Lectures: A combination of lectures and online lab activities are scheduled every week. The lecture topics outline shown at the end of this document is tentative, but it will closely follow the actual schedule on Angel.

Instructor: Terry Kuzma

Office hours: Tuesday morning 10:00-11:00 AM US ET.
E-mail to txk107@psu.edu will also be checked every business day and responses will be made within 24 hours.

Textbook:
Nanostructures & Nanomaterials; Synthesis, Properties & Applications.
by Guozhong Cao [ISBN 1-86094-480-9]

Semiconductor Manufacturing Technology

Course Objectives:
This course provides an overview of the materials, safety and equipment issues encountered in the practice of “top down” and “bottom up” nanofabrication. It focuses on environment, health, and safety (EHS) issues in equipment operation and materials handling. Topics to be covered include: cleanroom operation, OSHA lab standard safety training, health issues, and environmental concerns. Specific safety issues dealing with nanofabrication equipment, materials, and processing will also be discussed including those pertinent to biological materials, wet benches, thermal processing tools, plasma based equipment, optical, e-beam, vacuum systems and pumps, gas delivery systems and toxic substance handling and detection. Specific material handling procedures to be discussed will include corrosive, flammable, and toxic materials, biological materials, carcinogenic materials, DI water, solvents, cleaners, photo resists, developers, metals, acids, and bases. The course will also concentrate on safe and responsible equipment maintenance and operation. This aspect will be carried out as part of the equipment overview emphasizing EHS issues.
Topics Covered in this Course:

- OSHA lab standard safety training
- Gas and liquid materials handling, disposal, and detection
- Nanoscale particle handling and disposal
- Wet bench protocol
- Cleanroom protocol
- Materials overview
- Vacuum processing, operation principles of pumps, gauges, and hardware
- Wet processing summary and specific safety and environmental issues
- Plasma processing summary
- Physical vapor deposition summary
- Chemical vapor deposition summary
- Lithography processing summary
- Characterization tool summary

Examinations:

There will be six exams. The time allocation is listed for each exam.

Homework:

There will be four homework assignments. These assignments will be problem sets and will be due as noted in the syllabus below. Homework is answered in a time limited quiz format. You will be given the homework questions days before the homework quiz is due. Homework handed in up to 12 hours late will receive 30% off, homework handed in up to 24 hours late will receive 50% off. No homework will be accepted after 24 hours. You are responsible for checking to make sure that you have correctly submitted your homework on time. You will receive your grade and any comments back electronically.
Lab activities

There will be approximately six lab based exercises. These assignments will consist of watching or performing tasks and then evaluating the results. The lab activity results will be handed in electronically via the homework drop boxes on Angel. Lab activity reports handed in up to 12 hours late will receive 30% off, Lab activity reports handed in up to 24 hours late will receive 50% off. No lab activity reports will be accepted after 24 hours. You are responsible for checking to make sure that you have correctly submitted your assignments on time. You will receive your grade and any comments back electronically.

Grading:

The standard grading system will be used to assign final letter grades in the course

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<tr>
<th>Grade</th>
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<tr>
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Grading Rubric

Grades will come from three areas, tests, lab material, and homework. Currently tests are approximately 600 points, labs account for 230 points, and homework is worth 85 points. Of course these values could change, but this breakdown should be close.

Academic Honesty:

Students are encouraged to work together on homework assignments; however, original solutions are required. If cheating or copying is suspected, all students involved will receive a zero for that assignment. Cheating or plagiarism on any graded activity (homework or exam) will be penalized with a minimum of a zero points for the assignment, and up to a failing grade in the class. Any academic integrity violation report will be placed in the offender’s permanent files. If you are not familiar with what constitutes an academic integrity violation, read Penn State’s policies on the web site http://www.engr.psu.edu/CurrentStudents/acadinteg.asp.
Lecture Topics Covered:

- Course Introduction
- Safety and Environmental Concerns Chemicals safety
- Safety and Environmental Concerns Safety
- Safety and Environmental Concerns Safety Nano particles
- Safety and Environmental Concerns Environment
- Basic Characterization Tools
  - Optical Microscopy
  - Profilometry
  - Ellipsometry
  - Spectrophotometer
  - Scanning Electron Microscope (SEM)
- Vacuum Function, Operation and Systems
  - Vacuum Science
  - Deposition
  - Vacuum Hardware Training Video
  - Vacuum Simulator
- Materials Overview
  - Physical Chemistry
- General Processing Concerns, Contamination, and Damage