

Physics 299**Materials Science/Nanoscience****Spring 2023**

Class Mtgs: MWF 10:50 AM - 11:50 AM

Office: Trexler 266D

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Instructor:

Phone:

Classroom:

Dr. Fatima

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Trexler 272

Office Hours & Location: W 1:00 PM – 2:00 PM & Th 9:00 AM – 12:00 PM (Trexler 266D/via zoom by appointment)

Course Description:

Developed examination on synthesis, properties and applications of nanomaterials and nanostructures.

Textbook & Materials:

Nanostructures and Nanomaterials: Synthesis, Properties and Applications,

Guozhong Cao

ISBN-13:9781860944154

Suggested Course Materials

Introduction to Nanoscience, S. M. Lindsay, Oxford ISBN 978-019-954421-9 (2010).

Required Prerequisites: MATH-118 OR MATH-121 and PHYS-201

Purpose of the Course:

Nanotechnology involves behavior and control of materials and processes at the size of sub nanometer to several hundred nanometers. This course introduces the student to the theoretical basis, experimental techniques and synthetic processes for nanostructures and nanomaterials. You will also gain experience in working with materials characterization techniques. I hope that, as you work through the challenging problems this semester, you will also come to appreciate the beauty and elegance of Materials Science and Nanoscience.

Intended Learning Outcomes:

1. learn and articulate the fundamental concepts of Nanomaterials synthesis, properties and application
2. solve challenging problems related to Materials Science and Nanotechnology
3. gain facility with materials characterization techniques
4. improve skill in presenting research to a group of peers

Feedback and Evaluation:

Letter grades will be assigned at the end of the semester according to the following scale

A-	90-92	A	93-100		
B-	80-82	B	83- 86	B+	87-89
C-	70-72	C	73- 76	C+	77-79
D-	60-62	D	63- 66	D+	67-69
F	<60				

Grades *may* be curved at the end of the semester (only upward, never downward) but otherwise you should expect your grade to follow the scale above. You will be assessed according to the following categories:

Problem Sets:	25%	Participation:	10%
Tests:	30%	Final Exam:	20%
Case Study:	15%		

Problem sets are due **at the start of class** on the due date. You will learn the material best by working and persevering with problems. I encourage you to discuss problem sets with other students, but you must not just borrow a problem solution from another student; you should write up the solution independently. Due to the nature of problem solving, I expect that you will work together *toward* a solution. However, I also expect that you will create an original solution to each assigned problem. Substitutions and simplifications should **NOT** be left to the “reader” (that’s me) to figure out. If necessary, words and phrases need to be properly placed so that I can follow your train of thought.

Participation will include, listening (and responding) to lectures, attentive attendance, engagement in question and answer, working on in-class problems, summaries of two MCSP Colloquium Talks, and responsibility for your own learning (office hours, etc.).

Case Study: During the last week of classes, you will teach a class on a research as part of a team of students. I will provide a list of suggested topics.

Tests 1 and 2 will cover lectures and problem sets. The tests will be given in-class.

The final exam will be comprehensive (i.e., cover the entire semester) and will also include conceptual questions.

MCSP Colloquium Series:

The MCSP department offers a series of discussions that appeal to a broad range of interests related to these math, computer science and physics. Members of this class are invited to be involved with all of these meetings; however, participation in **at least two** of these sessions is mandatory. Within **one week** of attending a colloquium you must submit (via Inquire) a one-page single-spaced paper reflecting on the discussion. This should not simply be a regurgitation of the content, but rather a personal contemplation of the experience.

General Attendance Policy:

You are expected to attend every meeting. If you are going to be absent, I must be notified in advance. You are accountable for all work missed because of an absence. Your fourth and each additional absence will result in a 2-point reduction in your final course grade. You get three freebies so that I don’t have to distinguish between excused and unexcused absences. College athletes will be afforded wiggle room; please come see me immediately if you are an athlete. If you should have an emergency that requires you to miss a large chunk of the course, please notify me ASAP.

