

# Nanoscale Science and Engineering

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## Overview

The Graduate Group in Nanoscale Science and Engineering (NSE) administers the Designated Emphasis (DE). Faculty associated with the Group come from many engineering and physical science departments and share an interest in the growing body of research surrounding the synthesis, characterization, fabrication, and modeling of nanostructured materials and devices.

Doctoral students in associated departments who wish to pursue an emphasis in nanoscale research can add the Designated Emphasis to their PhD degree goals. The DE curriculum is designed to fulfill one of the required area emphases of the student's PhD program while providing additional opportunities for study and collaboration across the associated disciplines.

## Undergraduate Program

There is no undergraduate program in Nanoscale Science and Engineering.

## Graduate Program

Nanoscale Science and Engineering (<http://guide.berkeley.edu/archive/2014-15/graduate/degree-programs/nanoscale-science-engineering>) : Designated Emphasis (DE)

## Nanoscale Science and Engineering

**NSE C201 Introduction to Nano-Science and Engineering 3 Units**  
A three-module introduction to the fundamental topics of Nano-Science and Engineering (NSE) theory and research within chemistry, physics, biology, and engineering. This course includes quantum and solid-state physics; chemical synthesis, growth fabrication, and characterization techniques; structures and properties of semiconductors, polymer, and biomedical materials on nanoscales; and devices based on nanostructures. Students must take this course to satisfy the NSE Designated Emphasis core requirement.

### Rules & Requirements

**Prerequisites:** Major in physical science such as chemistry, physics, etc., or engineering; consent of advisor or instructor

**Repeat rules:** Course may be repeated for credit when topic changes.

### Hours & Format

**Fall and/or spring:** 15 weeks - 3 hours of lecture per week

### Additional Details

**Subject/Course Level:** Nanoscale Science and Engineering/Graduate

**Grading:** Letter grade.

**Instructors:** Gronsky, S.W. Lee, Wu

**Also listed as:** BIO ENG C280/MAT SCI C261/PHYSICS C201

## NSE C203 Nanoscale Fabrication 4 Units

This course discusses various top-down and bottom-up approaches to synthesizing and processing nanostructured materials. The topics include fundamentals of self assembly, nano-imprint lithography, electron beam lithography, nanowire and nanotube synthesis, quantum dot synthesis (strain patterned and colloidal), postsynthesis modification (oxidation, doping, diffusion, surface interactions, and etching techniques). In addition, techniques to bridging length scales such as heterogeneous integration will be discussed. We will discuss new electronic, optical, thermal, mechanical, and chemical properties brought forth by the very small sizes.

### Hours & Format

**Fall and/or spring:** 15 weeks - 3 hours of lecture and 1 hour of discussion per week

### Additional Details

**Subject/Course Level:** Nanoscale Science and Engineering/Graduate

**Grading:** Letter grade.

**Instructor:** Chang-Hasnain

**Also listed as:** EL ENG C235

## NSE C237 Computational Nano-mechanics 3 Units

Basic mathematics foundations, physical models, computational formulations and algorithms that are used in nanoscale simulations and modelings. They include (1) cohesive finite element methods and discontinuous Galerkin methods; (2) meshfree methods, partition of unity methods, and the eXtended finite element methods (X-FEM); (3) quasicontinuum method; (4) molecular dynamics; (5) multiscale simulations; (6) Boltzmann method.

### Hours & Format

**Fall and/or spring:** 15 weeks - 3 hours of lecture and 1 hour of laboratory per week

### Additional Details

**Subject/Course Level:** Nanoscale Science and Engineering/Graduate

**Grading:** Letter grade.

**Instructor:** Li

**Also listed as:** CIV ENG C237

**NSE C242 Computational Nanoscience 3 Units**

A multidisciplinary overview of computational nanoscience for both theorists and experimentalists. This course teaches the main ideas behind different simulation methods; how to decompose a problem into "simulatable" constituents; how to simulate the same thing two different ways; knowing what you are doing and why thinking is still important; the importance of talking to experimentalists; what to do with your data and how to judge its validity; why multiscale modeling is both important and nonsense.

**Rules & Requirements**

**Prerequisites:** Graduate standing or consent of instructor

**Hours & Format**

**Fall and/or spring:** 15 weeks - 3 hours of lecture and 1 hour of discussion per week

**Additional Details**

**Subject/Course Level:** Nanoscale Science and Engineering/Graduate

**Grading:** Letter grade.

**Also listed as:** PHYSICS C203

**NSE 290 Special Topics in Nanoscale Science and Engineering 3 Units**

Lectures and appropriate assignments on fundamental or applied topics of current interest in nanoscale science and engineering.

**Rules & Requirements**

**Prerequisites:** Graduate standing or consent of instructor

**Credit Restrictions:** Subject to home department limitations.

**Repeat rules:** Course may be repeated for credit as topic varies. Course may be repeated for credit when topic changes.

**Hours & Format**

**Fall and/or spring:** 15 weeks - 3 hours of lecture per week

**Additional Details**

**Subject/Course Level:** Nanoscale Science and Engineering/Graduate

**Grading:** Letter grade.

**NSE 298 Group Studies, Seminars, or Group Research 1 Unit**

Advanced studies in various subjects through special seminars on topics to be selected each year. Informal group studies of special problems, group participation in comprehensive design problems, or group research on complete problems for analysis and experimentation.

**Rules & Requirements**

**Prerequisites:** Required for participants in Designated Emphasis

**Repeat rules:** Course may be repeated for credit. Course may be repeated for credit when topic changes.

**Hours & Format**

**Fall and/or spring:** 15 weeks - 1 hour of seminar per week

**Additional Details**

**Subject/Course Level:** Nanoscale Science and Engineering/Graduate

**Grading:** Offered for satisfactory/unsatisfactory grade only.