

Materials Engineering 153
Electronic, Optical, and Magnetic Properties of Solids
Spring 2008 – San José State University

Course Objectives

The objective of Materials Engineering 153 is to provide an environment for engineering students to learn about some of the properties of materials which contribute to their usefulness in modern electronic, optical and magnetic devices. Mastery of the course learning objectives will establish the basis for understanding how crystalline structure and electronic properties determine material and device behavior. The lecture and laboratory will provide an introduction to the behavior of electrons in solids, emphasizing their effects on the electronic, magnetic, and optical properties. C or better in this course is a strict pre-requisite for EE 128.

Section 1

Class: MW 9:00-9:50 am
Engineering 329
Instructor: Dr. Stacy Gleixner
Office: Engineering 385B
Phone: 408-924-4051
E-mail: gleixner@email.sjsu.edu
Office Hours: M & W 10:30- 11:30, T & R
10:30 -12

Section 2

Class: TR 5:30-6:20 pm
CL 202
Instructor: Dr. Wonsuk Chung
Office: Engineering 385
Phone: 408-546-2047
E-mail: wchung07@gmail.com
Office Hours: TR 6:20-7:30 pm

Instructors are also available by appointment. Feel free to call or send e-mail to set up an appointment for another time if you can't come during regular office hours. The material in this class is tough; it will be to your benefit to get in the habit of keeping up on the reading and coming to see your instructor with questions!

Lab Section Schedule: All labs are in room E315.

Lab Coordinator: Ms. Anastasia Micheals (amicheal@email.sjsu.edu)

Section	Day	Time	Instructor	Email
5	T	900-1150	Jones, Curtis	curtis_jones@ieee.org
6	T	1830-2120	Saheli, Ghazal	gpsaheli@yahoo.com
7	W	1000-1250	Jones, Curtis	curtis_jones@ieee.org
8	W	1400-1650	Duorah, Smita	s_duorah@yahoo.com
9	W	1800-2050	Dong, Yujia	ydong1@email.sjsu.edu
10	R	900-115	Xu, Cheng	barkleyxu@yahoo.com

Note: The first lab sections will be held the week of January 28, 2008.

Course Prerequisites

MatE 153 is a required course for MatE and EE majors. Other Engineering or Science majors with proper prerequisites are welcome to enroll. Prerequisites (or equivalent at community college) are:

- Chem 1A
- Math 133A
- Physics 51/71 (Elec. & Magn.)
- EE98

Everyone planning to enroll in this class, whether already registered or not, must complete a pre-requisites form the first day of class. If you do not have the prerequisites, you will be dropped from the class.

There is a *significant* writing component to this course. If you have not yet passed English 1B (or equivalent) you may have difficulty.

This course may be taken as part of a 15-unit sequence in electronic materials for a Minor in Materials Science and Engineering. See your instructor or <http://www.engr.sjsu.edu/cme/> for more information.

Required Texts and LabNotes

Required Textbook: S. O. Kasap, Principles of Electronic Materials and Devices, McGraw Hill, 2002, 3rd Edition. The book is available in the Spartan Bookstore and Roberts Bookstore (on 10th Street south of San Fernando Street).

Required MatE 153 Laboratory Notes: They will be sold during the first lab section meeting, for \$12 cash only.

Required Lab Notebook: It must be bound (not spiral) and have quad-ruled paper (graph paper).

Optional: Materials Mentor Quicknotes is approximately \$3.50 in the bookstore for a laminated fold-out set of highlighted notes on materials science. About half of it is relevant to this course.

Online Resources

This course will conduct all of its communications outside of class using Blackboard Learning System (WebCT). You will be able to send questions to your instructors using Blackboard for both lecture and lab. You will also be able to send messages to the rest of the class and to both sections. All of the online resources such as homework and exam solutions will be at WebCT. To access the class site at Blackboard you must be enrolled in the course. Go to the <http://sjsu6.blackboard.com/> Your username is your 9 digit ID and your password is the 4 digit month and day of your birthday (such as 0804 for August 4th). If you had a password on a previous WebCT account, use your old password. If you can not access the class site, email Dr. Gleixner.

Learning Objectives

A set of *Learning Objectives (LOs)* was distributed with this greensheet (and are available on the course website). All of the course assignments (which includes lectures, homework assignments, lab assignments, in-class learning exercises, and lab reports) are designed to help you learn the

material and master the learning objectives. We recommend that you review the LOs *weekly* and highlight the ones you have achieved that week. This will help keep track of your progress in the course.

