MONTGOMERY COUNTY COMMUNITY COLLEGE

ESC 212

Basic Nanotechnology Processes

3-2-2

COURSE DESCRIPTION

This course is an overview of the broad spectrum of processing approaches involved in “top down”, “bottom up”, and hybrid nanofabrication. The majority of the course details a step-by-step description of the equipment, facilities processes and process flow used in today’s device and structure fabrication. Students learn to appreciate processing and manufacturing concerns including safety, process control, contamination, yield, and processing interaction. The students design process flows for micro- and nano-scale systems. Students learn the similarities and differences in “top down” and “bottom up” equipment and process flows by undertaking hands-on processing. This hands-on overview exposure covers basic nanofabrication processes including deposition, etching, and pattern transfer.

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 Curse Requirements

- ESC 211 Material Safety and Equipment Overview for Nanofabrication.

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 nanofabrication process through identification of those stages and their respective functions.	Lecture Group and individual skills training activities	Exams Projects Presentations Laboratory Activities
2. Describe processing of various materials used in nanofabrication.	Lecture Group and individual skills training activities	Exams Projects Presentations Laboratory Activities
3. Describe the various applications of nanofabrication.	Lecture Group and individual skills training activities	Exams Projects Presentations Laboratory Activities
4. Reinforce the importance of safe and accurate operation of nanofabrication manufacturing 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	Materials overview Evaporator training
Topic 2	Lecture Lab	p-n junction diode process flow electrical characteristics: curve tracer, I-V, C-V training
Topic 3	Lecture Lab	Equipment subsystems: oxidation furnace Oxidation training

Topic 4	Lecture Labs	Equipment subsystems: chemical vapor deposition Cleanroom subsystem identification
Topic 5	Lecture Lab	Equipment subsystems: plasma etching Exposure matrix on MA-6
Topic 6	Lecture Lab	Equipment subsystems: ion implantation Implanter subsystem demonstration
Topic 7	Lecture Lab	n-p-n bipolar transistor process flow lithography training
Topic 8	Lecture Lab	CMOS transistor process flow RIE training
Topic 9	Lecture Lab	Power device process flow Ellipsometry, Profilometery training
Topic 10	Lecture Lab	MEM process flow SEM training and demonstration
Topic 11	Lecture Lab	Biomedical device fabrication Wet chemical training

LEARNING MATERIALS

Textbooks per Penn State:

1. Nanostructures & Nanomaterials; Synthesis, Properties & Applications by Guozhong Cao [ISBN 1-86094-480-9]
2. Semiconductor Manufacturing Technology by Michael Quirk and Julian Serda [ISBN 0-13-081520-9]

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:	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.