Covid-19 Illness Attendance Policy:

If you have a temperature of 100.4 or higher or other COVID symptoms, don’t come to class. Call Health Services IMMEDIATELY. Do not come to class or go to any public area on campus. For your absence to be excused, you must give Health Services permission to notify me that you have consulted them about COVID symptoms. If Health Services informs you that you should isolate and not attend class for multiple days, inform me so that we can plan to keep you current in the course. All absences caused by consultation with Health Services about coronavirus symptoms or isolation ordered by Health Services will be excused but you will need to do the work and graded assignments even if we extend a deadline for you.

Masks:

The college is starting the term without a specific mask mandate. You are encouraged to wear mask. If the policy changes, I will update the syllabus.

Policy on Late Work:

I will grade an assignment with a 10% lateness deduction if turned in by 5:00PM on the due date. Following that, assignments will receive a further 10% lateness deduction for each successive day late (with days considered to end at 5:00 PM).

Make-up Tests:

Make-up tests will not be given. If you miss a test, and have an official college excuse for that absence, then your final exam grade will count for the missed test.

Academic Integrity:

The College academic integrity policies are vigorously enforced. Although you are encouraged to work in groups on your homework assignments, all work turned in for a grade must be your own. Please familiarize yourself with the College's academic integrity policies.

Disability Support Services:

Accessible Education Services (AES) is 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 Becky Harman, 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 Becky Harman at your earliest convenience to schedule an appointment and/or obtain your accommodation letter for the current semester.

Note: You should expect to spend a combined total of 12 hours per week (on average) on lecture, homework, and reading for PHYS 299.

Tentative Schedule:

Week	Date	Sections	Topic	Homework
			Introduction & Physical property	
1	16-Jan 18-Jan 20-Jan	1.1 – 1.2 1.3 – 1.4	Introduction, Emergence of Nanotechnology Bottom-up & Top-down approaches, Challenges in nanotech.	
	23-Jan	2.2	Surface energy	
			Synthesis of nanostructures	
2	25-Jan 27-Jan	3.2.3 3.2.4	Synthesis of metallic nanoparticles Synthesis of semiconductor nanoparticles	HW 1
3	30-Jan 1-Feb 3-Feb	3.5 4.2.1 4.2.2	Epitaxial Core-Shell Nanoparticles Evaporation (dissolution)-condensation growth <i>Vapor (or solution)-liquid-solid</i>	
4	6-Feb 8-Feb 10-Feb	4.5	Lithography <i>EXAM 1: IN-CLASS</i>	HW 2 & Review
5	13-Feb 15-Feb 17-Feb	5.3 5.4.1 –2 5.4.3– 4	Vacuum Science Physical Vapor Deposition (PVD) Physical Vapor Deposition (PVD)	
6	20-Feb 22-Feb 24-Feb	5.5 5.8 5.1	Chemical Vapor Deposition (CVD) Self-Assembly Electrochemical Deposition	HW 3
7	27-Feb 1-Mar 3-Mar	6.2	Carbon Fullerenes and Nanotubes <i>EXAM 2: IN-CLASS</i>	Review
8	6-Mar 8-Mar 10-Mar	Spring Break		
			Characterization of nanomaterials	

9	13-Mar	8.2	Structural Characterization	HW 4
	15-Mar	8.2	Structural Characterization	
	17-Mar	8.3	Chemical Characterization	
10	20-Mar	8.4	Physical Properties of Nanomaterials Electrical	
	22-Mar	8.4.4	conductivity	
			Application of nanomaterials	
11	24-Mar	9.2	Molecular Electronics and Nanoelectronics	Review
	27-Mar	9.6	Band Gap Engineered Quantum Devices	
	29-Mar		EXAM 3: IN-CLASS	
31-Mar				
12	3-Apr	9.8	Carbon Nanotube Emitters Photoelectrochemical	
	5-Apr	9.9	Cells	
	7-Apr	No Classes, Good Friday		
			Lab tour & Case study presentation	
13	10-Apr		Lab tour	HW 5
	12-Apr		Lab tour	
	14-Apr		Lab tour	
14	17-Apr		Lab tour	
	19-Apr		Case study presentation	
	21-Apr		Case study presentation	
15	24-Apr			Review
	28-Apr		FINAL EXAM: COMMULATIVE. (8:30AM – 11:30 AM)	

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