MSE 311/ECE 340 — Electrical, Optical, and Dielectric Materials

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Course Overview in a Nutshell

- Course conducted in a hybrid in-person/online/remote model using Zoom, YouTube, and other resources.
- Pseudo-flipped class approach – read textbook and listen/watch lectures online (asynchronously) and actively work together through problems (synchronously).
- Quizzes ensure that you are ready for the activities and identify items that need more discussion.
- Homework is collaborative, but it must be your work (not team based).
- Exams are individual (not collaborative).
- A special topics project let's you explore your own interests.
- This approach is flexible; we can adjust as necessary to meet your needs and my needs.
- Don't worry about grades. Seriously. Worry about learning the material to understand the basic concepts and be able to solve the problems; the grades will take care of themselves.

For all of the course details, see the full syllabus below.

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Why? The point is to gain a basic understanding of the key properties of the primary materials used in electrical and optical devices. This class explores the physical principles underlying the electrical and optical properties of metals, insulators (dielectrics), and semiconductors. The effects of energy band structure, thermal properties, and impurities on electrical conduction are considered. These concepts can be applied to electrical and optical devices including interconnects, diodes, and transistors.

Goals: The goal of this course is for you to be able to understand and apply the basic concepts and mathematical tools of classical and quantum physics underlying the electrical, optical, and dielectric properties of materials and devices.

Outcomes: After successfully completing this class, expected learning outcomes are that you should be able to demonstrate an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics. Specifically, you should be able to:

1. Describe the two statistical approaches used to model carrier populations and explain the contexts for which each model is relevant.
2. Discuss the key aspects of quantum mechanics that lead to the electronic bands of semiconductors and dielectrics.
3. Draw and mathematically model energy band diagrams in real and reciprocal space for conductors, dielectrics, and semiconductors.
4. Describe the operation of a variety of semiconductor devices using energy band diagrams.
5. Analyze and interpret data, and use engineering judgment to draw conclusions for electronic materials properties and device performance.
6. Recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.

Who? **Me:** Elton Graugnard (gruñard or grun-yard)
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You!

Where? In-person in the RUCH Bldg room 313 and remotely via Zoom (synchronous) and online at the course website (asynchronous)

When? 12:00–1:15 PM, Monday/Wednesday

How? Reading the course textbook (for real!), discussing the concepts, working through examples, and solving lots of problems.

The *required* textbook is *Principles of Electronic Materials and Devices*, S.O. Kasap, McGraw Hill. The current edition is the 4th, but either the 3rd or 4th will be fine (not 1st or 2nd).

Supplemental *optional* textbook: *Advanced Semiconductor Fundamentals, 2nd Ed.)*, R.F. Pierret, Pearson. I use this text for some of the quantum mechanical descriptions of carriers in semiconductors.

Help! Q&A Hours/Discussion Sessions: we'll schedule these.
If what we schedule doesn't work for you, email me and we'll find another time.

Accomodations: Students needing special accommodations are encouraged to let me know early in the course so that we can determine how to best meet the needs of the student.

Information on services available to students with special needs can be found at the Educational Access Center.

You have the tools: Prerequisites: MSE 201, MATH 333, curiosity, motivation, showing up.

Philosophy: You learn only what you teach yourself; I am your guide in this process.

Participation (100%): Learning is an active process that requires effort and time on your part. Participation includes, but is not limited to, attending class, reading the textbook, watching the videos, asking and answering questions, working on activities, attending office hours and/or discussion sessions, seeking out additional resources, cultivating and satisfying your curiosity, seeking help when you need it, and completing your homework and other assignments. *Participation is not an independent factor of your course grade, but it is 100% key to your success!*

Homework (30%): The purpose of homework is to provide you opportunities to develop, practice, and hone the knowledge and skills you acquire in this course. Thus, homework is an important tool for learning the material. The best way to learn, retain, and understand the material is to submit the homework problems in a clear, neat, and thorough fashion, with explanations and comments. Not only will this allow you to receive full credit for the assignment, it also helps me understand your approach to the problem.

