

Minor in Nanoscale Science & Engineering (MEMS)

Nanotechnology deals with materials, structures and devices with dimensions that are in the 1- to 100-nm length scale. These entities have properties (physical, chemical and biological) that are very different from their bulk counterparts, and they can be tuned to obtain novel and desired functionalities. The goal of this minor is to enhance the student's background, knowledge and skills in the topical area of nanotechnology. The minor includes courses in several fields of science and engineering; it encompasses all of the departments in the McKelvey School of Engineering as well as several departments in Arts & Sciences. It is open to undergraduate students pursuing an engineering degree or a related Arts & Sciences major (e.g., chemistry, physics, biology, environmental studies, pre-med).

The minor in nanoscale science and engineering involves the following components. Starting with courses covering the fundamentals, students gain knowledge in synthesis and applications as well as characterization, structure and modeling. Two additional requirements are a cleanroom lab class (MEMS 5611 or MEMS 5801) and the completion of a faculty-supervised independent study project over the course of at least two semesters. The mix of courses should provide the student with a significant background in nanotechnology, and it should promote independent thinking through the student's work on a research or educational project.

Units required: 18

Required courses: Select from the following menus:

Fundamentals (choose one course):

Code	Title	Units
CHEM 4010	Physical Chemistry I	3
CHEM 4620	Solid-State and Materials Chemistry	3
CHEM 4810	General Biochemistry I	3
EECE 3520	Materials Science	3
MEMS 2610	Materials Science	3
MEMS 5618	Electronic Behavior of Materials	3
PHYSICS 2170	Introduction to Quantum Physics	3
PHYSICS 3352	Physics of Biomolecules	3
PHYSICS 4072	Solid State Physics	3

Synthesis and Applications (choose one course):

Code	Title	Units
EECE 5040	Aerosol Science and Technology	3
EECE 5140	Environmental Nanochemistry	3
ESE 4360	Semiconductor Devices	3
ESE 4380	Applied Optics	3
ESE 5320	Introduction to Nano-Photonic Devices	3
MEMS 5606	Soft Nanomaterials	3

MEMS 5611	Principles and Methods of Micro and Nanofabrication	3
MEMS 5803	Nanotechnology Concepts and Applications	3

Characterization, Structure and Modeling (choose one course):

Code	Title	Units
CHEM 5014	Physical Properties of Quantum	3
CHEM 5843	Mass Spectrometry	3
EECE 5100	Measurement Techniques for Particle Characterization	3
MEMS 5602	Non-Metallics	3
MEMS 5603	Materials Characterization Techniques I	3
MEMS 5604	Materials Characterization Techniques II	3
MEMS 5612	Atomistic Modeling of Materials	3

Cleanroom Laboratory/Theory Class (choose one course):

Code	Title	Units
MEMS 5611	Principles and Methods of Micro and Nanofabrication	3
MEMS 5801	Micro-Electro-Mechanical Systems I	3

Independent Study Project (required):

Students should sign up for at least **two semesters** of independent study and work on a project related to nanotechnology under the supervision of a faculty member. A list of projects with potential faculty mentors will be circulated during the spring semester each year. Before completing the independent study project, students must be registered for the nanoscale science and engineering minor program, and they must have completed at least two of the courses from the above categories. Students can also come up with their own ideas for projects, but these require approval from the Nanoscale Science and Engineering Minor Committee and a faculty mentor. All independent study projects should address one of the following two criteria:

- Connect material processing to structural features on the length scale of 1 to 100 nm
- Connect structural features on the 1- to- 100-nm length scale in a material to its physical or chemical properties

The courses listed above will count for elective credit for all Engineering majors; however, students should check with their major advisors to confirm this.

Committee to Oversee Nanoscale Science and Engineering Minor

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Visit the EECE website for more information.