E SC 211
Course Syllabus

I. BASIC COURSE INFORMATION

A. Course Title: Material, Safety and Equipment Overview for Nanotechnology

B. Course Number: E SC 211

C. Credit Hours: 3:2:2

D. Prerequisites:

E SC 212
Course Syllabus

I. BASIC COURSE INFORMATION

A. Course Title: Basic Nanotechnology Processes

B. Course Number: E SC 212

C. Credit Hours: 3:2:2

D. Prerequisites: Concurrent: E SC 211

II. COURSE DESCRIPTION

This course is an overview of the broad spectrum of processing approaches involved in The majority of the course details a step-by-step description of the equipment, facilities processes and process flow used in 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 and equipment and process flows by undertaking hands-on processing. This hands-on overview exposure covers basic nanofabrication processes including deposition, etching, and pattern transfer.

III.

E SC 213
Course Syllabus

I. BASIC COURSE INFORMATION

A. Course Title: Materials in Nanotechnology

B. Course Number: E SC 213

C. Credit Hours: 3:2:2

D. Prerequisites: Concurrent: E SC 211, E SC 212

II. 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.

III. RATIONALE OF COURSE

The purpose of this course is to develop a detailed understanding of how materials used in nano-structures are produced. This course emphasizes the understanding of materials production approaches and of the operation of state-of-the-art materials production equipment.

IV. SPECIFIC TOPICS INCLUDED

Molecular films
Nanoparticles
Metal films
Semiconductor films
Dielectric films
Organic materials

E SC 214
Course Syllabus

I. BASIC COURSE INFORMATION

A. Course Title: Patterning for Nanotechnology

B. Course Number: E SC 214

C. Credit Hours: 3:2:2

D. Prerequisites: Concurrent: E SC 211, E SC 212

II. COURSE DESCRIPTION

This course is a hands-on treatment of all aspects of advanced pattern transfer and pattern transfer equipment including probe techniques; stamping and embossing; e-beam; and optical contact and stepper systems. The course is divided into five major sections. The first section is an overview of all pattern generation processes covering aspects from substrate preparation to tool operation. The second section concentrates on photolithography and examines such topics as mask template, and mold generation. Chemical makeup of resists will be discussed including polymers, solvents, sensitizers, and additives. The role or dyes and antireflective coatings will be discussed. In addition, critical dimension (CD) control and profile control of resists will be investigated. The third section will discuss the particle beam lithographic techniques such as e-beam lithography. The fourth section covers probe pattern generation and the fifth section explores imprinting lithography, step-and-flash, stamp lithography, and self-assembled lithography.

III. RATIONALE OF COURSE

Patterning materials on the nanoscale is a challenging but generally required aspect of nanofabrication. Tool and technique selection are key to creating products in the competitive modern workplace. This course addresses these issues and is a detailed study using hands-on applications of state-of-the-art pattern transfer equipment.

IV. SPECIFIC TOPICS INCLUDED

Resists Masks
Developing
Optical lithography
E-beam lithography
Probe lithography
Imprinting lithography
Step-and-flash lithography
Pen dip lithography
Stamp lithography
Lithography and etching for patterning
Lithography and lift-off for patterning

E SC 216
Course Syllabus

I. BASIC COURSE INFORMATION

A. Course Title: Characterization, Testing of Nanotechnology Structures and Materials