_____ North Seattle Community College _____

Math/Science/Social Sciences Division

Course Establishment Form

Outline

Fall 2010

Division:	Math/Science/Social Sciences	**Program/Dept:**	Nanotechnology
Course Number:	NANO 220	**Credits:** 5	**Variable:**
Course Title:	Nano/Microfabrication		
Inst. Intent:	21 Professional Technical	**CIP:**	15.0614
	Fee: Yes	**Type :** Laboratory Fee	

Degree/Certificate Requirement: **Yes** X **No:**

Name of Degree/Certificate: Nanotechnology AAS-T; Certificate in Nanotechnology

Distribution Requirement for AA/AS: NA

Transfer Status to 4-year institution: **Yes** **No:** X

If yes, please describe:

Course length: 1 quarter **Class Size:** 17

Course Contact Hours: 66

Lecture: 44 **Lab:** 22 **Clinical:** **Other:** System: 66

Prerequisite: **Yes:** X **No**:

If yes, please describe:

NANO 101, CHEM& 121 and MATH& 098 or by instructor permission

Required Placement Tests: **Yes** **No X**

If yes, please describe: N/A

Comments:

PHYS& 121 recommended

Course Description:

This course teaches the fabrication technologies used in the nano/micro fabrication laboratory and production environments. Subject matter includes cleanroom basics and proper technique; vacuum technology; lithography; methods of physical and chemical materials deposition and etching.

NSCC General Education Learning Outcomes and/or Related Instructional Outcomes (for technical courses) Met by Course:

Knowledge

Methodologies, facts, theories, and perspectives within and across disciplines

Intellectual and Practical Skills, including

- Critical thinking and problem solving
- Quantitative reasoning

Course Outcomes/Learning Objectives:

Upon successful completion of the course, students should be able to:

I. demonstrate a broad, and functional understanding of a variety of physical and chemical materials deposition and etching methods used in nano/micro fabrication and the vacuum systems they use
II. compare and contrast top-down and bottom-up fabrication technologies used across a range of industries.
III. describe the steps used in a nano/micro fabrication process and how varying process parameters at a given step will affect the outcome of the process.
IV. demonstrate the proper use of several specific fabrication tools, including proper cleanroom procedure
V. become active contributors in a nano/micro fabrication environment.

Topical Outline and/or Major Divisions:

1. Chemical and Cleanroom Safety and Procedures
    a. Chemical Hygiene
        i. Information resources
        ii. Materials handling
    b. Safety
        i. Protection and safety equipment
        ii. Emergency planning and response
    c. Cleanroom basics
        i. Ratings, filtration, regulation,
        ii. Proper technique
2. Crystallization-Deposition Techniques
    a. Physical
        i. Bulk crystal growth
        ii. Evaporation
        iii. Sputtering
        iv. Doping
            1. Diffusion
            2. Ion implantation
        v. Micro-printing
    b. Chemical
        i. Liquid phase epitaxy
        ii. Molecular beam epitaxy
        iii. Chemical vapor deposition (CVD)

1. Atmospheric and low pressure CVD
2. Plasma enhanced CVD
3. Metallorganic CVD

3. Lithography
    a. Spin coating
    b. Photolithography
        i. Negative process
        ii. Positive process
        iii. Soft lithography
        iv. Lift-off
        v. Materials and equipment
    c. Electron beam lithography
    d. X-ray lithography
4. Etching and Material Modification
    a. Wet chemical etching
    b. Plasma etching
    c. Rapid thermal processing and annealing
5. Nanomaterials fabrication
    a. Nanophase chemistry and synthesis
        i. Bottom-up synthesis
        ii. Molecular self assembly
        iii. Top-down synthesis
    b. Nanomaterial composites
        i. Bulk materials with nanoenhanced properties
        ii. Nanoscale formation of meso-structures
    c. Molecular machines and nanofactories
6. Vacuum Science
    a. Vacuum generation
        i. Compression pumps
        ii. Momentum transfer pumps
        iii. Entrapment pumps
    b. Vacuum measurement
        i. Mechanical gauges
        ii. Thermal-conductivity gauges
        iii. Ionization guages
        iv. RGA

Course Requirements (Expectations of Students)

Students will be expected to…

1) Participate in class activities.

2) Read text and article assignments.

3) Finish written homework assignments and present results to class.

4) Take scheduled quizzes and examinations

5) Attend all lab activities

6) Demonstrate the ability to perform specific competencies listed under “Course Outcomes/Learning Objectives.”

Methods of Assessment/Evaluation:

As determined by instructor, but usually includes at least exams, written homework assignments and class participation.

Final grades are assigned according to published grading standards for the course

Required and Supplemental Text(s) and/or Materials:
As determined by instructor.

Outline Developed by:	Vincenzo Casasanta / Mark Helsel	**Date:**	6/20/06
Outline Revised by:	Alissa Agnello	**Date:**	3/17/10