

Syllabus for NANOMATERIALS: (CHEM:5118:0001)

Fall 2019; Monday, Wednesday, Friday, 10:30-11:20 am in E215 CB

INSTRUCTION

Instructor: Prof. Amanda J. Haes (amanda-haes@uiowa.edu; (319) 384 – 3695)

Office/Office Hours Location: 238 IATL (initially in 204 IATL – I will let you know when this changes)

Office Hours: Mondays, 1:30-3 pm; Fridays, 8:30-10 am; by appointment as schedules permit

**Please note I will be traveling periodically throughout the semester. When this occurs, I will announce this in class and post updated office hours and class plans at least 48 hours in advance of any planned absence (under News on ICON). I have arranged for alternative activities, recorded lectures, and/or substitute instructors for lecture.*

***Guidance for communicating with me: Ask me questions! I am here to help you learn the course material, but learning is something you will need to do via studying and thinking. Use office hours to help me help you. Please come see me EARLY and OFTEN. Please know that if something is discussed in class, homework, and/or book; it has the potential of being on an exam. I will help you gauge importance throughout the semester.*

DEO: Prof. Len MacGillivray, Department of Chemistry; Office: E331 CB; Phone: 335-1341/335-1350

DESCRIPTION OF COURSE

Without nanomaterials, there is no nanotechnology. As such, this course will focus on the basic principles associated with nanoscience and nanotechnology including the fabrication and synthesis, size dependent properties, characterization, and applications of materials at nanometer length scales with an emphasis on recent technological breakthroughs in the field.

OBJECTIVES AND GOALS OF THE COURSE

Learning objectives for this course will focus on developing a fundamental understanding of the following topics as they relate to nanomaterials.

- **Motivation and Vision:** Feynman's vision, why use/explore new nanomaterials?
- **Synthesis, Fabrication, and Surface Energy:** Top down vs. bottom up techniques, nucleation theory, surface energy, and stabilization
- **Classification as a Function of Composition and Dimension:** Zero – two dimensional and assembled nanostructures, materials composition/function (metals, metal oxides, semiconductors, carbon, biological), analysis tools for composition, structure, porosity, crystallinity, and population
- **Size Dependent Chemical and Physical Properties:** Electrical, optical, catalytic, magnetic, thermodynamics
- **Implications, Ethics, and Safety:** Environment, health, and safety as well as impacts on policy, society, and education
- **Applications:** Electrical, optical, catalytic, magnetic, thermodynamic, purification, sensing, environmental remediation, biology, dentistry, medicine, alternative energy, etc.

TEXTBOOK AND OTHER RESOURCES

- *Nanostructures & Nanomaterials: Synthesis, Properties & Applications*, Guozhong Cao and Ying Wang, World Scientific (2011), ISBN: 13 978-981-4324-55-7 (pbk)
- See Relevant Reading Sections for detailed textbook and supplemental reading. All supplemental reading is posted on ICON for your convenience.
- If warranted, additional resources may be posted on ICON at least 1 week prior to discussion.

COURSE WEBSITE

<http://icon.uiowa.edu> Access with your username and password – lectures, homework, and up-to-date point totals will be available here. You will be required to submit assignments on this site.

HEALTH NOTE REGARDING FRAGRANCE, ODOR, SCENTS, AND FOOD ALLERGIES

Due to one or more individuals in this course having significant allergies to both mint and cinnamon, any food, gum, lotions, fragrances, or the like are prohibited from the classroom, discussion, and office hours. Failure to comply with the instructor's request regarding this issue may be subject to discipline with the Dean of Students Office.

EXAMS, ASSIGNMENTS, AND PERCENTAGE OF FINAL GRADE

Your course grade will be determined from the following elements:

- In class exams (2 x 100 points each) = 200 points (25 %)
- Cumulative final exam = 100 pts (12.5 %)
- Homework (2-3 assignments for a total of 100 points) = 100 points (12.5 %)
- Project (paper = 100 pt, presentation = 100 pt, peer assessments = 100 pts) = 300 points (37.5 %)
- Class participation/in-class and online activities = 100 points (12.5 %)
- **Total = 800 points**

Plus/minus grades will be appended to letter grades assigned. Exceptional performances will receive an A+.

