

Course Syllabus
EMA 3413 Electronic Properties of Materials
Section 9766, Spring 2014

1. Catalog Description (3 credits): Atomistic and quantum-mechanical description of the electrical, optical, magnetic and thermal properties of materials. This course deals with metals, alloys, semiconductors, polymers, dielectrics and amorphous materials. Special emphasis is given to technology applications of electronic materials.
2. Pre-requisites and Co-requisites - EMA 3010 or equivalent
Students are also expected to have taken calculus and college physics courses.
3. Course Objectives – Understanding the fundamental electronic properties of solid materials
4. Contribution of course to meeting the professional component - This is a 3 credit course. It provides 3 credits towards engineering sciences.
5. Relationship of course to program outcomes - This course addresses the following MSE Program outcomes:

Outcome 1: Ability to apply knowledge of mathematics, science, and engineering to materials systems. (High coverage) This course builds on the students' knowledge of physics and chemistry to develop an understanding of electronic properties of materials. Students are assigned homework and exam problems that examine the students understanding of semiconducting, metallic, and insulating electronic systems.

Outcome 12: Knowledge of contemporary issues. (Medium coverage) This course helps students to understand certain contemporary issues related to electronic and optical properties of materials. Students are assigned homework and exam problems that examine the students' understanding of these contemporary issues.

6. Instructor: Dr. Franky So
 - a. Office location: 166 RHN
 - b. Telephone: 846-3790
 - c. E-mail address: fso@mse.ufl.edu
 - d. Office hours: Monday 8:00 to 9:00 am, and Wednesday 9:00-10:00 am
7. Teaching Assistants:
8. Meeting Times: Tuesday 2nd and 3rd periods, Thursday 3rd period
9. Class/laboratory schedule - Three hours of class time each week, 2 hours on Tuesday and 1 hour on Thursday.
10. Meeting Location: FLG 0285

11. Materials and Supply Fees - none

12. Textbooks and Software Required – *Electronic Properties of Materials* by R. E. Hummel, Springer, 4th Ed. (ISBN: 978-1441981639).

13. Recommended Reading – Assigned in class; and

- a. *Principles of Electronic Materials and Devices*, by S. O. Kasap, McGraw-Hill, 3rd Edition (ISBN: 0-07-295791-3)
- b. *Introduction to Solid State Physics*, by C. Kittel, Wiley, 8th Edition (ISBN: 0-471-41526-X)
- c. *Solid State Physics*, by N. W. Ashcroft and N. D. Mermin, Saunders College Publishing (ISBN: 0-03-083993-9)

14. Course Outline – Table below is a list of topics to be covered in the lectures along with the corresponding reading assignment in the textbook. This list is subject to change.

Section subject	Lecture	Date	Lecture topic	Reading assignment
Electrons in solids	1	1/7	Electron theory and Schrödinger's Eq.	1-18
	2	1/7	SE solutions: free and bound particle	19-25
	3	1/9	SE solutions: finite well	25-28
		1/14	No Class	
	4	1/16	SE solutions: periodic crystal	29-35
	5	1/21	Energy bands (theory)	37-46
	6	1/21	Band structure for metals/semiconductors	56-60
	7	1/23	Fermi energy and Fermi distribution	63-65
	8	1/28	Density of states/effective mass	65-74
	9	1/28	Electron theory in metals	79-84
		1/30	Exam 1	
Elec. prop./metals	10	2/4	QM description of metals	85-93
	11	2/4	Superconductivity and thermoelectrics	93-105
	12	2/6	Intrinsic semiconductor	115-122
		2/11	Extrinsic semiconductor	122-127
Elec. prop./semicon.	13	2/11	Hall effect and compound semicon.	127-131
	14	2/13	pn junction and diode	137-141
	15	2/18	Metal-semiconductor contacts	131-137
	16	2/18	Three terminal devices	147-155
	17	2/20	Conducting polymers	181-191

	18	2/25	Ionic conduction and amorphous mater.	191-200
	19	2/25	Dielectrics and ferroelectrics	202-209
Elec. prop./insulator	20	2/27	Optical constants	215-225
	21	3/11	Optical prop./atomistic theory	227-245
Optical properties	22	3/11	Band structure and photons	247-256
	23	3/13	Optical prop./metals	259-278
	24	3/18	Semiconductors and photons	278-284
	25	3/18	Optical emission	284-297
	26	3/20	Optical components	297-334
	27	3/25	Magnetic fields	339-344
	28	3/25	Magnetic response of materials	347-352
Magnetic properties	29	3/27	Ferromagnetism	352-364
		4/1	Exam 2	
		4/3	No class	
	30	4/8	Microscopic theory of magnetism	373-382
	31	4/8	Applications of soft magnetic materials	385-391
	32	4/10	Magnetic memory	391-400
	33	4/15	Defining thermal properties	405-416
	34	4/15	Heat capacity and thermal conductivity	419-436
Thermal properties	35	4/17	Thermal expansion	439-441
		4/29, 3:00-5:00 pm	Final exam	

15. Attendance and Expectations - attendance is not required, but expected and strongly recommended. Cell phones should be turned off or set to vibrate.

16. Grading – Two exams (in-class, 50 min each): 50%
Final exam (comprehensive, 100 min): 40%
Homework: 10%

17. Grading Scale – Final letter grade will be assigned based on a student's overall performance during the semester (the instructor has the discretion to curve the grades to reflect upon the difficulty levels of the exams and homework). The following scale will be used as a guideline:

A(100-92), A-(91-88), B+(87-84), B(83-80), B-(79-77), C+(76-74), C(73-71), C-(70-68), D+(67-65), D(64-62), D-(61-60), E(59-0)

“A C- will not be a qualifying grade for critical tracking courses. In order to graduate, students must have an overall GPA and an upper-division GPA of 2.0 or better (C or

better). Note: a C- average is equivalent to a GPA of 1.67, and therefore, it does not satisfy this graduation requirement. For more information on grades and grading policies, please visit: <https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

18. Make-up Exam Policy – Requirements for class attendance and make-up exams, assignments, and other work are consistent with university policies that can be found at: <https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>

19. Honesty Policy – All students admitted to the University of Florida have signed a statement of academic honesty committing themselves to be honest in all academic work and understanding that failure to comply with this commitment will result in disciplinary action. This statement is a reminder to uphold your obligation as a UF student and to be honest in all work submitted and exams taken in this course and all others.

Note that failure to comply with this commitment will result in disciplinary action compliant with the UF Student Honor Code Procedures.

See <http://www.dso.ufl.edu/sccr/procedures/honorcode.php>

20. Accommodation for Students with Disabilities – Students Requesting classroom accommodation must first register with the Dean of Students Office. That office will provide the student with documentation that he/she must provide to the course instructor when requesting accommodation.

21. UF Counseling Services –Resources are available on-campus for students having personal problems or lacking clear career and academic goals. The resources include:

- UF Counseling & Wellness Center, 3190 Radio Rd, 392-1575, psychological and psychiatric services.
- Career Resource Center, Reitz Union, 392-1601, career and job search services.

22. Software Use – All faculty, staff and student of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.