NCSU Department of Materials Science and Engineering
MSE 490C and 791C: Introduction to Nanomaterials
Spring 2009, MW, 10:40-11:55 am, EB2-1230

Instructors:	**Dr. Joe Tracy**	**Dr. Jay Narayan**
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On-Campus Office Hours:	Thursday, 3:00-4:00 pm Other times by appointment.	TBA
Engineering Online Office Hours:	Thursday, 4:00-5:00 pm EST Other times by appointment.	TBA

During EOL office hours, the instructors will give priority to responding to distance-education students' questions. Email and the message boards are the preferred means of communication, but telephone calls are fine too. Because the instructors cannot answer multiple phone calls simultaneously, prearranged telephone appointments during or outside of office hours are the most reliable way to plan for a telephone conversation.

Email Policy:
The instructors usually receive more Email each day than they can immediately respond to. Your instructors will make sincere efforts to respond to Emails within 12-24 hours.

Prerequisites: MSE 490: MSE 201 or equivalent, or permission of instructor.
MSE 791C: Graduate standing and a BS in engineering or the physical sciences is required.

Course Description:
Introduction to nanoparticles, nanotubes, nanowires, and nanostructured thin films, emphasizing their synthesis, structural and property characterization, novel physical and chemical properties, applications, and contemporary literature.

Course Objectives: Students who complete this course will be able to:

- Describe methods for fabricating nanoparticles, nanotubes, nanowires, and nanostructured thin films.
- Describe the physical properties of nanomaterials.
- Describe tools for structure and property characterization of nanostructures.
- Describe applications for nanomaterials.
- Use literature resources for further self-guided learning about nanoscale materials.

Electronic textbooks are available through NCSU libraries and have been posted to the course website:
Kenneth J. Klabunde: *Nanoscale Materials in Chemistry*
Luis M. Liz-Marzán and Prashant V. Kamat: *Nanoscale Materials*
Günter Schmid: *Nanoparticles*: *From Theory to Application*
Jin Z. Zhang, Zhong-lin Wang, Jun Liu, Shaowei Chen, and Gang-yu Liu: *Self-Assembled Nanostructures*

Note about multiple courses and sections:
This syllabus covers three course sections with *common lectures and common exam times*. This combined undergraduate/gradate and on-campus/distance-education course provides opportunities for interactions among different groups of students but also requires clarification of additional logistical details. The three sections are:
MSE 490C-001: undergraduate students, on-campus
MSE 791C-001: graduate students, on-campus
MSE 791C-601: graduate students, distance-education course offered through Engineering Online at NCSU.
The following guidelines clarify the similarities and differences among the sections:

1. Both sections of MSE 791C (001 and 601) will have the same assignments and exams. These sections will be graded on a common scale.
2. MSE 490C will have a different set of assignments and exams from MSE 791C, but there will be substantial overlap. In MSE 490C, there is greater emphasis on the basic principles of nanomaterials and less emphasis on reading and analyzing reports of contemporary research in nanomaterials.
3. *Every policy described in the syllabus applies uniformly for all three sections, unless otherwise specified.*

Lecture and Exam Schedule:

