UNIVERSITY OF CALIFORNIA, MERCED

MSE 118 – Introduction to Nanotechnology and Nanoscience

Fall 2017

Course Details:
Lecture meets Thursday 3:00 – 4:20 PM, CLSSRM 116
Discussion meets Thursday 4:30 – 5:30 PM, CLSSRM 116
Total units 3
Lectures/discussions will start promptly; *you are expected to arrive on time* to hear important announcements including the learning objectives for each lecture.

Instructor:
Professor Lilian P. Davila, Ph.D.
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Office hours: Thursday 11:00 am – 1:00 pm and by appointment

TA:
Xuan Wei, Graduate Student, xwei4@ucmerced.edu
Office and hours: AOA 142, Monday 2:00 – 3:00 pm and by appointment

I. Course Description:

An introduction for engineers in nanotechnology and nanoscience. Topics covered include nanoscale phenomena; nanofabrication (top-down and bottom-up approaches); and applications relevant to engineering, the physical sciences and biology. Interdisciplinary aspects of nanotechnology and nanoscience are discussed, including perspectives from materials science, chemistry, physics, and biology.

Moreover, computer simulations have been used in many disciplines to improve our understanding of different phenomena at the nanoscale. In particular, computational and novel methods have impacted nanoscience and nanotechnology research in recent years.

A term project will be developed throughout the term. Also, relevant cases studies will illustrate the variety of topics through contemporary research and presentations.

II. Course Goals and Learning Outcomes:

Course Goals: You will

- Gain basic knowledge in the synthesis of nanomaterials, their properties and characterization.
- Be able to apply basic knowledge of physics and materials science to develop proficient understanding of how nanoscale properties affect macroscale performance and enable new technologies such as:
  a) Energy harvesting and conversion, water purification;
  b) Electronics and photonics;
  c) Environmental monitoring and sensing and biomedicine.
- Acquire much needed critical thinking ability through reading assigned literature articles, online quizzes and participating in related discussions.

- Analyze contemporary studies. Be able to clearly communicate knowledge gained.

Learning Outcomes: You will

By the end of this course through readings, quizzes, discussions, interactions, project, presentations and exams demonstrate:

- Gain sufficient nanoscience and nanotechnology-related vocabulary to enable effective communication with practitioners in a diverse range of literature fields, including materials science and engineering, biomaterials, solid state physics, mechanical engineering, electrical engineering, materials chemistry and environmental engineering.
- Acquire general knowledge and techniques of how to synthesize nanomaterials and understand their nanoscale properties.
- Acquire insight into how macroscopic properties can be changed via molecular level engineering and nanoscale manipulation.
- Acquire fundamental knowledge of nanotechnology principles and applications.
- Obtain critical thinking skills through reading scientific (6-8) papers.
- Ability to critically evaluate current research literature in the field of materials science and engineering and nanotechnology.

The learning outcomes include:

- Graduates will demonstrate the ability to apply basic knowledge in chemistry synthesis and materials science to nanomaterials synthesis.
- Graduates will demonstrate the ability to apply key concepts in physics to understand nanomaterial properties.
- Graduates will gain appreciation for integrating knowledge from chemistry, physics, mechanical engineering and electrical engineering for design, synthesis and applications of nanomaterials for social welfare and economic growth.
- Graduates will demonstrate the ability to identify current nanotechnology solutions to address societal challenges.
- Graduates will demonstrate enhanced ability in science literature reading and self-learning abilities and developing the ability of acquiring new knowledge through reading and writing.
- Graduates will demonstrate professional and ethical responsibility.

You will practice related skills – in homework, quizzes and discussions. You will demonstrate your proficiency formally in examinations and final project report.

III. Format and Procedures:

This course is structured as follows: weekly interactive sessions where lectures, discussions, project, presentations and exams will take place. Punctuality, attendance, active participation and respectful behavior are expected from all students.

Use of electronic devices during class is disruptive and a discourtesy to fellow students and the instructor, and detracts from the learning environment. Students are requested not to operate electronic devices in the classroom other than for purposes related to the course (note-taking, entry of due dates into a PDA, etc.). Violations of this policy will result in confiscation of the device by the instructor for the duration of the class session. Repeated violations will result in referral for academic discipline.

