am**	**Phone: (619) 849-2439**
Meeting Location: Rohr Science 365	**Email: AnthonyCortez@pointloma.edu**
Final Exam: **Mon. 1-May 7:30am**	**Office hours:** **By Appointment** **Location: Rohr Science 282**

PLNU Mission
To Teach ~ To Shape ~ To Send

Point Loma Nazarene University exists to provide higher education in a vital Christian community where minds are engaged and challenged, character is modeled and formed, and service is an expression of faith. Being of Wesleyan heritage, we strive to be a learning community where grace is foundational, truth is pursued, and holiness is a way of life.

Department Mission

The Physics and Engineering Department at PLNU provides strong programs of study in the fields of Physics and Engineering. Our students are well prepared for graduate studies and careers in scientific and engineering fields. We emphasize a collaborative learning environment which allows students to thrive academically, build personal confidence, and develop interpersonal skills. We provide a Christian environment for students to learn values and judgment, and pursue integration of modern scientific knowledge and Christian faith.

COURSE DESCRIPTION

PHY/EGR 4063 – Solid State Physics (3)

An introduction to the study of solids, including crystal structure, reciprocal lattices, crystal binding, phonons, and electron band theory.

Prerequisite(s): PHY 2054 with a grade of C- or higher.

COURSE LEARNING OUTCOMES

1. Gain a fundamental understanding of Solid State Physics.
2. Explain crystal systems by defining atomic packing and lattice type.
3. Ability to work in reciprocal space and Brillouin Zones.
4. Explain bonding types in crystals such as Van der Waals-London Interaction and the repulsive interaction.
5. Explain phonons by crystal vibrations and thermal properties.
6. Explain the fermi free electron gas, Fermi-Dirac Distribution, and energy bands.
7. Explain properties of semiconductors including band gap.
8. Gain a fundamental understanding of superconductivity.

REQUIRED TEXTS AND RECOMMENDED STUDY RESOURCES

Introduction to Solid State Physics by Kittel, Charles – 8th Edition

NOTE: Students are responsible to have the required textbooks prior to the first day of class. Students are also encouraged to begin reading the books in preparation for the class as soon as possible.

COURSE CREDIT HOUR INFORMATION

In the interest of providing sufficient time to accomplish the stated Course Learning Outcomes, this class meets the PLNU credit hour policy for a 3 unit class delivered over fifteen weeks. It is anticipated that students will spend a minimum of 37.5 participation hours per credit hour on their coursework. For this course, students will spend an estimated 112.5 total hours meeting the course learning outcomes.

Class Enrollment

It is the student's responsibility to maintain his/her class schedule. Should the need arise to drop this course (personal emergencies, poor performance, etc.), the student has the responsibility to follow through (provided the drop date meets the stated calendar deadline established by the university), not the instructor. Simply ceasing to attend this course or failing to follow through to arrange for a change of registration (drop/add) may easily result in a grade of F on the official transcript.

ASSESSMENT AND GRADING

Graded Components

- **Homework**: Homework will be assigned weekly and is due at the start of class the following week.
- **Examinations and the Final Examination**. Examinations and the Final Examination will include problems and questions over material assigned in the text, readings and handouts, as well as material presented in class. No examination shall be missed without prior consent or a well-documented emergency beyond your control. A score of zero will be assigned for an examination that is missed without prior consent or a well-documented emergency beyond your control. Only your two highest exam scores (not including the final) will be included in the calculation of your grade. You must take all three exams in order to drop the lowest score, otherwise all three exams will be used in the calculation of your grade. The final exam date and time is set by the university at the beginning of the semester and may not be changed by the instructor. This schedule can be found on the university website and in the course calendar. No requests for early examinations will be approved. Only in the case that a student is required to take three exams during the same day of finals week, is an instructor authorized to consider changing the exam date and time for that particular student.

Grading Distribution	**Percent**
Exams (Lowest Score Dropped)	30
Final Exam	30
Homework	40
Total	100

Grading Scale

Grades are based on the number of points accumulated throughout the course with the following exception. Approximate minimal percentages required to obtain a given grade are:

Standard Grade Scale Based on Percentages					
	A	**B**	**C**	**D**	**F**
+		87.5- 89.5	77.5-79.5	67.5-69.5	
	91 -100	81-87.5	71-77.5	61 -67.5	0-57
_	89.5-91	79.5-81	69.5-71	57-61	

STATE AUTHORIZATION

State authorization is a formal determination by a state that Point Loma Nazarene University is approved to conduct activities regulated by that state. In certain states outside California, Point Loma Nazarene University is not authorized to enroll online (distance education) students. If a student moves to another state after admission to the program and/or enrollment in an online course, continuation within the program and/or course will depend on whether Point Loma Nazarene University is authorized to offer distance education courses in that state. It is the student's responsibility to notify the institution of any change in his or her physical location. Refer to the map on State Authorization to view which states allow online (distance education) outside of California.

LATE ASSIGNMENTS

All assignments are to be submitted by the due dates. Assignments will be considered late if posted after the due date and time using Pacific Standard Time. Late assignments will receive a grade of 0.

PLNU COPYRIGHT POLICY

Point Loma Nazarene University, as a non-profit educational institution, is entitled by law to use materials protected by the US Copyright Act for classroom education. Any use of those materials outside the class may violate the law.

