

## **PHYSICS 104: Experimental Techniques in Condensed Matter Physics (#35680, 35681)**

**Spring 2009**

CALIFORNIA STATE UNIVERSITY, FRESNO  
Department of Physics

**Course No:** Phys 104 (#35680, 35681)

**Unit Value:** 4

**Instructor:** Daqing Zhang

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**Phone:** 278-7096

**Lecture:** 11:00—11:50am F

**Class Room:** McLane 258

**Labs:** 12:00-02:50 T Th

**Class Room:** McLane 258

12:00—02:50 F

**Class Room:** McLane 257

**Office Hours:** 2:00—3:00pm MW, 9:00—11:00am T, 10:00—12:00pm Thu or by appointment

**Grading:** Letter (A, B, C, D, F)

**References:** 1. *Introduction to Solid State Physics*, 8<sup>th</sup> edition, Charles Kittel.

2. *Elementary Solid State Physics*, revised printing, M. Ali Omar.

**Prerequisite:** Physics 4C.

### **Course Description:**

This course introduces students the fundamental concepts and principles of condensed matter physics, and some useful research techniques and equipments relative to the condensed matter physics as well. In this experimental coursework a number of experiments will be conducted through this semester including X-ray diffraction on crystals, nuclear magnetic resonance, optical pumping, optical interference, electrical conductivity /resistivity of metal and semiconductor. In addition, some basic machine shop techniques, which taught by Mr. John Beckman, is designed to let students be familiar with some common machine equipments such as the lathe, the milling machine.

### **Course Goals:**

The primary goals of this course for students are to apply theoretical knowledge into typical and fundamental experiments in the field of condensed mater physics. In addition, students will have basic training in doing experiments in research level laboratory and machine shop skill.

### **Course Objectives (Student Learning Outcomes):**

Condensed matter Physics is quite broad topic. This course is designed for physics-major undergraduate students to learn fundamental concepts and principles, and basic experimental techniques in condensed matter physics. Through lectures and those hands-on experiments covering essential topic of condensed matter physics, students will learn and have a good grasp of the following points:

1. Students will be able to solve problems related to solid-state physics such as crystal structures, reciprocal lattice, phonons and photons, metal and semiconductor energy band, *etc.*
2. Students will be able to demonstrate basic knowledge conducting to experimental techniques in the laboratory.
3. Students will be able to design, setup experiments, and predict experimental results related to the condensed matter physics.
4. Students will be able to complete experimental data acquisition and analysis, and write formal scientific reports.
5. Students will be able to master some basic machining techniques.

**Attendance:**

Students are responsible for class attendance; in all cases of absence, students are accountable for the work missed. In the case of officially approved absence and on the request of the student, the instructor will provide an opportunity for the student to make up for missed work. An absence is considered "official" when the student is: (a) participating in an approved field trip or other official Fresno State activity (e.g., athletics, debate, music, or theatre arts); (b) confined under doctor's orders; (c) called to active military duty during emergency situations; or (d) granted a leave of absence from Fresno State for reasonable cause by his or her academic dean. An official absence requires written documentation. If you are absent from class, it is your responsibility for the material presented in the lecture, reading assignments, the homework, and to check on announcements made while you were away.

**Homework:**

Homework will be assigned on approximately a weekly basis in lecture class. The homework is due exactly one week after at the beginning of the lecture class). **LATER HOMEWORK WILL NOT BE ACCEPTED EXCEPE FOR A VALID EXCUSE** (see attendance part below)

**Physics lab report:**

Each experiment will require a laboratory report. The lab reports are due at the beginning of Tuesday lab session the week following the completion of the experiment.

**Machine shop lab:**

For safety reason, there will be two sections, one on Friday (12:00—2:50pm) and the other to be arranged between Mr. John Beckman and students.

**Exam:**

There will be one midterm test and a comprehensive final exam. Both midterm and final are CLOSED BOOK exams. You are allowed to bring one formula sheet in each test. There is no make up exams in general unless **documented** medical or legal excuses (a judgment will be made by the instructor and/or the department) must be provided at least three days before a missed exam if allowances are to be made. You will be responsible for material presented in the lecture, laboratory, and the homework.

**Exam Schedule:**

Midterm test:	Friday, March 13
Final exam:	11:00am-01:00pm Monday, May 18 (Comprehensive exam)

**Course Grading:**

Your grade in this class will be based on:

Homework	20% (~2% each)
Physics lab reports	40% (~5% each)
Machine shop work	10%
Midterm test	10%
Final exam	20%

**Final Grades: A 85.0~100, B 75.0~84.9, C 60.0~74.9, D 50.0~59.9, F 0~49.9.**

<b>UNIVERSITY POLICIES</b>
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**Cheating and Plagiarism:**

“Cheating is the actual or attempted practice of fraudulent or deceptive acts for the purpose of improving one's grade or obtaining course credit; such acts also include assisting another student to do so. Typically, such acts occur in relation to examinations. However, it is the intent of this definition that the term 'cheating' not be limited to examination situations only, but that it include any and all actions by a student that are intended to gain an unearned academic advantage by fraudulent or deceptive means. Plagiarism is a specific form of cheating which consists of the misuse of the published and/or unpublished works of others by misrepresenting the material (i.e., their intellectual property) so used as one's own work.”  
Penalties for cheating and plagiarism range from a 0 or F on a particular assignment, through an F for the course, to expulsion from the university. For more information on the University's policy regarding cheating and plagiarism, refer to the Schedule of Courses (Legal Notices on Cheating and Plagiarism) or the University Catalog (Policies and Regulations)

**Disruptive Classroom Behavior:**

“The classroom is a special environment in which students and faculty come together to promote learning and growth. It is essential to this learning environment that respect for the rights of others seeking to learn, respect for the professionalism of the instructor, and the general goals of academic freedom are maintained. ... Differences of viewpoint or concerns should be expressed in terms which are supportive of the learning process, creating an environment in which students and faculty may learn to reason with clarity and compassion, to share of themselves without losing their identities, and to develop and understanding of the community in which they live . . . Student conduct which disrupts the learning process shall not be tolerated and may lead to disciplinary action and/or removal from class.”

**Students with Disabilities:**

Upon identifying themselves to the instructor and the university, students with disabilities will receive reasonable accommodation for learning and evaluation. For more information, contact Services to Students with Disabilities in Madden Library 1049 (278-2811).

**Right to Changes:**

The instructor reserves the right to change the course policy during the term due to unforeseen problems in the course pace, fairness, conflicts, etc.

**List of experiments (tentative):**

1. X-Ray diffraction of crystals
2. Pulsed nuclear magnetic resonance
3. Measuring resistivity of metal and semiconductor
4. Optical pumping in Rubidium
5. Muon measurement
6. Two-slit interference
7. Sonoluminescence
8. X-ray fluorescence