

MONTGOMERY COUNTY COMMUNITY COLLEGE

ESC 216

Characterization, Packaging, and Testing of Nanotechnology Structures and Materials
3-2-2

COURSE DESCRIPTION

This course examines a variety of techniques and measurements essential for testing and for controlling material fabrication and final device performance. Characterization includes electrical, optical, physical, and chemical approaches. The characterization experience will include hands-on use of tools such as the Atomic Force Microscope (AFM), Scanning Electron Microscope (SEM), 1 nm resolution field emission SEM, fluorescence microscopes, and Fourier transform infrared spectroscopy.

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

None

Concurrent Course Requirements

None

COURSE COMMENT

A Department recommendation, upon review of appropriate educational background, academic performance and personal interview are required for registration.

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
2. Apply skills in the testing and packaging of manufactured micro- and nano level circuits.	Lecture Group and individual skills training activities	Exams Projects Presentations Laboratory Activities
3. Discuss operation of the various test and packaging instruments used in nanofabrication manufacturing.	Lecture Group and individual skills training activities	Exams Projects Presentations Laboratory Activities
4. Safely and accurately operate nanofabrication test and packaging 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	Overview of process monitoring techniques
Topic 2	Lecture Lab	Plasma process monitoring: residual gas analysis (RGA), Optical emission spectroscopy (OES), laser interferometry

Topic 3	Lecture	Surface analysis techniques
	Lab	Tour of Materials Characterization Laboratory
Topic 4	Lecture	Ellipsometry and Profilometry
	Lab	Ellipsometry and Profilometry of oxide
Topic 5	Lecture	Oxide electrical characterization
	Discussion	C-V and I-V measurements
Topic 6	Lecture	Transistor characterization
	Lab	Curve tracer, Hp system
Topic 7	Lecture	Yield analysis techniques
	Lab	
Topic 8	Lecture	Electron Microscopy
	Lab	Surface and cross-section examination
Topic 9	Lecture	MEM and biomedical devices: characterization and testing
	Lab	
Topic 10	Lecture	Interconnect metalization
	Lab	Contact evaluation: ohmic vs. rectifying
Topic 11	Lecture	Planarization: CMP and etch back
	Lab	Photoresist, BPSG reflow
Topic 12	Lecture	Packaging: wire bonding, die bonding encapsulation
	Lab	Field trip
Topic 13	Lecture	Reliability Issues
	Lab	

LEARNING MATERIALS

Textbook: Per 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 Compliance Verification: B. 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.