Course: Electronic Properties of Materials

Schedule: M/W/F 09:00 am – 09:50 am; 213 Gregory; exams in: Computer-based Testing Facility (CBTF), basement of the Digital Computer Laboratory (DCL) building, room L416 (directions)

Course websites:
- Class schedule, lecture slides/recordings, homework assignments, links: MSE 304 website
- Gradebook and offline-homework deposit: Compass
- Online homework and pre-lecture questions: PRAIRIELEARN
- Announcements, online discussion forums: Piazza

Scope: Fundamentals of quantum mechanics; atoms and small molecules; tunneling and Heisenberg’s uncertainty principle; angular momentum; spectroscopy techniques; solids, in particular metals and semiconductors; Students should obtain a fundamental understanding of quantum mechanics and how it governs electronic properties of materials and devices.

Objectives: Students will be able to understand the theoretical description of various semiconductor devices and how that traces back to the materials they are made of. Students will obtain a grasp of the equations of quantum mechanics and their (analytical) solution for model systems. Moreover, students will obtain insight into modern computational techniques to describe electronic properties of solids as well as semiconductor devices.

Prerequisites: PHYS212, PHYS214, MATH214, MATH285; as well as their prerequisites. If you have not passed a prerequisite course, please see the instructor before continuing.

Instructor: André Schleife (schleife); 204A MSEB.
Office hours: By appointment only; Please contact instructor via Piazza in advance.

Teaching Assistants:
Office hours: see Piazza for times and location of the TA and study hall office hours.


Special accommodations: To obtain disability-related academic adjustments and/or auxiliary aids, students with disabilities must contact their lecturer and the Disability Resources and Educational Services (DRES, disability.illinois.edu) as soon as possible, and no later than Jan. 22.

i>clickers: Quizzes will be administered in lectures using the i>clickers. The i>clicker remote may be purchased at any of the book stores and must be registered on Compass. The navigation bar on the left of the MSE304 page should have an item “Register my i>clicker ”. You need to register your i>clicker by Jan. 29, when the i>clicker roster will be synced for the last time.

Course evaluation:

20%×(Homework: Online and Offline) + 8%×(In-lecture i>clicker) +
6%×(Prerequisite exam) + 22%×(Exam 1) + 22%×(Exam 2) + 22%×(Exam 3) = Total

Numerical total score corresponds to the following final grades:
Homework: All homework (online or offline) will be assigned through the MSE 304 website. Links will either direct you to online homework through PRAIRIELEARN or to an assignment sheet in Compass with problems/computational homework (offline homework), see details below. All homework assignments (offline and online) are due on Sunday at 11.59 pm (as posted on the MSE 304 website). Late submissions will be penalized by 50% for each day late. Your lowest homework score will be dropped.

Online Homework: Assignments on PRAIRIELEARN.

- You can rework completed items after the due date. This work will not be saved and will not affect your grades.
- You will receive a grade for ALL assigned online homework problems. Your HW score will also appear in the grade book.
- The online homework problems give explicit values and units to the relevant lengths, material properties, etc., and therefore you should give your final answer with an explicit numerical value. Nevertheless, when solving a homework problem you should (to the utmost extent possible) assign symbols to all the relevant lengths, material properties, etc., and then solve the problem symbolically. As a last step, you should substitute the value and units of each of the symbols in the symbolic formula. You are encouraged to solve all problems symbolically.
- This symbolic form of working out the problems will be used in the lectures, in offline-homework assignments, and exams.
- You are encouraged to print out each homework problem and derive your symbolic solution on this print out. Store these solutions for your future reference.
- You should come to office hours with the symbolic solution for your online assignment. We will be able to check your work better if you have that in hand.
- The “zeroth” online homework is optional, it contains multiple choice questions regarding the syllabus. You will only have one attempt for each multiple choice item. You can earn up to 0.5 of extra points to be added to your final grade.

Offline Homework: Your solutions to work sheets must be submitted via Compass. The only format that will be accepted for submission is a single, properly-ordered PDF, in portrait format; your name must be printed legibly on the top of the first page. The TAs will grade the report. You may submit each report a maximum of two times; only the latest submission will be graded.

Computational reports. Computational materials science and engineering is a field with increasing importance in research and industry; to give you experience in applying the tools of computational modeling to materials science and engineering, some of the offline work sheets that are assigned throughout the semester will require computational work. Additional information will accompany these assignments, and you will be able to take advantage of additional support from a teaching assistant on these assignments.

Written reports are assigned to practice the communication of engineering concepts in writing. They will be graded based on presentation, neatness, correct use of symbols, quality of drawings and diagrams, and clarity of explanation (60%). Reports should be neat and organized, hand-written or typed.
and graphical representations of results should be generated using some software program such as Excel, TecPlot, MatLab, etc., rather than being hand-drawn. Correct interpretation of the problem and correct final answers are important (40%). Point breakdown for the written report:

- 2: Correct interpretation of the problem
- 2: Correct final answer
- 1: Presentation quality
- 2: Clarity of explanation
- 1: Clear drawings and diagrams
- 1: Use of symbolic work
- 1: Use of units on numerical answers

Pre-lecture Questions: Pre-lecture questions on the reading material will be assigned in PrairieLearn before class and answers are due at 9 pm the day before each lecture. Answering those is optional, but by participating (80%) and answering correctly (20%), you can earn up to 1.0 extra point to be added to your final grade.