Lecture	Date	Instructor	Topic
1	Jan. 7	Tracy	Why nanoscale materials? Overview, definitions, and examples. Top-down and bottom-up approaches.
2	Jan. 12	Tracy	Structurally Confined Materials: Thin Films, Islands, Nanowires, and Nanoparticles
3	Jan. 14	Tracy	Nanoscale Characterization: Electron Microscopy and X-Ray Techniques
	Jan. 19	**Holiday: Martin Luther King, Jr. Day**	
4	Jan. 21	Tracy	Chemical Approaches to Nanoparticle, Nanorod, and Nanotube Synthesis
5	Jan. 26	Tracy	Metal Nanoparticles: Fundamentals
6	Jan. 28	Tracy	Metal Nanoparticles: Applications
7	Feb. 2	Tracy	Self-Assembled Monolayers
8	Feb. 4	Tracy	Semiconductor Quantum Dots: Fundamentals
9	Feb. 9	Tracy	Semiconductor Quantum Dots: Applications
Exam 1	Feb. 11	Tracy	**Exam 1: Lectures 1-9**
10	Feb. 16	Tracy	Ceramic Nanomaterials: Fundamentals
11	Feb. 18	Tracy	Ceramic Nanomaterials: Applications
12	Feb. 23	Tracy	Fullerenes and Carbon Nanotubes and Nanofibers: Fundamentals
13	Feb. 25	Tracy	Fullerenes and Carbon Nanotubes and Nanofibers: Applications
	Mar. 2 & 4	**Spring Break**	
14	Mar. 9	Tracy	Magnetic Nanoparticles: Fundamentals
15	Mar. 11	Tracy	Magnetic Nanoparticles: Applications
16	Mar. 16	Tracy	Nanolithography: E-beam, Interference, Dip-Pen
17	Mar. 18	Tracy	Bionanomaterials (Guest lecture by Yaroslava Yingling)
18	Mar. 23	Tracy	Self-Assembly and Soft Lithography
19	Mar. 25	Tracy	Computational Nanomaterials (Guest lecture by Yaroslava Yingling)
20	Mar. 30	Tracy	Composite Nanomaterials and Applications
Exam 2	Apr. 1	Tracy	**Exam 2: Lectures 11-21**
21	Apr. 6	Narayan	Physical methods for nanostructures (thin film processing and self-assembly): (a) Fundamentals of vacuum science and technology (b) Thin film growth modes for nanolayers (c) Thin film growth modes for nanodots and self-assembly processing
22	Apr. 8		
23	Apr. 13		
24	Apr. 15	Narayan	Ion-implantation based methods for nanostructures: (a) Fundamentals of ion implantation (b) Non-equilibrium processing (c) Control of clustering kinetics and Ostwald ripening
25	Apr. 20		
26	Apr. 22	Narayan	Toxicology of Nanomaterials (Guest lecture by Nancy Monteiro-Riviere)
Final Exam	May 1, 8:00-11:00 am	Narayan	**Exam 3: Lectures 23-28**

Web Resources:

A course webpage will be maintained, where copies of the course syllabus, slides presented in class, homework sets, homework solutions, course textbooks, links to lectures, and other course material will be posted: http://engineeringonline.ncsu.edu/onlinecourses/coursehomepages/SPRING09/MSE791C.html

Attendance and Video Recordings:

On-campus students are expected to attend lectures and will be given access to the recorded lectures through the course webpage. *If this privilege is abused, access for on-campus students may be taken away at any time.*

Grading:

- Total grades will be computed out of a total of 100%: homework (20%), term paper (15%), and exams (65%).
- For each student, the two exams with the highest scores will each be worth 25% of the grade, and the remaining exam with the lowest score will be worth 15% of the final grade.
- Grades for each assignment will be recorded and available to students through Wolfware: http://courses.ncsu.edu/mse
- For computing final grades, the following grading scale will be used to determine your *minimum* grade for this course:

A+	**> 97**	**B+**	**88 – 89.9**	**C+**	**78 – 79.9**	**D+**	**68 – 69.9**	**F**	**< 60**
A	**92 – 96.9**	**B**	**82 – 87.9**	**C**	**72 – 77.9**	**D**	**62 – 67.9**		
A-	**90 – 91.9**	**B-**	**80 – 81.9**	**C-**	**70 – 71.9**	**D-**	**60 – 61.9**		

Homework:

Homework will normally be assigned on Monday and collected on the following Wednesday. Homework will usually be returned by the Wednesday after it was due. For on-campus students, homework is due *at the beginning of class* on its due date and will not be accepted by Email or by fax. *Late homework will only be accepted with a valid excuse*, such as defined here:
http://www.ncsu.edu/policies/academic_affairs/courses_undergrad/REG02.20.3.php

For distance education students, homework is due *on its due date by noon, EST*. The time when each homework assignment is received will be recorded. Distance-education students should use the cover sheet posted here:
http://engineeringonline.ncsu.edu/policiesandprocedures/homework_coversheet.pdf
For submission by Email, send homework as an attachment to homework_eol@ncsu.edu. For submission by fax, if you use pencil, make a photocopy of the homework with the contrast adjusted to make the text dark, and then fax the copy to (919) 515-8415.

