Phys 250 Introduction to Nanoscience: Materials and Engineering Fall 2018

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Office Hours: MWF 10.30-11.30; T Th 1.30-2.30 pm; Additional Hours: By Appointment

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Lectures: Block 5 – MWF 1:10-2:10 pm
Required Textbook: Materials science and Engineering: An introduction by William Callister, 8th Ed, Wiley Publishers **Recommended:**

- *Electronic Properties of Materials,* Rolf Hummel, 2nd Edition, Spring-Verlag
- *Nanophysics and Nanotechnology*, Edward Wolf, 3rd Edition, 2017

Overview: An introduction to the physics of materials including the collective behavior of atoms and molecules, crystal structure, mechanical, electrical, magnetic properties of metals, electronic materials, composites, and nanostructures.

Learning Objectives: By the end of this course, successful students will be able to
• describe solid materials in terms of their interatomic forces and bonds
• describe crystals in terms of lattice structures and dynamics
• describe diffusion principles and phase transformation in materials
• explain the theory of semiconductors and provide common examples and their use
• understand the role of nanomaterials for future applications

Expectation: Students are expected to put in a minimum of 12 hours/ week work inclass and outside the class in order to successfully complete this course.

Homework: Homework will be assigned weekly, typically on Wednesday, and due at the beginning of class on the announced due date. I will follow the homework policy of physics group. Assignments that are due one week late from the deadline will be worth 50%, two weeks late will be worth 0%. One low homework score will be dropped.

In-Class Activity: You will also be required to complete problems assigned in class. In addition, you must participate in discussions of case studies, journal articles, latest trends in materials science and technology. The evaluation for in class activity will be based on individual participation as well as participation as a team.

Design Problems: Approximately every two weeks, you will tackle some design issues relating to the topics you have covered in class, and you have to come up with a creative solutions for design problems. These can be physical design solutions or analytical solutions or theoretical solutions. You will have approximately two weeks to work on the solutions and present it to the class as a team.

Team Roles: The class will be divided into three teams, viz., **Team FCC, Team BCC and Team HCP**. On each team activity, your team should designate a ***coordinator*** to organize work sessions, make sure everyone knows where and when to meet and understand who is supposed to be doing what, a ***recorder*** to prepare and turn in papers/presentations, and/ a ***checker*** to check the research and the strategies used to prepare the discussion document. The team roles must rotate on every activity – once a team member has carried a role, he/she may not do it again until everyone else on the team has done it. If a team is unhappy with the performance of a non participative member, he/she can be fired from the team. If you get fired, you will lose points.

MCSP Colloquium Series: You are required to attend at least 2 of the several talks as a part of the MCSP colloquia this semester. You should submit a 1 page reflection paper, using turn it in link before the end of last day of classes. Simply regurgitating the talk will get you only ½ the credit. MCSP credits, a maximum of 2 extra points, will be added to your final exam score. This can swing the needle between a + /-. Do not wait till the end of the semester to attend one of these talks, as you may run out of options. A schedule of this semester's talk can be found on MCSP webpage.

Quiz: There will be 10 minute long quizzes every week on the lecture material covered during the two week period. Announcement about the quiz will be made in the class.

Exams: There will be three mid-term exams, indicated in your syllabus. If you have any problems with these dates, **tell me soon**. There will also be a 3-hour final exam and will be a cumulative one.

Presentation: At the end of the semester you will give a 20 minute presentation as a team. Presentations topics will be related to applications of modern day materials. More information on this will be provided after Fall Break.

Grading:

Homework	10%
Mid-term Exams	30% (10% each)
Presentation (Team Project)	10%
Quiz	10%
In-class Activity	10%
Design problems	10%
Final Exam	20%

Your final letter grade will be determined based on your final numerical score as per the guidance below.

Points	Grade	Points	Grade
<60	F	76-79	C+

60-62	D-	80-82	B-
63-65	D	83-85	B
66-69	D+	86-89	B+
70-72	C-	90-94	A-
73-75	C	≥95	A

Attendance: It is your responsibility to show up for the lecture in a timely manner and complete all the work assigned in class. Should you have a medical condition/emergency situation/participation in a conference or sporting events representing the College, that you cannot attend the class, you must let me know immediately. Proper documentation (like doctor's note, court order, and schedule of conference/sports events) must be presented. **Just sending an email will not be sufficient.** You must meet with me in person. It is your responsibility to make up for the work that you missed. Inclass activities, quizzes, design problems cannot be made up if you are absent. I will not extend the deadline for turning in homework or other work assigned in the class unless you have my prior approval. If you miss more than 3 classes (both excused and unexcused), you will be dropped from the course with a grade of DF. A warning email will be sent to the registrar, and copies to your academic advisor when a third absence occurs. Absence also includes the following. ***If a student shows up for class 10 minutes late/walks out in the middle of the class/is caught napping/texting/checking social media/ playing games/ browsing internet/watching videos/ checking emails, he/she will be marked absent.*** Unless I authorize, students should refrain from all activities that cause unnecessary distractions. A physical presence alone does not construe as being present in the class. (Cell Phones can happily rest in the happy box or they can take a nice nap in your backpacks)

Class Disruption: All students are entitled to a professional learning environment. Students should not act in a manner which will distract and disrupt the class learning experience. Such practices will not be tolerated. **Cell-phones, gaming devices or any other electronic communication/entertainment devices must be turned off** at all times during the lecture period.

Academic Integrity: Policies of Academic integrity are enforced in all aspects of this course. It is the responsibility of the student to strictly adhere to the policies of Academic Integrity of Roanoke College.

