

Montgomery County Community College
 ESC 213
 Materials in Nanotechnology
 3-2-2

COURSE DESCRIPTION

This course is an in-depth, hands-on exposure to the producing and tailoring of the materials used in nanofabrication. The course will cover chemical materials production techniques such as colloidal chemistry; atmosphere, low-pressure and plasma enhanced chemical vapor deposition; nebulization; and atomic layer deposition. It will also cover physical techniques such as sputtering; thermal and electron beam evaporation; and spin-on approaches. This course is designed to give students experience in producing a wide variety of materials tailored for their mechanical, electrical, optical, magnetic, and biological properties.

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 Luber 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 mixture of tests, presentations, reports and project assignments. Teaming and team problem solving will be stressed.

REQUISITES:

Previous Course Requirements

- ESC 212 Basic Nanotechnology Processes

Concurrent Course Requirements

None

LEARNING OUTCOMES	LEARNING ACTIVITIES	EVALUATION METHODS
Upon successful completion of this course, the student will be able to:		
1. Obtain a better understanding of the interfacing of the various stages 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 deposition and etching procedures.	Lecture Group and individual skills training activities	Exams Projects Presentations Laboratory Activities
3. Discuss the various applications of deposition and etching.	Lecture Group and individual skills training activities	Exams Projects Presentations Laboratory Activities
4. Safely and effectively operate deposition and etching 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 Lab	Deposition processes overview
Topic 2	Lecture Lab	Chemical Vapor deposition (CVD) processes LPCVD nitride deposition
Topic 3	Lecture Lab	Chemical Vapor deposition (CVD) processes LPCVD oxide deposition
Topic 4	Lecture Lab	Chemical vapor deposition (CVD) processes LPCVD polysilicon deposition
Topic 5	Lecture Lab	Plasma Enhanced CVD ECR PERCVD demonstration

Topic 6	Lecture Lab	Physical vapor deposition: sputtering Sputter tool demonstration: tin oxide
Topic 7	Lecture Lab	Physical vapor deposition: thermal and e-gun evaporation Aluminum and Titanium deposition
Topic 8	Lecture Lab	Wet chemical etching Buffered Oxide Etch (BOE) rate determination
Topic 9	Lecture Lab	Plasma etching
Topic 10	Lecture Lab	Reactive Ion Etching (RIE) Metal etching in Plasmathcrm 720
Topic 11	Lecture Labs	High ion density reactors: dielectrics Oxide etching in Applied Materials MERIE
Topic 12	Lecture Lab	High ion density reactors: polymers
Topic 13	Lecture Lab	High ion density reactors: MEMs deep silicon Membrane Membrane release procedure

LEARNING MATERIALS

Textbook: Identified 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.