Lectures: Prompt and regular attendance at lectures is required to obtain credit for i>clicker quizzes: 60% participation, 40% correctness. Your lowest four i>clicker scores will be dropped.

Prerequisite Exam, Midterm Exams, and optional Comprehensive Final Exam: To aid in learning, this class uses examinations to evaluate your learning and recall. There are four mandatory exams: one prerequisite exam and three midterms; they will take place in the Computer-based Testing Facility (CBTF), basement of the Digital Computer Laboratory (DCL) building, room L416 (directions). You will be able to pick the exact date and time at which you will take your exam by signing up online. The weeks for each exam are highlighted in the schedule on the MSE 304 website. The optional comprehensive final exam will take place TBD. If you are unable to attend an exam then you must inform your professor by email at the earliest possible opportunity. For non-emergency absences this notification must be at least one week in advance. Conflict-exam arrangements will be announced in the week before the final exam, and will be scheduled for students with a legitimate scheduled conflict according to the final exam policies. Exams are closed to all electronics (no calculators, no laptops, no phones, etc.). Bring your student ID to the exam, and arrive with sufficient time to sign in.

Each exam will cover a subset of topics from the class. The prerequisite exam covers a review of topics from the prerequisites for the class, while exams 1, 2, and 3 each cover a broad topic (quantum mechanics, solid-state physics, and semiconductor devices). Lastly, the class will conclude with an optional comprehensive final exam. If you choose to take the final exam, your grade on the final exam will replace your lowest single exam grade (exam 1, 2, or 3), provided that your final exam grade is not lower. This exam is an opportunity for you to demonstrate your understanding of the topics from class.

Grade Reporting: All assessment scores are stored in the gradebook in Compass. Any errors in grade reporting appearing in the gradebook must be reported within 1 week of the grade being posted in the gradebook or by the last day of class, whichever is earlier. If you have a missing grade, contact the instructor.

Expectations: To succeed in this class, you will need to
- read the chapter before coming to class, and formulate questions;
- participate in the class;
• make sure you understand the homework problems and solutions;
• seek out help when you have trouble.

**Obtaining help:** The main two ways to obtain help are online at Piazza or in person at office hours. You can also speak with your professor briefly after lecture. Please do not send email directly to TAs or professors for routine help or absences. In cases of emergencies related to exams (e.g., illness) you should email your professor at the earliest possible opportunity.

**Online Forum (Piazza):** This class uses Piazza for all communication between the instructor, TAs, and students. Please visit piazza.com/illinois/spring2016/mse304 to register. The Piazza link will take you to the current class page at any time. Official class announcements will be sent via Piazza, so you must register with an email address that you regularly check. If you desire, you can post anonymously on Piazza or make a private post just to the instructors (this should be done rather than emailing the professor directly). TAs are scheduled to be checking Piazza three times per day during the week. *Note that Piazza should be used to communicate with your instructors, rather than email.*

**Office Hours:** TA office hours will be held, see Piazza for location and time. Do not ask TAs to work the homework problems before they are due; it is fine to ask specific questions on the details of your attempted solutions, or to work out problems that are similar to homework problems.

**Absences:** Excused Absence Request Form: illinois.edu/fb/sec/7838715

1. Excuses from assessments will only be given in the following circumstances:
   (a) Illness.
   (b) Personal crisis (e.g., car accident, required court appearance, death of a close relative).
   (c) Required attendance at an official UIUC activity (e.g., varsity athletics, band concert).

2. In all cases you must complete the online Excused Absence Request Form and upload a scan of the official written documentation explaining your absence.

3. In cases (a) or (b) an official excuse letter from the Dean on Duty must be submitted via the online form within 2 weeks of the due date of the missed assessment, but no later than reading day (May 5). In cases of extended or unusual illness, late submission of excuse documentation will be considered. See Student Assistance Center.

4. In case (c) an official letter from the designated university official must be submitted via the online form at least one week prior to the due date of the missed assessment.

5. If you will not be able to take an exam due to illness or any other reason, you must send email to your professor at the earliest possible opportunity. Excused exams will be replaced by a weighted average of the other exam scores at the end of semester.

6. Notwithstanding the above, at the professor’s discretion you may be required to make up any excused work or attend substitute instruction or assessment.

**Academic Integrity, Harassment, and Discrimination:** You are bound by the University Honor Code in this course. Any violation of the Honor Code will result in disciplinary action. In addition, harassment or discrimination of any kind will not be tolerated. Please report any concerns immediately to your professor.

**Changes to syllabus:** may occur as deemed necessary by the professor; they will be announced.

**Calendar and Topics:** Changes to schedule will be announced; see MSE 304 website calendar for exact schedule, assignments, and to remain up to date.