CALENDAR OF COURSE ASSIGNMENTS AND EXAMS

Important Course Deadlines (Due at 10:30 am on the deadline date unless otherwise noted)

- Early TBD Homework Assignments (will be made available at least one week in advance)
- September 30 Project Topic Selection and Primary Literature Article Finalized
- October 14 Exam 1
- October 21 First but Complete Draft of Project Paper
- October 28 Peer Evaluations of Project Papers
- November 4 Final Draft of Project Paper
- November 18 Exam 2
- November 22 Project Presentation (Video and Slides)
- December 9 Peer Evaluations of Project Presentations
- TBD Cumulative Final Exam (A single, one-sided 8.5" x 11" page of *hand-written* notes is allowed. This page must be turned in with your final exam.)

A NOTE ON COLLABORATION

Homework should help you master knowledge in readings, lectures, and assignments. Collaboration is not allowed unless noted. Problems are turned in for credit and must represent your work and understanding. Sharing your completed work or asking others to see their completed assignments is considered academic misconduct. You are responsible for understanding this policy. Ask questions if you need clarification.

COURSE POLICIES

- A 3 hour class typically entails at least 2 hours of outside preparation for the average student for each hour spent in class. You are expected to study an additional 6 hours/week outside of class.
- Attendance on exam days is required. If you have to miss an exam, please notify me by electronically submitting the form [Reason for Absence from Class Form](#) via email. You will be allowed to make up *examinations* that have been missed due to illness, mandatory religious obligations, other unavoidable circumstances, or University activities as defined in the Operations Manual, section 8.1.
- Class participation points can only be earned by attending class. Only 10 out of ~15 activities need to be completed to earn full credit. Given this flexibility, make-up requests will not be considered.
- Make up exams must be scheduled BEFORE the original exam starts and taken within 48 hours of the originally scheduled exam time. Additional accommodations will be provided if warranted.
- 10 pts will be deducted/day for homework and will only be accepted within 48 hours after the due date.
- Re-grade requests will be considered 5 business days after their return. Only electronic or assignments completed in pen will be considered and must be accompanied by a written description of your request.
- Projects deliverables must be original work but can be related to your research if relevant. In other words, your project cannot be used to satisfy requirements in another course (past, present, or future). These assignments will be checked for plagiarism.
- Please silence and refrain from using all electronic devices for non-course purposes during class.
- Video recording, audio recording, or photography of lectures is not permitted unless explicitly authorized by the instructor. One warning will be given before points are deducted.
- Homework assignments will be posted on ICON and announced in class. Follow instructions carefully.
- You may find the Writing Center (<https://writingcenter.uiowa.edu/>) and the Speaking Center (<https://speakingcenter.uiowa.edu/>) very useful for this course.

COURSE TOPICS AND RELEVANT READING (presented in the following order).

Text book chapters are considered required reading. Unless noted, reading of all other material is optional but has been used to assemble lecture material.

Thanks to the University of Iowa's excellent electronic book collection and/or Google Books in the area of nanoscience and nanotechnology, all supplementary reading material is available to you for no additional cost. See ICON for details.

Additional material may be added throughout the semester.

1. Motivation & Vision (Unit 1)

- a. "There's Plenty of Room at the Bottom: An Invitation to Enter a New Field of Physics," Richard Feynman (*required reading*)
- b. "What is Nanotechnology?" Nanotechnology - An Introduction, ISBN: 9780080964478, Chapter 1, pages 1-14.

2. Synthesis, Fabrication, & Surface Energy (Unit 2)

- a. Chapters 1, 2, 3, 7
- b. "Phase Transformations in Metals: Development of Microstructure and Alteration of Mechanical Properties," Materials Science and Engineering: An Introduction, ISBN: 9780470419977, Chapter 10.3, pages 344-355.
- c. "Introduction," An Introduction to Interfaces and Colloids, ISBN: 9814299820, Chapter 1, pages 1-22.
- d. "Contrast between Intermolecular, Interparticle, and Intersurface Forces," Intermolecular and Surface Forces, ISBN: 9780123751829, Chapter 11, pages 205-222.

3. Tools for Characterizing Nanomaterials (Unit 3)

- a. Chapter 8
- b. "Analytical Instrumentation for Nanomaterial Characterization," Environmental Engineering Science (2013) 30, 101-108.

4. Dimensional Classification & Size-Dependent Chemical & Physical Properties (Unit 4)

- a. Chapters 3, 4, 5, 6, 8.4-8.5, 9
- b. "Semiconductor Clusters, Nanocrystals, and Quantum Dots," *Science* (1996) 271, 933.
- c. "Introduction to the Physical and Chemical Properties of Gold," Gold Nanoparticles for Physics, Chemistry, and Biology, ISBN: 1848168071, Chapter 2, pages 29-42.
- d. "What are Plasmon Resonances?" Plasmon Resonances in Nanoparticles, ISBN: 9814350664, Chapter 1.1, pages 1-7.

