

Montgomery County Community College
 ESC 215
 Nanotechnology Applications
 3-2-2

COURSE DESCRIPTION

This course covers the applications of nano-scale devices and systems and the material chemical, physical, biological, or multiple-property requirements necessitated in these applications. Material modifications to meet these requirements will be addressed including structure control, composition control, surface property control, strain control, functionalization, and doping.

This course is designed to be one of six capstone courses (Esc 211, 212, 213, 214, 215, 216) for the Penn State Semiconductor Manufacturing Technology (SMT) program. The course is lab intensive, leveraging the Nanofabrication Facility on the University Park campus. All lectures will be given in a technology classroom, Suite 114 Lubert Bldg., Research Park. This classroom is dedicated to the Center for Semiconductor Manufacturing Technology and thus has a wide variety of very specialized, "hands-on" materials and facilities continually available to students. The course grade evaluation will use a mixture of tests, presentations, reports, and project assignments. Teaming and team problem solving will be stressed.

REQUISITES

Previous Course Requirements

- ESC 214 Patterning for Nanotechnology

Concurrent Course Requirements

None

LEARNING OUTCOMES Upon successful completion of this course, the student will be able to:	LEARNING ACTIVITIES	EVALUATION METHODS
1 . Obtain a better understanding of the interfacing of the various stages of the of the nanofabrication process through identification of those stages and their respective functions.	Lecture Group and individual skills training activities	Exams Projects Presentations Laboratory Activities

LEARNING OUTCOMES	LEARNING ACTIVITIES	EVALUATION METHODS
2. Apply skills in the development of micro- and nano-level circuitry.	Lecture Group and individual skills training activities	Exams Projects Presentations Laboratory Activities
3. Discuss the precision necessary in nanofabrication.	Lecture Group and individual skills training activities	Exams Projects Presentations Laboratory Activities
4. Safely and efficiently operate Oxidation, Implantation, Annealing, Diffusion, and Epitaxial growth equipment.	Lecture Group and individual skills training activities	Exams Projects Presentations Laboratory Activities

At the conclusion of each semester/session, assessment of the learning outcomes will be completed by course faculty using the listed evaluation method(s). Aggregated results will be submitted to the Associate Vice President of Academic Affairs. The benchmark for each learning outcome is that *70% of students will meet or exceed outcome criteria.*

SEQUENCE OF TOPICS

Topic 1	Lecture Labs	Introduction to thermal processes Review oxidation furnace
Topic 2	Lecture Discussion Labs	Surface preparations Pre-furnace wafer cleaning
Topic 3	Lecture Discussion Labs	Oxidation fundamentals-kinetics Field oxide growth
Topic 4	Lecture Discussion Labs	Oxidation fundamentals-measurements Lab 3 results (oxide furnace uniformity) Pad oxide for LOCOS

Topic 5	Lecture Discussion Labs	Ion implantation Lab 4 results (cross-wafer uniformity) Boron implant into n-type substrate
Topic 6	Lecture Discussion Labs	Rapid thermal annealing Activation of boron implant
Topic 7	Lecture Discussion Labs	Diffusion processes Lab 6 results Simulations for deep n-well
Topic 8	Lecture Discussion Labs	Epitaxial growth-silicon Phosphorous implant
Topic 9	Lecture Discussion Lab	Epitaxial growth-III-V, II-VI Lab 8 results

LEARNING MATERIALS

Textbook: Determined by Penn State

Instructor handouts

Guest speakers

Other learning materials may be required and made available directly to the student and/or via the College's Libraries and/or course management system.

COURSE APPROVAL:

Prepared by: William Brownlowe

Date: 4/11/2000

VPAA/Provost or designee Compliance Verification:
Brad Gottfried

Date: 4/20/2000

Revised by: William Brownlowe

Date: 9/24/2013

VPAA/Provost or designee Compliance Verification:
Victoria L. Bastecki-Perez, Ed.D.

Date: 6/11/2014

This course is consistent with Montgomery County Community College's mission. It was developed, approved and will be delivered in full compliance with the policies and procedures established by the College.