Lectures (preparation & participation)
Prepare by reading assigned sections for the lecture. Each lecture will begin promptly thus be sure to be on time, a short reading pop-quiz consisting of definitions, key ideas or concepts will be due before each lecture as per schedule. Lectures will be interactive – ask questions, participate in lectures and discussion. Lectures will include writing on whiteboard, PowerPoint slides and the use of selected websites in the Internet. *I will do my best to post promptly class materials on the course website via CatCourses*. Bonus points may be awarded for exceptional student participation.

Discussions (preparation & participation)
Punctuality, attendance, active participation and thoughtful work are rewarded in this course. You will review material and case studies provided by the instructor. Bring discussion materials and notes to class.

Project (write-up and presentation)
Each student will develop a project a using resources available to the class. Each student will submit a term paper and present his/her project to the class at the end of the semester.

IV. My Assumptions:

This course builds on the assumption that students took ENGR 45 (Introduction to Materials). Students are responsible for reviewing basic concepts taught in ENGR 45 as needed to understand material presented in this class. Students are expected to exercise intellectual independence in consulting materials outside the class in order to strengthen the depth and breadth of their understanding. Supplemental resources may include consulting other textbooks, Wikipedia, and materials science learning modules on the web that are hosted by professional societies or universities. I believe that to effectively learn the content presented in this course, the students need to prepare for the lectures via the assigned reading material, participate actively, analyze case studies via critical thinking, work diligently on their project and use the instructor's office hours effectively.

V. Course Requirements and Grading Procedures:

Reference textbooks and articles:
The scope of this class is not covered by any textbook. Your class notes will be your primary source of reference materials. In addition, readings from research literature will be assigned. Two reference books and articles:

- *Fundamentals of Nanotechnology* by G. Hornyak
- *Introduction to Nanoscience* by Stuart Lindsay
- Several cases studies in the form of journals will be provided by the instructor

Homework assignment, online quizzes and discussions:
Homework is a critical component of this course and is designed to help you learn, understand and practice the material. Homework (readings) will be due on the dates indicated in the detailed schedule provided to students in the syllabus (see last page) or via Catcourses. Online quizzes will follow homework to be completed before class and to participate in discussions. **Hence, late homework will not be accepted.**

Exams: There will no make-up exams. See Course Policies below for details.

Required attendance and participation in lectures and discussions:

a. Regular attendance is expected.
b. Complete all assigned readings before class.
c. Participate in discussions and classroom activities.
d. Turn in completed assignments on time. No late work will be accepted.
e. **Make at least one visit to instructor's office hours per week.**
f. For term report, review drafts with writing tutors on campus for feedback.

Course Policies:

1. **Turn in completed assignments in class. No late work will be accepted.**
2. **No make-up exams will be given.** Missed exams will be prorated, provided the absence was due to illness documented by a physician's statement.
3. Unless you are instructed otherwise, you may discuss assignments and project topics with other students in the class, but submitted work must be your own. The UCM Code of Academic Conduct will be strictly enforced (see below).
4. Students are expected to abide by the UC Merced Principles of Community (see http://ucmerced.edu/principles-of-community).

Grading:

The table below summarizes the weight and total points for each portion of the course. All scores will be posted on CatCourses. It is your responsibility to check that scores are recorded accurately.

Element of Course	**Percentage (Approx.)**
Homework/Online Quizzes/Participation	25%
Exam 1	25%
Exam 2	25%
Project: Write-up & Presentation	25%
Total	**100%**

Grading Scale: The flavor of letter grade (+, even, -) will be decided by the instructor when exams and remainder grades are assigned, based on the student performance throughout the semester. Thus, grades will not be assigned on a curve but on your work.

