

Course syllabus

Fall Semester 2010

Department of Industrial Technology

University of Northern Iowa

Cedar Falls, IA 50614--0178

330:188g Nanotechnology Fabrication

Instructor: Dr. Nageswara Rao Posinasetti

Office: ITC Rm 35

Telephone: 273 6429

Email: posinasetti.rao@uni.edu

Office Hours: W 8:00 am - 12:00 p.m. or by appointment

Class Hours: Lecture: W 5.00 to 7.50 pm – ITC 7;

Lab: Arranged

Catalog Description

Developmental analysis of nano technological fabrication developments with a focus on nano particles, nano scale devices, production techniques, and their interdisciplinary applications in various industrial fields such as material science, manufacturing, physical sciences, electronic technology. Prerequisites: 860:148 or 880:148; Junior standing

Course Goals

Nanotechnology promises to be the technology of the future benefitting the humanity in a number of ways. This course is aimed at preparing students for further industrial or academic work in the field of nano manufacturing.

Course Objectives

The course content has been structured to help the student achieve the following objectives:

1. To gain an understanding of the principles of nanotechnology; characterization of nano structured materials; and tools and equipment for producing and assembling at the nano scale.
2. To acquire practical experience in the use of equipment used in nanotechnology such as AFM.
3. To cultivate interest in the research and development of nanotechnology for future advancement of the career.

Required Texts

1. Guozhong Cao (2004). *Nanostructures and Nanomaterials: Synthesis, Properties & Applications*, 448 pages, Imperial College Press, **ISBN-10:** 1860944159
2. Jeremy Ramsden (2009) – Nanotechnology, Ventus Publishing ApS, (download from <http://bookboon.com/us/student/chemistry>)

Reference Materials

1. Ratner, D. & Ratner, M. (2003). *Nanotechnology: A gentle introduction to the next big idea*. New Jersey: Pearson Education Inc, ISBN: 0131014005.
2. Charles P. Poole Jr. and Frank J. Owens (2003). *Introduction to Nanotechnology*, 400 pages, Wiley-Interscience, 1st edition, **ISBN-10:** 0471079359
3. Michael Quirk (2006). *Semiconductor Manufacturing Technology*, 704 pages, Prentice Hall; 2nd edition, **ISBN-10:** 0131130471

4. Dieter K. Schroder (2006). *Semiconductor Material and Device Characterization*, 800 pages, Wiley-IEEE Press; 3rd edition, **ISBN-10:** 0471739065, **ISBN-13:** 978-0471739067
5. John F Mongillo (2007), *Nanotechnology 101*, 304 pages, Greenwood Press, Westport, CT, ISBN: 0313338809.
6. Gabor L. Hornyak, H.F. Tibbals, Joydeep Dutta, and John J. Moore (2009). *Introduction to Nanoscience and Nanotechnology*, CRC Press, Boca Raton, 1574 pages, **ISBN 10:** 1420047795.

Internet Sources

ASME Nanotechnology Institute	http://www.nanotechnologyinstitute.org
EUSPEN (European Union Precision Engineering and Nanotechnology)	http://www.euspen.eu/
Foresight Institute	http://www.foresight.org/
Information on Nanotechnology	http://www.nanomagazine.com/
Institute of Nanotechnology	http://www.nano.org.uk/
National Nanotechnology Initiative	http://www.nano.gov/
Google Nanotechnology directory	http://www.google.com/Top/Science/Technology/Nanotechnology/
Information on Nanotechnology	http://www.nanowerk.com/
Nanocolors – the nanotech 2.0 hub	http://nanocolors.wordpress.com/
Swiss Nanoscience Institute	http://www.nanoscience.ch/nccr/
Nanotechnology Education	http://www.nano4me.org/
	http://nanoengineer-1.com/content/index.php?option=com_frontpage&Itemid=1
	http://nanozone.org/
Center of Integrated Nano mechanical Systems	http://mint.physics.berkeley.edu/coins/
Video on Nanotechnology	http://www.vega.org.uk/video/programme/3
IBM Research labs in Zurich	http://www.zurich.ibm.com/st/nanoscale/
European Nanotechnology gateway	http://nanoforum.org/
Toward Advanced Nanotechnology	http://e-drexler.com/index.html
AAAS	http://www.eurekalert.org/context.php?context=nano&show=background
Medical applications of nano	http://nano.cancer.gov/
Small Times magazine	http://www.electroiq.com/index.html
Carbon Nano Tubes	http://www.pa.msu.edu/cmp/csc/nanotube.html
International Council on Nanotechnology	http://icon.rice.edu/
Nanoparticle Information Library	http://nanoparticlelibrary.net/index.asp
Univ. of Sussex and Bristol, UK	http://www.nanofolio.org/win/
Nano Dictionary	http://pages.unibas.ch/colbas/ntp/NanoDictionary.pdf

Grading Policies:

Course grade will be based on the following components:

