Fall 2015

PHYS 4901/5901

Leszek Malkinski
University of New Orleans

PHYS- 4901-001/5901-001 – Condensed Matter Physics and Materials Science, Fall 2015

Instructor: **Prof. Leszek MALKINSKI**
Contacts: **Phone: 504-280-1346** **E-mail:** **lmalkins@uno.edu**

Class times: **Mondays, Wednesdays and Fridays 9:00 AM-9:50 AM**
Location: **Room SC 2068**
Office hours: Room SC 2009**,** Hours: Mondays, Wednesdays and Fridays, 11:00AM-1:00 PM. Other hours are available by appointment.
Textbook: **Electronic, Magnetic and Optical Materials**, by Pradeep Fulay, published by CRC Press, Taylor and Francis Group, 2010 ISBN 978-0-8493-9564-2
Prerequisites: Physics for Scientists and Engineers: **PHYS 1061 and PHYS 1062**

General information: This materials science course will cover broad spectrum of topics including: modern semiconductors, magnetic and optical materials which are commonly used in electronic devices. The discussion of the physical properties of these materials which are central to operation of modern electronic devices will be enriched by interesting real-world examples. Applications include diodes, transistors, microprocessors, CCD cameras, computer memories, Blue-Rays, solar cells and LED TV screens, lasers. The course will not require deep knowledge of quantum mechanics; however it will use results of quantum mechanical calculations, such as energy bands. Therefore, calculus-based general physics courses should be sufficient to be successful in this course.

Additional requirement for Phys-5901 students

- Graduate students taking 5901 class will receive more advanced topics for their presentations than the undergraduates. They will be required to search literature to find materials for their presentation. Time of their presentation will be doubled as compared to the students who take 4901 class.
- In addition, on the test and exams the graduate students will be required to solve problems with higher degree of complexity than the undergraduate students.
- Graduate students will receive additional homework problems which take advantage of their knowledge of quantum mechanics and computer programming.

Learning outcomes (4901 course students): All students attending this course will receive a solid background in condensed matter physics and technology of materials and devices made from these materials. They will have good understanding of the various properties of materials and principles of operation of electronic devices. They will be able to use advanced mathematical techniques and computer programming to evaluate these properties and design electronic devices.

Learning outcomes (5901 course students):
In addition, graduate students will learn to search, comprehend and analyze scientific articles.
They will also have deeper understanding of the materials science which includes quantum mechanical effects. They will be able to analyze and design simple electronic devices, such as transistors or solar cells.

Grading policy: The grade will be determined by student's performance on homework assignments, one project, two 1-hour tests and a comprehensive 2-hour final exam. The project will require literature study followed by a presentation on selected topic on materials science. Also, student's attendance will be taken into account during final evaluation. If you know in advance you will have problems with attending tests or the final exam you should document this fact and let me know as soon as possible.
Additional requirement for 5901 students

Grade Division:		**Grading Scale**:	
Participation	5%	A	89-100 %
Project	10%	B	75-88 %
Homework	35 %	C	60-74 %
Test#1	15 %	D	50-59 %
Test#2	15 %	F	below 50 %
Final Test	20 %		

Academic dishonesty: Students who violate the standards of honest academic conduct are subject to disciplinary action. If you have any questions about the definition of academic dishonesty, you should consult UNO Student Handbook (or similar documents at two participating universities)

Special Needs: At UNO, we make every effort to accommodate students with special needs. If you have special needs, you should contact Office of Disability Services at 280-7327

Please, check syllabus attachment on Moodle for more information on policies and procedures.

Class schedule PHYS 4901-001/5901-001, Fall 2015

#	Date	Day	In Class Activities	Chapter
1	Aug 19	Wed	Introduction to the Course	
2	Aug 21	Fri	Classification of materials	1
3	Aug 24	Mon	Crystal structures	1
4	Aug 26	Wed	Defects in materials	1
3	Aug 28	Fri	Electrical conduction in metals	2
5	Aug 31	Mon	Microstructure and conductivity	2
6	Sep 2	Wed	Quantum theory of conductivity	2
7	Sep 4	Fri	Intrinsic semiconductors	3
8	Sep 7	Mon	**No class - Labor Day**	
9	Sep 9	Wed	Band structure	3
10	Sep 11	Fri	Extrinsic semiconductors	3
11	Sep 14	Mon	Temperature dependence of conductivity	4
12	Sep16	Wed	Fermi energy levels in semiconductors	4
13	Sep 18	Fri	P-N Junctions	5

14	Sep 21	Mon	Depletion zone	5
15	Sep 23	Wed	Diodes	5
16	Sep 25	Fri	Review and catch-up	
17	Sep 28	Mon	**Test #1**	
18	Sep 30	Wed	Schottky diodes	6
19	Oct 2	Fri	Light emitting diodes and solar cells	6
20	Oct 5	Mon	Bipolar junction transistor	6
21	Oct7	Wed	Field effect transistors	6
22	Oct 9	Fri	MOSFET and MESFET	6
23	Oct 12	Mon	Dielectrics	7
24	Oct 14	Wed	Electronic and optical polarization	7
25	Oct 16	Fri	**No class – Semester Break**	
26	Oct 19	Mon	Frequency dependence of the dielectric constant	7
27	Oct 21	Wed	Losses in dielectrics	7
28	Oct 23	Fri	Ferroelectrics	8
29	Oct 26	Mon	Review and catch-up	
30	Oct 28	Wed	**Test #2**	
31	Oct 30	Fri	Project Presentations	
32	Nov 2	Mon	Project Presentations	
33	Nov 4	Wed	Piezoelectrics	8
34	Nov 6	Fri	Applications of ferroelectrics	8
35	Nov 9	Mon	Origin of magnetism	9
36	Nov 11	Wed	Classification of magnetic materials	9
37	Nov 13	Fri	Magnetic anisotropy	9
38	Nov 16	Mon	Magnetic domains and hysteresis	9
39	Nov 18	Wed	Magnetostriction	9
40	Nov 20	Fri	Soft magnetic materials	9
41	Nov 23	Mon	Permanent magnets	9
42	Nov 25	Wed	Magnetic storage materials	9
43	Nov 27	Fri	**No class- Thanksgiving**	
44	Nov 30	Mon	Superconductors	Other resources
45	Dec 2	Wed	Amorphous and nanomaterials	Other resources
46	Dec 4	Fri	Review and catch-up	
47	Dec 9	Wed	**Final exam 7:30AM - 9:30 AM room SC 2068**	comprehensive