Percentage of Course Points (Approx.)	**Number of Course Points**	**Grade**
> 80 %	> 800	A-, A, A+
60-79%	600 - 790	B-, B, B+
40-59%	400 - 590	C-, C, C+
30-39%	300 - 390	D
< 30%	< 300	F

VI. Academic Integrity:

a. **Each student in this course is expected to abide by the University of California, Merced's Academic Honesty Policy.** Any work submitted by a student in this course for academic credit will be the student's own work. For this course, collaboration is allowed in the following instances: discussions and project.

b. You are encouraged to study together and to discuss information and concepts covered in lecture and the sections with other students. You can give "consulting" help to or receive "consulting" help from such students. However, this permissible cooperation should never involve one student having possession of a copy of all or part of work done by someone else, in the form of an e mail, an e mail attachment file, a diskette, CD or a hard copy. ***Should copying occur,*** *both the student who copied work from another student and the student who gave material to be copied will both automatically receive a zero for the assignment*. Penalty for violation of this Policy can also be extended to include failure of the course and University disciplinary action.

c. During **examinations**, you must do your own work. Talking or discussion is not permitted during the examinations, nor may you compare papers, copy from others, or collaborate in any way. *Any collaborative behavior during the examinations will result in failure of the exam, and may lead to failure of the course and University disciplinary action*.

d. The **Academic Honesty Policy** is available online at the Office of Student Life: http://studentconduct.ucmerced.edu/sites/studentconduct.ucmerced.edu/files/page/documents/academic_honesty - 800.pdf under UCM Academic Honesty Policy. A practical handout can be found at: http://studentlife.ucmerced.edu/files/page/documents/integrity.pdf

e. Note that most of the handouts provided in this course are protected by copyright, and are flagged accordingly on CatCourses. They are for your *personal* use only. Re-posting the files or their contents on sites is an explicit violation of this copyright.

VII. Accommodations for Students with Disabilities:

The University of California Merced is committed to ensuring equal academic opportunities and inclusion for students with disabilities based on the principles of independent living, accessible universal design and diversity. I am available to discuss appropriate academic accommodations that may be required for student with disabilities. Requests for academic accommodations are to be made during the first three weeks of the semester, except for unusual circumstances. Students are encouraged to register with Disability Services Center to verify their eligibility for appropriate accommodations.

VIII. Tentative Weekly Schedule: *Subject to Change* to accommodate for necessary adjustments (i.e. guests, student needs, cancelled classes, etc.) over the course of the semester. *The CatCourses site will be used for any changes, announcements and related*.

Wk.	Dates	Topics & Learning Goals	Homework: Assigned Readings, Other	Assessments: Online Quizzes, Discussion, Exams, Final Project
1	Aug 31	Introduction/logistics ---- Class overview/Why nano	None	None
2	Sept 7	Background (props & appls.) ------- Literature research/project	**Reading#1 Due** ---- Demo	**Online Quiz#1 Due** ---- Discussion
3	Sept 14	Electrochemical storage & electrocatalysis ---------- Case study/guest speaker	None	None
4	Sept 21	Electrochem/electrocat (cont.) ---------- Case study/guest speaker	**Reading#2 Due** ---- Discussion	**Online Quiz#2 Due** ---- Discussion
5	Sept 28	**Exam 1 Due (1 hr)** ---------- Nanomaterials synthesis methods	None	**Exam 1 Due (1 hr)**
6	Oct 5	Synthesis methods (cont.) ---------- Case study/guest speaker	**Reading#3 Due** ---- Discussion	**Online Quiz#3 Due** ---- Discussion
7	Oct 12	Synthesis methods (cont.) ---------- Case study/guest speaker	None	None
8	Oct 19	Synthesis methods (cont.) ---------- Case study/guest speaker	**Reading#4 Due** ---- Discussion	**Online Quiz#4 Due** ---- Discussion
9	Oct 26	Clean energy ---------- Case study/guest speaker	None	None
10	Nov 2	Clean energy (cont.) ---------- Case study/guest speaker	**Reading#5 Due** ---- Discussion	**Online Quiz#5 Due** ---- Discussion
11	Nov 9	Clean energy (cont.) ---------- Case study/guest speaker	None	None
12	Nov 16	**Exam 2 Due (1 hr)** ---------- Clean energy/case study	None	**Exam 2 Due (1 hr)**
13	Nov 23	*Thanksgiving Week*	*No class*	*No class*
14	Nov 30	Nanomechanics, nanophotonics, nanoelectronics ---------- Case study/guest speaker	None	None
15	Dec 7	Nanomechanics (cont.) ---------- Case study/guest speaker	**Reading#6 Due** ---- Discussion	**Online Quiz#6 Due** ---- Discussion
16	Dec 11	6:30 – 9:30 pm, CLSSRM 116	None	Write-up due In-class presentation