5. Implications, Ethics, & Safety of Nanomaterials (Unit 5)

- a. "Size Matters When it Comes to Safety- Report Warns," *Nature* (2004) 430, 599.
- b. "What about Toxicity and Ecotoxicity of Gold Nanoparticles?" Gold Nanoparticles for Physics, Chemistry, and Biology, ISBN: 1848168071, Chapter 12, pages 333-353.
- c. "Nanomaterials and the Environment," Nanoscience and Nanotechnology: Environmental and Health Impacts, ISBN: 9780470081037, Chapter 1, pages 1-14.
- d. "Design of a Primitive Nanofactory," *Journal of Evolution and Technology* (2003) 13.
- e. "NanoEHS: defining fundamental science needs: no easy feat when the simple itself is complex," *Environmental Science Nano* (2016) 3, 15-27 (DOI: 10.1039/C5EN00112A).

6. Applications of Nanomaterials (Your Interests/Your Projects)

- a. Chapter 9
- b. Your projects

University of Iowa and College of Liberal Arts and Sciences (CLAS)
Teaching Policies & Resources

ABSENCES AND ATTENDANCE. Students are responsible for attending class and for contributing to the learning environment of a course. Students are also responsible for knowing their course absence policies, which will vary by instructor. All absence policies, however, must uphold the UI policy related to student illness, mandatory religious obligations, including Holy Day obligations, unavoidable circumstances, or University authorized activities (<https://clas.uiowa.edu/students/handbook/attendance-absences>). Students may use this absence form to aid communication; the instructor will decide if the absence is excused or unexcused (<https://clas.uiowa.edu/sites/default/files/ABSENCE%20EXPLANATION%20FORM2019.pdf>).

ACADEMIC INTEGRITY. All undergraduates enrolled in courses offered by CLAS have, in essence, agreed to the College's [Code of Academic Honesty](#). Misconduct is reported to the College, resulting in suspension or other sanctions, with sanctions communicated with the student through the UI email address (<https://clas.uiowa.edu/students/handbook/academic-fraud-honor-code>).

ACCOMMODATIONS FOR DISABILITIES. UI is committed to an educational experience that is accessible to all students. A student may request academic accommodations for a disability (such as mental health, attention, learning, vision, and physical or health-related condition) by registering with Student Disability Services (SDS). The student is then responsible for discussing specific accommodations with the instructor. More information is at <https://sds.studentlife.uiowa.edu/>.

ADMINISTRATIVE HOME OF THE COURSE. CLAS is the administrative home of this course and governs its add/drop deadlines, the second-grade-only option, and related policies. Other colleges may have different policies. CLAS policies may be found here: <https://clas.uiowa.edu/students/handbook>.

COMMUNICATION AND THE REQUIRED USE OF EMAIL. Students are responsible for official correspondences sent to the UI email address (uiowa.edu) and must use this address for all communication within UI ([Operations Manual, III.15.2](#)).

COMPLAINTS. Students with a complaint about an academic issue should first visit with the instructor or course supervisor and then with the Chair of the department or program offering the course; students may next bring the issue to the College of Liberal Arts and Sciences. For more information, see <https://clas.uiowa.edu/students/handbook/student-rights-responsibilities>.

FINAL EXAMINATION POLICIES. The final exam schedule is announced around the fifth week of classes; students are responsible for knowing the date, time, and place of a final exam. Students should not make travel plans until knowing this information. No exams of any kind are allowed the week before finals. Visit <https://registrar.uiowa.edu/final-examination-scheduling-policies>.

NONDISCRIMINATION IN THE CLASSROOM. UI is committed to making the classroom a respectful and inclusive space for all people irrespective of their gender, sexual, racial, religious, or other identities. Toward this goal, students are invited to optionally share their preferred names and pronouns with their instructors and classmates. The University of Iowa prohibits discrimination and harassment against individuals on the basis of race, class, gender, sexual orientation, national origin, and other identity categories set forth in the University's Human Rights policy. For more information, contact the Office of Equal Opportunity and Diversity (diversity.uiowa.edu).

SEXUAL HARASSMENT. Sexual harassment subverts the mission of the University and threatens the well-being of students, faculty, and staff. All members of the UI community must uphold the UI mission and contribute to a safe environment that enhances learning. Incidents of sexual harassment must be reported immediately. For assistance, please see <https://osmrc.uiowa.edu/>.

These CLAS policy and procedural statements have been summarized from the web pages of the [College of Liberal Arts and Sciences](#) and [The University of Iowa Operations Manual](#).