Montgomery County Community College
ESC 211
Material, Safety and Equipment Overview for Nanofabrication
3-2-2

COURSE DESCRIPTION
This course overviews basic material properties as well as environment, health, and safety (EHS) issues in equipment operation and materials handling in "top down" and "bottom up" nanofabrication. The chemical and physical materials properties underlying nanotechnology are surveyed. EHS topics arising from the processing and disposal of these materials are addressed including: cleanroom operation, OSHA lab standard safety training, health issues, biosafety levels (BSL) guidelines, and environmental concerns. Specific safety issues dealing with nanofabrication equipment, materials, and processing will also be discussed including those pertinent to wet benches, thermal processing tools, vacuum systems and pumps, gas delivery systems and toxic substance handling and detection.

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 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 preliminary 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. Identify the safe handling of various materials used in nanofabrication.	Lecture Group and individual skills training activities	Exams Projects Presentations Laboratory Activities
3. Identify the rules and regulations associated with nanofabrication manufacturing.	Lecture Group and individual skills training activities	Exams Projects Presentations Laboratory Activities
4. Utilize procedures to safely operate nanofabrication 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	Overview: industry safety, health, environmental issues General safety training, Nanofab orientation
Topic 2	Lecture Labs	Cleanrooms: operation, safety, and health issues Facility tour: chase, catwalks, control room

Topic 3	Lecture Labs	Vacuum pump systems: operation, environmental, safety and health issues Cleanrooms demos, pump rebuilding, training module
Topic 4	Lecture Labs	Vacuum accessories Cleanroom demos, training module: gauges and controllers
Topic 5	Lecture Discussion Lab	Gas delivery: regulators, purge systems, valves and fittings, Toxic gas monitoring Hands-on assembly in classroom Cleanroom examples
Topic 6	Lecture Lab	RF-systems Cleanroom power supply and matching network
Topic 7	Lecture Discussion Lab	Chemical handling MSDS review Cleanroom identification
Topic 8	Lecture Discussion	Equipment overview: subsystems Subsystem identification: vacuum, AC power, pneumatic, RF power, cooling, gas distribution, control
Topic 9	Lecture Discussion Lab	Equipment overview: training Virtual tour review Cleanroom subsystem identification.

LEARNING MATERIALS
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: 4/2000

VPAA/Provost or designee Compliance Verification:

Brad Gottfried Date: 4/20/2000

Revised by: William Brownlowe Date: 7/20/2013

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.