You must work the homework problems yourself, but formation of study groups and use of the message boards is encouraged.

Exams:

For on-campus students, exams will be given during the 75 minute class period. Distance-education students will also have 75 minutes to complete each exam, and appropriate proctoring arrangements must be made with Engineering Online *in advance of the exams*. Distance-education students will not be allowed to take the exam, unless the proctor has been approved by Engineering Online. For Exams 1 and 2, distance-education students will have until 5:00 pm EST on Friday of the week when the exam is given in class to turn it in. For Exam 3, distance-education students must turn it in by 5:00 pm EST on May 1. No makeup exams will be given.

Message Boards:

All students are encouraged to use the message boards available through the course website to discuss and clarify the course material. Students are encouraged to post questions to the message boards. Discussion of specific solutions to homework problems on the message boards is prohibited, but discussion of underlying concepts is encouraged. The instructors may also choose to repost (anonymously) student questions and answers to the message boards.

University Policies:

All NC State University policies can be found at the following web page:
http://www.ncsu.edu/provost/academic_policies/index.html

Three of these policies are reprinted on the next page for your convenience:

Academic Integrity:
As a student enrolled in this class, you are expected to honor the NCSU policies regarding academic integrity found in the Code of Student Conduct at
http://www.ncsu.edu/policies/student_services/student_discipline/POL11.35.1.php

In this course, this policy applies primarily to cheating on exams and inappropriate collaboration on homework assignments, which will not be tolerated. Evidence of cheating on exams will automatically result in a grade of 0 on that exam, and additional penalties may also be applied, such as an F in the course or attendance at a judicial board for consideration of suspension. Students must sign the Honor Pledge ("I have neither given nor received unauthorized aid on this test.") on each exam. See the homework and message board sections for a discussion of collaboration on homework assignments.

If there are questions regarding any matter relating to the standards of academic integrity in this course or on a given assignment, they should be discussed with the instructor prior to doing any work. If any violation of the academic integrity policies is observed, please notify the instructor immediately. Once a violation has occurred, the case will be pursued through procedures outlined by the University.

Students with Disabilities:
Reasonable accommodations will be made for students with verifiable disabilities. In order to take advantage of available accommodations, students must register with Disability Services Office (http://www.ncsu.edu/dso/) located at 1900 Student Health Center, Campus Box 7509, 515-7653. For more information on NC State's policy on working with students with disabilities, please see the Academic Accommodations for Students with Disabilities Regulation at
http://www.ncsu.edu/policies/academic_affairs/courses_undergrad/REG02.20.1.php

Anti-Discrimination Statement:
NC State University provides equality of opportunity in education and employment for all students and employees. Accordingly, NC State affirms its commitment to maintain a work environment for all employees and an academic environment for all students that is free from all forms of discrimination. Discrimination based on race, color, religion, creed, sex, national origin, age, disability, veteran status, or sexual orientation is a violation of state and federal law and/or NC State University policy and will not be tolerated. Harassment of any person (either in the form of quid pro quo or creation of a hostile environment) based on race, color, religion, creed, sex, national origin, age, disability, veteran status, or sexual orientation also is a violation of state and federal law and/or NC State University policy and will not be tolerated. Retaliation against any person who complains about discrimination is also prohibited. NC State's policies and regulations covering discrimination, harassment, and retaliation may be accessed at http://www.ncsu.edu/policies/campus_environ or http://www.ncsu.edu/equal_op. Any person who feels that he or she has been the subject of prohibited discrimination, harassment, or retaliation should contact the Office for Equal Opportunity (OEO) at 515-3148.

Online Course Evaluations:
Online class evaluations will be available for students to complete during the last two weeks of class. Students will receive an email message directing them to a website where they can login using their Unity ID. All evaluations are confidential; instructors will never know how any one student responded to any question, and students will never know the ratings for any instructor.

Evaluation website: https://classeval.ncsu.edu
Student help desk: classeval@ncsu.edu
More information about ClassEval: http://www2.acs.ncsu.edu/UPA/classeval/index.htm