Class & Lab Times

The lecture period will be used to establish fundamental concepts. The lab periods will be used to practice the engineering skills of problem-solving and data acquisition and analysis. Your *ACTIVE* participation in both the lecture and laboratory sessions is required. This means you will be required to ask questions, answer questions, and work together with your peers to solve problems during the class time.

The **reading assignments** for each week are listed on the Lecture Activity Schedule (attached to this Greensheet). You are expected to do the reading *before* class and *before* attending the lab section. The LN numbers refer to the LabNotes Chapter. There are reading review notes for each week on WebCT. Review these notes after you have completed the assigned reading to make sure you understood the main points of the reading. **There may be unannounced quizzes on the reading in both lecture and lab.** Always bring your calculator to both lab and lecture.

Collaborative group learning activities will take place during lecture and lab and *will contribute* to students' overall grades. These group learning activities are called *Bluesheets*, where you will work through problems on material just covered in class or in the reading. Bluesheets are graded on participation. Coming to class generally insures that you will earn an easy 5% of your grade!

Laboratory Sessions

Some weeks the lab sessions will be devoted to experiments; other sessions will be devoted to tutorials, workshops, demonstrations or other activities. Laboratory activities are considered an integral part of this course. **Participation in lab is required.** You must attend the lab section you are registered for. Substitution of lab sections in case of emergency may be approved by the lab instructors of your assigned lab and the substitute lab *once* during the course. **Unexcused absences in lab will result in a zero for any assignments related to that lab as well as your overall lab grade being reduced 5% for every lab missed.**

Laboratory quizzes will be averaged into the overall laboratory grade along with lab reports and other activities. There will generally be a *group quiz* at the beginning of each lab period, covering the previous week's lab material. There will also be an *individual exit quiz* each week, which will demonstrate your mastery of the material covered in the week's lab.

You can prepare for the quizzes by reviewing what we did in lab the previous week and by doing the appropriate data analysis on your experimental data from the previous week. Preparing for the lab by reading ahead will help you achieve success on the lab bluesheets and exit quizzes. The appropriate reading assignment for the lab is listed in the Activity Schedule. The section numbers refer to the textbook (Kasap). The LN numbers refer to the LabNotes chapter. Laboratory activities will be performed in small groups which will be rotated every few weeks and assigned by the instructor. Lab Bluesheets will generally be due at the end of every lab period. These may be group worksheets or individual worksheets. Always bring your LabNotes to the lab session!

Section lab grades may be scaled up or down to account for discrepancies in grading between lab instructors.

Lab Reports

There will be four written laboratory reports (*WLR*) and one group oral lab report (*OLR*) due during the semester. Guidelines for writing these reports are given in the Lab Notes. For tips on writing lab reports also see the excellent resources at <http://writing.eng.vt.edu/workbooks/laboratory.html>

Due dates for lab reports are listed in the Lab Activity Schedule. Lab reports are due at the **beginning of the lab section**. No lab reports will be accepted more than two days late, and they will be marked down one letter grade for each day late. Late lab reports must be time stamped at the CME office (E385) and left for the instructor.

Electronic copies of all lab reports must be uploaded into Turnitin.com (for instructions see the LabNotes) prior to the due date of the lab. You must also bring a hard copy to your lab instructor. **If you do not upload an electronic copy, you will receive a zero on the report.**

Academic Honesty

Your own commitment to learning, as evidenced by your enrollment at San Jose State University, and the University's Academic Integrity Policy, requires you to be honest in all your academic coursework. Faculty members are **required** to report all infractions to the Office of Student Conduct and Ethical Development. The policy on academic integrity can be found at http://sa.sjsu.edu/student_conduct.

Strict standards of academic honesty will be enforced in this class. Students who plagiarize any portion of their lab reports will receive an F (0) on that report with no chance of make-up and be reported to the University. Plagiarism constitutes copying *any portion* of your lab report from textbooks, lab notes, previous years' lab reports, or the reports of other students. Plagiarism includes copying data. Any figures used from textbooks or the LabNotes must be properly footnoted. Homework assignments that you turn in must have been worked out entirely by you. You can study with friends and work out the problem together, but you must then independently work it through and record your own work. *Students who provide their homework or labs to other students such that they can be copied are also committing a breach of academic honesty. This includes leaving your work on shared computers, leaving your flash drive where others can copy it, etc.* If you wish to help other students learn the material, studying together is acceptable as long as each individual goes on to produce their own independent work.

For more information about avoiding plagiarism in written reports, see: <http://www.indiana.edu/~wts/pamphlets/plagiarism.shtml>

Blackboard Discussions

We will be using the Blackboard (WebCT) discussion board to continue to learn and apply the material outside of class. All students are expected to participate in the discussions. To participate, you can post questions, answer other postings, or refer students to related links and

applications you found. Full participation would be a minimum of five thoughtful postings over the course of the semester.

