

Syllabus

EMA 6110 Electron Theory in Solids Fall 2014

1. Catalog Description (3 credits): Wave equation and its application to free electrons, bound electrons, and electrons in crystals. Electron-band theory and its applications. Electrical properties of metals, alloys, and semiconductors, heat capacity and thermal properties.
2. Pre-requisites and Co-requisites: EMA 3010, PHY 2049, and MAP 2302, or equivalents
3. Course Objectives: Understanding the fundamental electronic properties of solid materials
4. Instructor: Prof. Franky So
 - a. Office location: 166 Rhines Hall
 - b. Telephone: 846-3790
 - c. E-mail address: fso@mse.ufl.edu
 - d. Class Web site: e-Learning in Sakai, <https://lss.at.ufl.edu/>
5. Office hours: 8:00-9:00 am on Monday and Wednesday
Teaching Assistant: Eugene Ragasa
 - a. Office location: 267 Rhines Hall
 - b. Telephone: 917-415-8691
 - c. E-mail address: eragasa@ufl.edu
 - d. Office hours: 3:00 pm Monday and Wednesday, and 5:00 pm Thursday
6. Meeting Times: 4:05-4:55 pm, T (9th period);
 3:00-4:55 pm, Th (8th and 9th period)
7. Class/laboratory schedule: 3 classes (each 50 min) per week
8. Meeting Location: CSE E118
9. Material and Supply Fees: None
10. Textbooks and Software Required
 "Principles of Electronic Materials and Devices," by S. O. Kasap, McGraw Publishing, 3rd edition, ISBN 0073104647
11. Recommended Reading: "Solid State Physics for Engineering and Materials Science", by John McKelvey, Krieger Publishing Co., 978-0894644368
12. Course Outline: Table below is a list of topics to be covered in the lectures along with the corresponding reading assignment in the textbooks. This list is subject to change.

Section subject	Lecture no.	Date	Lecture topic	Reading assign. (Kasap, 3rd ed.)	Reading assign. (McKelvey)	Homework due
Electrons and Classical Physics	1	8/26	Free electrons in metals	113-145	267-285	
Classical electron theory	2	8/28	Quantum vs. classical mechanics	191-205	106-117	
Quantum Mechanics	3	8/28	Intro to wave mechanics	205-212	28-33, 63-74	
	4	9/2	The quantum mechanics formalism		117-129	
	5	9/4	Schrödinger's eqn			
	6	9/4	Solution for free electron		129-134	

	7	9/9	Infinite and finite potential wells	212-231	134-145	
	8	9/11	Hydrogen atom	231-254	164-174	
	9	9/11	Pauli exclusion principle and the periodic potential		177-181	
	10	9/16	Maxwell-Boltzmann statistics	303-315	199-214	HW1
	11	9/18	Fermi-Dirac statistics		214-224	
Band structure	12		Kronig-Penney Model		321-327	
		9/18	Crystal momentum and effective mass	303-305	328-333	
		9/23	Band theory		361-367	
	13	9/25	Intrinsic semiconductors	373-388	372-380	HW2
	14	9/25	Extrinsic semiconductors			
No class		9/30				
Exam 1	15	10/2	Chapter 2, 3,4 of Kasap			
	16	10/2		388-396	381-385	
	17	10/7	Quantitative derivation of carrier density	396-424	385-393	
	18	10/9	Carrier transport			
	19	10/9	Conductivity and Hall effect		306-308, 393-402	
Semiconductor properties	20	10/14	pn junction physics	476-494	443-457	HW3
	21	10/16	Pn junction as rectifier	494-506	458-467	
	22	10/16	Heterojunctions			
Dielectric materials	23	10/21	Dielectric materials	583-593		HW4
	24	10/23	Clausius-Mosotti relationship	593-595		
	25	10/23	Dielectric properties in alternating field	597-603		
Exam 2		10/28	Chapters 5-6 of Kasap			
	26	10/30	Frequency and temperature dependence	603-614		
	27	10/30				
	28	11/4	Ferroelectricity and piezoelectricity	638-654		
	29	11/6	Dielectric polarization	583-601		
	30	11/6	Frequency dependence, dielectric loss	602-630		
Optical properties	31	11/11	Piezoelectricity and ferroelectricity	638-677		HW5
		11/13	Optical dielectric function	804-825		
	33	11/13	Absorption, transmission and reflectance			
	34	11/18	Electromagnetic waves and polarization	773-804		
	35	11/20	Fresnel equation, optical absorption	825-841		
		11/20	Optical devices,			
		11/25	LEDs and lasers			HW6
Thanksgiving		11/27				
Thanksgiving		11/27				
No Class		12/2				
Exam 3		12/4	Chapters 7 and 9 of Kasap			
		12/4				
No class		12/9				

13. Attendance and Expectations: attendance strongly encouraged.

Attendance is strongly encouraged for all non-EDGE students to enhance classroom learning and interaction. Special conditions for absence will be accepted only with prior approval by the instructor.

14. Grading –

Three exams (equal weight 30%)

Homework (10%)

Homework will be assigned biweekly, but not graded. Students are strongly recommended to solve the homework problems to enhance learning.

15. Grading Scale: Final letter grade will be assigned based on a student's overall performance during the semester. 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)

In order to graduate, graduate students must have an overall GPA and an upper-division GPA of 3.0 or better (B or better). Note: a B- average is equivalent to a GPA of 2.67, and therefore, it does not satisfy this graduation requirement. For more information on grades and grading policies, please visit:

<http://gradschool.ufl.edu/catalog/current-catalog/catalog-general-regulations.html#grades>

16. Make-up Exam Policy: allowed if requested at least one week before the regular exam time and approved by the instructor. Make-up exams will differ from regularly-scheduled exams.
17. 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.
18. 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.
19. 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.
20. 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.