

SYLLABUS

Modern Condensed Matter Physics (Physics 4650) – Online **Instructor: Carsten A. Ullrich**

COURSE DESCRIPTION

This course provides an introduction to the basic concepts of modern condensed-matter physics for undergraduate students in Physics, Chemistry, Materials Science and Engineering.

It is an online course that covers the same material in 8 weeks as the regular, classroom-taught version of the course during the fall or spring semester (16 weeks). Therefore, everything will be more condensed and at a faster pace, and you should expect to spend more time per week than you would during fall or spring.

PREREQUISITES

Introductory Physics courses (Physics 2750, 2760) and Modern Physics (Physics 3150), or Instructor's consent. Students should have some knowledge of the basic concepts of quantum mechanics, electrodynamics, and thermodynamics/statistical mechanics.

COURSE LEARNING GOALS

- Students will learn about bonding and structure of materials. They will understand the difference between metals, insulators and semiconductors based on their respective electronic structure.
- Students will understand the unique behavior of matter at the nanoscale: clusters, nanocrystals, quantum dots, and semiconductor heterostructures. They will learn about the physical basis for nanotechnologies such as transistors and light-emitting diodes.
- The basic concepts of magnetism and related applications will be covered.
- Students will get a flavor for the hot topics at the forefront of the vibrant field of condensed – matter physics. Important areas of current research will be discussed at an elementary level, such as photovoltaics, energy-related materials, superconductivity, or low-dimensional quantum liquids. Students will be prepared to begin active research in condensed-matter physics or materials science and engineering.

INSTRUCTOR INFORMATION

Dr. Carsten A. Ullrich
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Office Location: 424 Physics Bldg.
Phone: (573) 882-2467

There are no designated office hours. You can email me questions at any time and I will respond as soon as I can. If you wish to talk to me in person you may call or come to my office, but please email me before to set up an appointment.

TEXTBOOKS AND COURSE MATERIAL

The required textbook for this course is *The Oxford Solid State Basics* by Steven H. Simon (Oxford University Press, 2013). It is a paperback which costs around \$40.

SEQUENCE OF TOPICS

Week 1: Structure of materials: chemical bonding

Week 2: Crystal structure, reciprocal lattice and X-ray diffraction

Week 3: Lattice vibrations, phonons and thermal properties

Week 4: Electrons in metals: Drude and Sommerfeld Theory

Week 5: Electrons in periodic solids: metals, insulators and semiconductors

Week 6: Semiconductor nanostructures and their applications in electronics and optics

Week 7: Magnetic properties of solids

Week 8: Highlights of modern condensed-matter physics: photovoltaics, superconductivity, materials for energy storage, low-dimensional and nanoscale systems, quantum liquids

ASSIGNMENTS

- Students are expected to view all online lectures and do the assigned reading in the textbook.
- There will be 6 homework assignments, counting 25 points each. The homework problems will be posted as pdf files on Blackboard. You work out the problems and scan them in or take a picture with your cell phone, and then upload your solutions to Blackboard.
- Deadline for turning in the homework solutions will be 1 week after the assignments are posted. Solutions will then be posted on Blackboard. After that, no late homework will be accepted.
- There will be two exams, counting 75 points each. The exams will be administered through the test center. The exams will be open book and notes. The dates will be June 30/July 1 for Exam 1 and July 28/29 for Exam 2.
- Total points = 300 (Homework: 150; Exams: 150).

GRADING SCALE:

Less than 140 points:	F
140-179 points:	D
180-219 points:	C
220-259 points:	B
260-300 points:	A

Please note that the range of points for each letter grade includes plus and minus grades.

TECHNICAL HELP

If you are having any technical difficulties (e.g., logging in) please email helpdesk@missouri.edu or contact the *DoIT Help Desk* (for out-of-area MizzouOnline students, toll-free at 866/241-5619).

ONLINE CLASS NETIQUETTE

Your instructor and fellow students wish to foster a safe on-line learning environment. All opinions and experiences, no matter how different or controversial they may be perceived, must be respected in the tolerant spirit of academic discourse. You are encouraged to comment, question, or critique an *idea* but you are not to attack an *individual*.

Our differences, some of which are outlined in the University's nondiscrimination statement below, will add richness to this learning experience. Please consider that sarcasm and humor can be misconstrued in online interactions and generate unintended disruptions. Working as a community of learners, we can build a polite and respectful course ambience.