PLNU ACADEMIC HONESTY POLICY

Students should demonstrate academic honesty by doing original work and by giving appropriate credit to the ideas of others. Academic dishonesty is the act of presenting information, ideas, and/or concepts as one's own when in reality they are the results of another person's creativity and effort. A faculty member who believes a situation involving academic dishonesty has been detected may assign a failing grade for that assignment or examination, or, depending on the

seriousness of the offense, for the course. Faculty should follow and students may appeal using the procedure in the university Catalog. See ADC Academic and General PoliciesLinks to an external site. for definitions of kinds of academic dishonesty and for further policy information.

PLNU ACADEMIC ACCOMMODATIONS POLICY

PLNU is committed to providing equal opportunity for participation in all its programs, services, and activities. Students with disabilities may request course-related accommodations by contacting the Educational Access Center (EAC), located in the Bond Academic Center (EAC@pointloma.edu or 619-849-2486). Once a student's eligibility for an accommodation has been determined, the EAC will issue an academic accommodation plan ("AP") to all faculty who teach courses in which the student is enrolled each semester.

PLNU highly recommends that students speak with their professors during the first two weeks of each semester/term about the implementation of their AP in that particular course and/or if they do not wish to utilize some or all of the elements of their AP in that course.

Students who need accommodations for a disability should contact the EAC as early as possible (i.e., ideally before the beginning of the semester) to assure appropriate accommodations can be provided. It is the student's responsibility to make the first contact with the EAC.

PLNU SPIRITUAL CARE

Please be aware PLNU strives to be a place where you grow as whole persons. To this end, we provide resources for our students to encounter God and grow in their Christian faith.
If students have questions, a desire to meet with the chaplain or have prayer requests you can contact the Office of Spiritual Development Links to an external site.

PLNU ATTENDANCE AND PARTICIPATION POLICY

Attendance is expected at each class session. In the event of an absence, you are responsible for the material covered in class and the assignments given that day. Regular and punctual attendance at all class sessions is considered essential to optimum academic achievement. If the student is absent for more than 10 percent of class sessions, the faculty member will issue a written warning of de-enrollment. If the absences exceed 20 percent, the student may be de-enrolled without notice until the university drop date or, after that date, receive the appropriate grade for their work and participation.

PLNU USE OF TECHNOLOGY

In order to be successful in the online environment, students need to meet the minimum technology and system requirements; please refer to the Technology and System Requirements Links to an external site.information. If a student is in need of technological resources please contact student-tech-request@pointloma.edu

Problems with technology do not relieve students of the responsibility of participating, turning in assignments, or completing class work.

TENTATIVE SCHEDULE (Subject to Updates)

Date	Topic	Reading	HW Due
10-Jan (WEEK 1)	Introductions	None	
11-Jan	Crystal Structure I	pp. 1-11	
13-Jan	Crystal Structure II	pp. 11-22	
16-Jan (WEEK 2)	MLK Day NO CLASS		
18-Jan	Crystal Structure II	pp. 11-22	
20-Jan	Diffraction and Scattered Wave Amplitude	pp. 23-32	HW 1
23-Jan (WEEK 3)	Brillouin Zones	pp. 33-38	
25-Jan	Fourier Analysis of the Basis	pp. 39-43	
27-Jan	Fourier Analysis of the Basis	pp. 39-43	HW 2
30-Jan (WEEK 4)	Crystal Binding I	pp. 47-60	
1-Feb	Crystal Binding II	pp. 60-70	
3-Feb	Elasticity in Crystals	pp. 73-85	HW 3
6-Feb (WEEK 5)	Exam 1		
8-Feb	Elasticity in Crystals	pp. 73-85	
10-Feb	Crystal Vibrations I: Monatomic Basis	pp. 89-99	HW 4
13-Feb (WEEK 6)	Crystal Vibrations II: Two Atoms	pp. 99-102	
15-Feb	Crystal Vibrations II: Two Atoms	pp. 99-102	
17-Feb	Phonon Heat Capacity I	pp. 105-111	HW 5
20-Feb (WEEK 7)	Phonon Heat Capacity II	pp. 111-117	

22-Feb	Phonon Heat Capacity III	pp. 117-126	
24-Feb	Free Electron Fermi Gas	pp. 134-147	HW 6
27-Feb (WEEK 8)	Electrical Conductivity	pp. 147-152	
1-Mar	Hall Effect and Thermal Conductivity	pp. 152-157	
3-Mar	Exam 2		HW 7
6-10 Mar	Spring Break NO CLASSES		
13-Mar (WEEK 9)	Energy Bands I	pp. 163-169	
15-Mar	Energy Bands II	pp. 169-180	
17-Mar	Energy Bands III	pp. 180-182	HW 8
20-Mar (WEEK 10)	Band Gap	pp. 185-191	
22-Mar	Equations of Motion	pp. 191-202	
24-Mar	Impurity Conductivity	pp. 205-213	HW 9
27-Mar (WEEK 11)	Thermoelectric Effects, Semimetals, and Superlattices	pp. 214-217	
29-Mar	Nanostructures	pp. 519-526	
31-Mar	Nanostructures	pp. 533-540	HW 10
3-Apr (WEEK 12)	Catch Up/Review		
5-Apr	Exam 3		
6-10 Apr	Easter Recess – NO CLASSES		
12-Apr (WEEK 13)	Superconductivity History		
14-Apr	Superconductivity I	pp. 259-266	HW 11
17-Apr (WEEK 14)	Superconductivity II	pp. 270-278	
19-Apr	Josephson Junctions	pp. 289-292	
21-Apr	Josephson Junctions		HW 12
24-Apr (WEEK 15)	Superconducting Devices		

26-Apr	Catch Up		
28-Apr	Review		HW 13
1-May	Final Exam @ 7:30am		