Problem Solving Exercises

Problem Solving Exercises (PSE) will be assigned and due approximately every two weeks. The *tentative* due dates are listed on the Lecture Activity Schedule. Homework is **due at the start of class** on the assigned date. Students who pass in their homework after the start of class will get 10% off. After the end of class, no late homework will be accepted.

Your name and section number must be listed in the upper right hand corner of the assignment.

PSE solutions will be posted on the course WebCT site on the Friday afternoon after the due date.

You are encouraged to work together on the assignment. However, you must pass in individual homework solutions. You must ultimately work out the problem on your own and submit your own calculations and solutions. You are required to list the names of the students you worked with below your name in the upper right hand corner of your packet. Groups can be no larger than 3 students. **If similar solutions are passed in by multiple students but they do not state they worked together, all the students will receive a 0 on that assignment.**

Test questions will target material learned through the problem solving exercises. If you do not fully understand the solutions you pass in, you not only risk getting a 0 on that assignment but you will not be able to answer the related questions during the tests. This will significantly affect your overall grade! **Come to office hours if you are having trouble doing the problem solving exercises.**

Examinations & Quizzes

There will be two midterms and a comprehensive final exam. You must bring a calculator to the examinations. There may also be quizzes given during lecture and lab. Links to past midterms are on the website. To study for the tests, you should review the readings, course lecture notes, homework, and learning objectives **well in advance** of the test date.

Workload

The material in this course will require a lot of time and effort on your part to learn it. Be aware that every 3-credit engineering course requires 6-8 hours outside of class a week on average to pass, and 8-10 hours a week to get an A or a B. **Thus 3 classes plus a 20-hour a week job is a 60-hour work week.** The 15 to 18-unit semesters suggested in Department brochures are not realistic for students who are working part-time jobs or supporting themselves or their families. Since many SJSU students are working at jobs more than 30 hours a week, very few should expect to finish their upper division in four semesters. Therefore please think seriously about how many semester units you have registered for. If you find that you are not completing and submitting the homework in this class, you are probably taking too many units. Evaluate your workload before the drop deadline.

Being Successful in MatE 153

It is not difficult to be successful in MatE 153. Students who get a grade of C or better usually have turned in every homework assignment, **after doing it themselves and being sure to understand each problem**; they attend every lab meeting and turn in every lab report, **after writing it themselves and being sure to understand all the concepts**. If you are having trouble understanding the material in lecture, lab, the readings, or the homework assignments, go to the instructors with questions!

Withdrawing/Changing Sections

The University Withdrawal schedule is as follows:

Monday February 4 is last day to drop the class without a “W” on transcript.

Monday February 11 is last day to add the course.

Withdrawals after the drop deadline are granted only for “serious and compelling reasons”; this usually refers to extreme personal or family problems. *Registering for too many units is not considered a serious and compelling reason*. Please think about the above workload advice before deciding to stay in the course. Note that if you fail the course and attempt to take it the following semester under Academic Renewal, you will have last choice for adding the class.

If you stop coming to class without filing a withdrawal slip, or do not take examinations, you will receive a grade of “WU” which reverts to an F on your transcript.

Accommodation for Students with Disabilities

If you need course adaptations or accommodations because of a disability, or if you need special arrangements in case the building must be evacuated, please make an appointment with me as soon as possible, or see me during office hours. Presidential Directive 97-03 requires that students with disabilities requesting accommodations must register with DRC to establish a record of their disability.

Additional Reference Materials

The following books are in the SJSU library. They may help you to gain additional insight into the topics we are studying. Attempting to solve the problems in these books may also strengthen your ability to tackle the problems assigned in the course.

W. Callister, Materials Science and Engineering: An Introduction TA403.C23 1985 c.2

David Jiles, Introduction to the Electronic Properties of Materials, Chapman & Hall, 1994.

R. Pierret, Semiconductor Device Fundamentals, Addison-Wesley, 1996. TK7871.85.P484 1996

R. Hummel, Electronic Properties of Materials, Springer-Verlag, 2nd ed., 1993. QC176.H86 1993

C. Kittel, Introduction to Solid State Physics, 4th ed., John Wiley and Sons, NY, 1976.

QC176.K5 1986

R.L. Comstock, Introduction to Magnetism and Magnetic Recording, John Wiley and Sons, 1999

Grading Method

Course Element:	Percentage of Course Grade:
Problems Solving Exercises	10%
WebCT Discussion	5%
In-class Quizzes & Bluesheets	5%
Two Midterms	15% each
Lab Score	25%
Lab Reports	(70%)
Group Quizzes+ Bluesheets	(15%)
Individual Quizzes	(15%)
Final Exam	25%
Total	100 %

Total Course Score	Letter Grade
97-100	A+
93-96	A
90-92	A-
87-89	B+
83-86	B
80-82	B-
77-79	C+
70-76	C
60-69	D
< 60	F

Note that there is no grade of C- in this course. You must master at least 70% of the course material to pass with a C.