STUDENTS WITH DISABILITIES

If you anticipate barriers related to the format or requirements of this course, if you have emergency medical information to share with me, or if you need to make arrangements in case the building must be evacuated, please let me know as soon as possible.

If disability related accommodations are necessary (for example, a note taker, extended time on exams, captioning), please register with the Office of Disability Services (<http://disabilityservices.missouri.edu>), S5 Memorial Union, 573- 882-4696, and then notify me of your eligibility for reasonable accommodations. For other MU resources for students with disabilities, click on "Disability Resources" on the MU homepage.

UNIVERSITY POLICY ON ACADEMIC DISHONESTY

Academic honesty is fundamental to the activities and principles of a university. All members of the academic community must be confident that each person's work has been responsibly and honorably acquired, developed, and presented. Any effort to gain an advantage not given to all students is dishonest whether or not the effort is successful. The academic community regards academic dishonesty as an extremely serious matter, with serious consequences that range from probation to expulsion. When in doubt about plagiarism, paraphrasing, quoting, or collaboration, consult the course instructor.

Academic Dishonesty includes but is not necessarily limited to the following:

- A. Cheating or knowingly assisting another student in committing an act of cheating or other academic dishonesty.
- B. Plagiarism which includes but is not necessarily limited to submitting examinations, themes, reports, drawings, laboratory notes, or other material as one's own work when such work has been prepared by another person or copied from another person.
- C. Unauthorized possession of examinations or reserve library materials, or laboratory materials or experiments, or any other similar actions.
- D. Unauthorized changing of grades or markings on an examination or in an instructor's grade book or such change of any grade report.

Academic Integrity Pledge:

Students are expected to adhere to this pledge on all graded work whether or not they are explicitly asked in advance to do so: "I strive to uphold the University values of respect, responsibility, discovery, and excellence. On my honor, I pledge that I have neither given nor received unauthorized assistance on this work."

The University has specific academic dishonesty administrative procedures. Although policy states that cases of academic dishonesty must be reported to the Office of the Provost for possible action, the instructor may assign a failing grade for the assignment or a failing grade for the course, or may adjust the grade as deemed appropriate. The instructor also may require the student to repeat the assignment or to perform additional assignments. In instances where academic integrity is in question, faculty, staff and students should refer to Article VI of the Faculty Handbook. Article VI is also available in the M-Book. Article VI provides further information regarding the process by which violations are handled and sets forth a standard of excellence in our community.

In the event of a suspected incident of misconduct, the instructor plans to use option B (M-book, page 17; see <http://conduct.missouri.edu/wp-content/uploads/2011/08/M-Book-2011-2012.pdf>).

INTELLECTUAL PLURALISM

The University community welcomes intellectual diversity and respects student rights. Students who have questions or concerns regarding the atmosphere in this class (including respect for diverse opinions) may contact the Departmental Chair or Divisional Director; the Director of the [Office of Students Rights and Responsibilities](http://osrr.missouri.edu/) (<http://osrr.missouri.edu/>); or the [MU Equity Office](http://equity.missouri.edu/) (<http://equity.missouri.edu/>), or by email at equity@missouri.edu. All students will have the opportunity to submit an anonymous evaluation of the instructor(s) at the end of the course.

ACADEMIC INQUIRY, COURSE DISCUSSION AND PRIVACY

University of Missouri System Executive Order No. 38 lays out principles regarding the sanctity of classroom discussions at the university. The policy is described fully in Section 200.015 of the Collected Rules and Regulations. In this class, students may not make audio or video recordings of course activity, except students permitted to record as an accommodation under Section 240.040 of the Collected Rules. All other students who record and/or distribute audio or video recordings of class activity are subject to discipline in accordance with provisions of Section 200.020 of the Collected Rules and Regulations of the University of Missouri pertaining to student conduct matters.

Those students who are permitted to record are not permitted to redistribute audio or video recordings of statements or comments from the course to individuals who are not students in the course without the express permission of the faculty member and of any students who are recorded. Students found to have violated this policy are subject to discipline in accordance with provisions of Section 200.020 of the Collected Rules and Regulations of the University of Missouri pertaining to student conduct matters.