Examinations (3):	40%
Home assignments	50%
Class participation (Class work)	10%

Course Outline

Week	Description	Assignment submission	Reading
8/26	Introduction to the course, Historical perspective of micro and nano manufacturing technology, Advantages and applications of nanotechnology		Ch 1, 9
9/2	Materials overview, atomic structure, bonding, polymers, electrical characteristics, periodic table, crystal structures and defects, physical chemistry of solid surfaces, Introduction to Si-based materials, Ge-based materials		Ch 2
9/9	Overview of Nano Fabrication Methods: Top-down and bottom-up approaches, lithography, deposition, CVD, PVD, etching, and material modification methods, processes and equipment	Report 1	Ch 7
9/16	Characterization Tools, Optical microscopy, Profilometry, Ellipsometry, Spectrophotometer, Scanning Electron Microscope, AFM, FFM.		Ch 8
9/23	Zero dimensional Nano structures (Nano Particles) - Fabrication procedures, sol-gel processing, applications, properties and applications of Nano Particles	Report 2	Ch 3
9/30	Test 1		
10/7	One dimensional Nano structures - Nano wires and nano rods, fabrication methods, Properties and applications of Nano Wires	Report 3	Ch 4
10/14	Two dimensional nano structures		Ch 5
10/21	Top down fabrication procedures, Lithography, Pattern transfer methods, Wet Etching and Dry etching,	Report 4	Ch 7
10/28	Nano material characterization methods,		Ch 8
11/4	Application of nano materials, Carbon Nano Tubes, Quantum dots, etc., Organic compounds and bio-applications of nano materials	Report 5	Ch 6, 9
11/11	Test 2		
11/18	Class Presentations	Report 6	
11/25	Thanksgiving week		
12/1	Review		
12/8	Final Exam		

Grade scale:

Percentage range	Grade	Percentage range	Grade
95 – 100	A	74 – 76	C
90 – 94	A-	70 – 73	C-
87 – 89	B+	67 – 69	D+
84 – 86	B	64 – 66	D
80 – 83	B-	60 – 63	D-
77 – 79	C+	< 60	F

Course Requirements and Organization Lectures

Lectures will be given to describe the fundamental principles and concepts of nanotechnology fabrication. This will require attendance by every student. Attendance is required for all scheduled lectures and final presentation by graduate students. There will be lost of marks for students who absent themselves without prior permission.

Class Participation

This will require completion of weekly readings and active participation in class based on these readings. Occasionally, the instructor will provide activity sheet(s) on the presentation to facilitate intensive discussions in class. In addition, this will require participating in the final presentation to be made by graduate students.

Tests

Two (2) Tests will be given during the semester covering lectures and assigned readings. The tests will consist of multiple choice(s), and/or true or false answer and short answer formats. There will be no opportunity to make up missed tests.

Assignments

There shall be six (6) assignments/topics:

S No	Description	Submission date	Points
1	Introduction and Historical aspects of Nano	Sept. 9	6%
2	Special properties of Nano materials	Sept. 23	6%
3	Details of top down fabrication methods	Oct. 7	6%
4	Details of top bottom up fabrication methods	Oct. 21	6%
5	Advances in Nano characterization methods	Nov. 4	6%
6	Special topic related to any nano application methods assigned with a presentation	Nov. 18	20%

The report (about 8 to 10 pages in APA format) for each assignment must be produced from a computer word processing program. You must use this format:

- 1) Margins: 1" all around
- 2) Font: Garamond, New Times Roman, Arial (or similar) (10cpi or 12pt)
- 3) Print in "normal" or "high quality" mode (do not use draft or quick print mode).
- 4) Set up your report as an internal memo:

MEMORANDUM

DATE:	September 28, 2010 (<i>you may use Month, Date, Year format</i>)		
To:	Dr. N. R. Posinasetti, Professor		
FROM:	A. Student,	RE:	Project Name

- 5) Use *single* space in header and *double* space in body of document.
- 6) Staple in upper left corner.
- 7) Writing style can be in 1st or 2nd person. The narrative should be clear and concise.
- 8) Spell check and grammar check for accuracy.

Research/Term Paper

Graduate students are required to submit a research paper as part of the department policy. It is expected to be a detailed study and presentation of a topic relevant to the course content. The topic must be discussed with the instructor within two (2) weeks of commencement of class prior. The topic and a written brief, describing the topic should be submitted three (3) weeks after commencement of class for approval. The term paper, about 8-10 pages in APA format should be submitted on the day of presentation. Non- graduate students are to be present during the presentation. Questions in final examination may include some of the presentations.

Laboratory Demonstration.

Students will be exposed to practical operations, and experimental demonstrations of some of the equipment for Nano fabrication available in UNI. Students will produce a technical report on the experiences.

Final Examination

The final examinations will cover all topics covered during lectures, quizzes and presentations made by graduate students. The coverage for the examinations will be known prior to the examination.

Academic dishonesty: Cheating of any kind on examinations and/or plagiarism of papers or projects is strictly prohibited. Anyone caught passing off the work of others as their own (i.e., copying from a book/journal or cut and pasting from internet sources without appropriate citation) runs the risk of immediately failing the course and expulsion from the class and the University. For more institutional rules regarding academic dishonesty, please see the University catalogue on “Academic Ethics Policies” (<http://www.uni.edu/policies/301>).

Special needs: The Americans with disability Act of 1990 provides protection from illegal discrimination for qualified individuals with disabilities. Students requesting instructional accommodations due to disabilities must arrange for such accommodation through the Office of Disability Services. The ODS is located at 213 Student Services Center, and the phone number is (319) 273 2676.