Homework will be assigned and collected regularly using the course's Gradescope site throughout the semester. I encourage you to *collaborate with your classmates* on the homework, but *the work you submit must be your own.* Copying is not acceptable. It is a great idea to write out your homework solutions by hand, neatly. Submitted homework should follow the Homework Guidelines. Submitting homework on time is kindest to the grader and makes it easier to get you timely feedback. If you need extra time for the homework, let me know.

Quizzes (15%): Quizzes serve two purposes: 1) they provide you with opportunities to measure your learning, and 2) they provide me with an opportunity to see where you stand (individually and as a class) in learning the material. This is called the **Readiness Assurance Process (RAP)**. Prepare for quizzes as you would prepare for class: review the material from the prior week and read/view the sections scheduled for the day, and work through the relevant textbook examples and problem sets.

Project (15%): One of the best ways to learn a topic is to apply the knowledge you are developing to something that interests you. Therefore, an important part of the class will involve researching the electronic, optical, and dielectric properties of a material you find interesting. This project will be completed in stages, with feedback provided after each stage as you work toward a completed project. Details regarding the project will be provided separately. The tentative due dates for the assignment stages are listed in the course schedule.

Exams (40%): Exams function as assessment tools. While the outcome of an exam is some measure of what you have learned, preparing for an exam is a really important part of the learning process.

The exams are closed book, but I will provide necessary reference materials. Exams are cumulative, but focus on the material covered since the prior exam.

Grades: Course grades are not competitive; it is possible (and desired!) for everyone in the class to earn an A. Grades for homework and tests may be contested for up to one week after which time they become permanent. Student grade reports are based on the following definitions:

Superior Work: Grade '**A**' is reserved for work that is exceptional in quality and shows keen insight, understanding, and initiative.

Good Work: Grade '**B**' is given for work that is consistently high quality and shows interest, effort, or originality.

Mediocre Work: Grade '**C**' is a respectable grade. A 'C' average (2.00) or greater is required for graduation. It reflects consistent daily preparation and satisfactory completion of all work required.

Below-mediocre Work: Grade '**D**' is below the average necessary to meet graduation requirements and ordinarily is not accepted for transfer by other institutions.

Failure: Grade '**F**' is failing.

Grading Scale: Although I reserve the right to change the grading scale, the approximate scale that will be used is

A−	90–93	A	≥94		
B−	78–81	B	82–85	B+	86–89
C−	66–69	C	70–73	C+	74–77
D−	51–55	D	56–60	D+	61–65
		F	≤50		

Academic Honesty: The university's goal is to foster an intellectual atmosphere that produces educated, literate people. Because cheating and plagiarism are at odds with that goal, they shall not be tolerated in any form. Students are expected to adhere to the rules and regulations as set forth in the Student Code of Conduct. Therefore, all work submitted by a student must represent that student's own ideas and effort; when the work does not, the student has engaged in academic dishonesty.

Plagiarism occurs when a person passes in another person's work as their own or borrows directly from another person's work without proper documentation. For example, academic dishonesty occurs whenever a student:

- copies from another student's exam, either before, during, or after the exam
- uses "crib notes" while taking an exam or uses information stored in a computer or calculator (if prohibited from doing so)
- allows another person to take an exam in their place or takes an exam for another person
- copies the work of another person and attempts to receive credit for that work
- fails to properly document source material in a paper or project
- receives editorial assistance that falls outside the scope of acceptable assistance

NOTE: The list above is intended only to provide general guidelines for recognizing and avoiding common types of academic dishonesty. It is in no way an exhaustive or comprehensive list of all the types of academic dishonesty.

Except in cases of major offenses, responding to academic dishonesty is the responsibility of the instructor of the course in which the dishonesty occurs. If a student is academically dishonest, the student may be dismissed from the class and may receive a failing grade. Other penalties may include suspension or expulsion from school.

For more information about academic honesty, see the following publications:

- Boise State University Policy Manual
- Boise State University Student Handbook
- Student Code of Conduct

Cheating will result in an F in the course and will be reported to the Dean of Students.