Philosophy: My teaching philosophy is not to make you memorize equations but rather help you understand the Physics. Please talk to me if you have any problems understanding the materials presented. I will not usually offer help over phone/e-mail.

You can also use the resources offered by the **Goode-Pasfield Center for Learning and Teaching**

The Writing Center @ Roanoke College, located on the Lower Level of Fintel Library, offers tutorials focused on writing projects and oral presentations for students working in any field. Writers and presenters at all levels of competence may visit the Writing Center at any point in their process—including brainstorming, drafting, organizing, editing, or polishing presentation skills—to talk with trained peer tutors in informal, one-on-one sessions. The

Writing Center is open Sunday through Thursday from 4 to 9 pm. Simply stop in, or schedule an appointment by going to www.roanoke.edu/writingcenter, where our staff members and workshops are also posted. Questions? Email writingcenter@roanoke.edu or call 375-4949. Like our Facebook page for hours and event updates!

Subject Tutoring, located on the lower level of Fintel Library (Room 5), is open 4 pm – 9 pm, Sunday – Thursday. We are a Level II Internationally Certified Training Center through the College Reading and Learning Association (CRLA). Subject Tutors are highly trained Roanoke College students who offer one-on-one tutorials in a variety of general education and major courses such as: Business, Economics, Mathematics, INQ 240, Modern Languages, Lab Sciences, INQ 250, and Social Sciences (see all available subjects at www.roanoke.edu/tutoring). Tutoring sessions are available in 15, 30, or 45-minute appointments. Feel free to drop by for a quick question or make an appointment at www.roanoke.edu/tutoring for a longer one-on-one appointment. For questions or concerns, please contact us at 540-375-2590 or subject_tutoring@roanoke.edu.

Accessible Education Services (AES) is located in the Goode-Pasfield Center for Learning and Teaching in **Fintel Library**. AES provides reasonable accommodations to students with documented disabilities. To register for services, students must self-identify to AES, complete the registration process, and provide current documentation of a disability along with recommendations from the qualified specialist. Please contact Laura Leonard, Assistant Director of Academic Services for Accessible Education, at 540-375-2247 or by e-mail at aes@roanoke.edu to schedule an appointment. If you have registered with AES in the past and would like to receive academic accommodations for this semester, please contact Laura Leonard at your earliest convenience to schedule an appointment.

Diversity and Preferred Name/Pronoun Statement:
" I consider this classroom to be a place where you will be treated with respect, and I welcome individuals of all ages, backgrounds, beliefs, ethnicities, genders, gender identities, gender expressions, national origins, religious affiliations, sexual orientations, ability – and other visible and nonvisible differences. All members of this class are expected to contribute to a respectful, welcoming and inclusive environment for every other member of the class."
Course Plan: We will cover as much of the following material as possible.

Week	Date	Chapter	Topic	Chapter Sections
1	29-Aug	Ch 1	Introduction	
	31-Aug		Importance of Materials	1.3-1.6
2	3-Sep	Ch 2	Atomic Structure	2.1-2.4
	5-Sep		Bonding in Solids	2.5-2.6
	7-Sep		Secondary Bonding, Molecules	2.7-2.8

3	10-Sep		Applications	
	12-Sep		Video of nanomaterials	
	14-Sep		Design Problems (Ch 1 , 2)	
4	17-Sep	Ch 3	Crystal Structures	3.1-3.5
	19-Sep		Crystallographic Directions and Planes	3.9-3.12
	21-Sep		Crystallography	3.14-3.16
5	24-Sep	Ch 4	Imperfections in Solids- Point Defects	4.1-4.4
	26-Sep		Dislocations	4.5-4.8
	28-Sep		Exam 1 (Ch 1, 2, 3)	
6	1-Oct		Microscopic Examination	4.9-4.11
	3-Oct	Ch 5	Diffusion	5.1-5.3
	5-Oct		Non-steady state diffusion	5.4-5.5
7	8-Oct		Diffusion in materials	5.6-5.7
	10-Oct		Design Problems (Ch 4, 5)	
	12-Oct	Ch 6	Stress, Strain, Elastic Deformation	
8	15-Oct	**Fall Break - No Classes**		
9	22-Oct	Ch 6	Modulus of Elasticity	6.1-6.3
	24-Oct		Elastic Properties of Materials	6.4-6.5
	26-Oct		Plastic Deformation	6.6-6.9
10	29-Oct		Hardness and Materials Property	6.10-6.12
	31-Oct	Ch 9	Phase Diagrams	9.1-96
	2-Nov		Exam 2 (Ch 4, 5, 6)	
11	5-Nov	Ch 9	Binary phase diagrams	9.7-9.12
	7-Nov		Equilibrium Diagrams	9.13-9.14
	9-Nov		Microstructure evolution	9.18-9.20
12	12-Nov		Design Problems (Ch 6, 9)	9.18-9.20
	14-Nov	Ch 11	Ferrous and Non-ferrous Alloys and Fabrication	11.1-11.5

	16-Nov		Thermal Processing of Metals	11.7-11.9
13	19-Nov	Ch 18	Electrical Conductivity, Semiconductivity	18.1-18.6
	Thanksgiving Break - No Classes			
14	26-Nov		Semiconductors and devices	18.10-18.15
	28-Nov		Nanomaterials and Nanotechnology	
	30-Nov		Exam 3 (Ch 9, 11, 18)	
15	3-Dec		Applications of nanomaterials	
	5-Dec		Team Presentations	
	7-Dec		Review	
16	12-Dec	Wednesday	Final Exam (2:00 - 5:00 pm)	

Disclaimer: Everything above is subject to change with notice and, where appropriate, your approval.