Lecture and Lab Activity Schedule

Week of:	Lecture	Lab
1: Jan 23	The Nature of Solids <i>Reading: Kasap 1.1-1.5</i>	NO LAB SECTIONS THIS WEEK
2: Jan 28	Classical Theory of Electrons <i>Reading: Kasap 2.1-2.2</i>	Atomic Bonding, Elements & Alloys <i>Reading: LN1, Kasap 1.1-1.4</i>
3: Feb 4	Metal Resistivity <i>Reading: Kasap 2.2-2.4</i> Problem Set 1 Due W/Th	Linear Regression of Data <i>Reading: LN 5</i>
4: Feb 11	Particles & Waves <i>Reading: Kasap 3.1-3.2</i>	Temp. Dependence of Metal Resistivity (WLR1) <i>Reading: LN 6, Kasap 2.1-2.3</i>
5: Feb 18	Electron in a Box <i>Reading: Kasap 3.3- 3.6</i> Problem Set 2 Due W/Th	Crystallography & Defects , Pt 1 <i>Reading: LN 1&2, Kasap 1.8-1.9, 1.13</i> Lab Report WLR1 Due
6: Feb 25	Hydrogen Atom <i>Reading: Kasap 3.7</i> Midterm 1 on Wed/Th	Hall Effect (WLR2) <i>Reading: LN 4, Kasap 2.5</i> Lab Report 1 Returned
7: Mar 3	Periodic Table <i>Reading: Kasap 3.8</i>	Crystallography & Defects , Pt 2 <i>Reading: LN 1&2, Kasap 1.8-1.9, 1.13</i>
8: Mar 10	Energy Bands & Density of States <i>Reading: Kasap 4.1-4.5</i>	Bandgap Measurement by Optical Abs. (WLR3) <i>Reading: LN 7, 5.7</i> Lab Report WLR2 Due
9: Mar 17	Fermi-Dirac Statistics & Fermi Energy <i>Reading: Kasap 4.6-4.8</i> Problem Set 3 Due W/Th	Microelectronics Fabrication <i>Reading: LN 3</i> Lab Report 2 Returned
Mar 24 – Mar 28 Spring Break		
10: Mar 31	No class on Monday: Cesar Chavez Day Intrinsic Semiconductors <i>Reading: Kasap 5.1</i>	Minority Carrier Lifetime (OR1) <i>Reading: LN 8, Kasap 5.4</i> Lab Report WLR3 Due
11: Apr 7	Extrinsic Semiconductors <i>Reading: Kasap 5.2</i> Problem Set 4 Due W/Th	Minority Carrier Lifetime (OR1) INDIVIDUAL ORAL REPORT Lab Report 3 Returned
12: Apr 14	Temperature Dep. Of Semiconductors <i>Reading: Kasap 5.3</i> Midterm 2 on W/Th	Temp. Dep. of Semicon. (WLR4) <i>Reading: LN 9, Kasap 5.1-5.3</i>
13: Apr 21	Drift & Diffusion of Carriers <i>Reading: Kasap 5.5-5.6</i>	Optoelectronic Devices (OR2): Part 1 Lab meets in E105 <i>Reading: LN 10, Kasap 6.1-6.2, 6.9-6.10</i> Lab Report WLR4 Due
14: Apr 28	Intro to Magnetism <i>Reading: Kasap 8.1-8.2</i> Problem Set 5 Due M/Tu	Optoelectronic Devices (OR2): Part 2 <i>Reading: LN 10, Kasap 6.1-6.2, 6.9-6.10</i> Lab Report WLR4 Returned
15: May 5	Ferromagnetism & Domains <i>Reading: Kasap 8.3-8.6</i>	Group Oral Report (OR2) Lab Report WLR4 Returned
16: May 12	Magnetic Devices <i>Reading: Kasap 8.7-8.8</i> Last Day of Class is Tuesday Problem Set 6 Due M/Tu	NO LABS THIS WEEK
Section 1 Final: Wednesday, May 21, 7:15 AM - 9:30 AM Section 2 Final: Tuesday, May 20, 5:15 PM – 7:30 PM		

Key: LN: LabNotes; WRL: Written Lab Report; OQ: Oral Quiz; OR: Oral Report