The Minor in Nanoscale Science & Engineering

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 the cleanroom lab class (MEMS 5801 Micro-Electro-Mechanical Systems I) 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
Biol 4810	General Biochemistry I	3
Chem 401	Physical Chemistry I	3
Chem 465	Solid-State and Materials Chemistry	3
EECE 305	Materials Science	3
MEMS 3601	Materials Engineering	3
MEMS 3610	Materials Science	3
Physics 217	Introduction to Quantum Physics	3
Physics 352	Physics of Biomolecules	3
Physics 472	Solid State Physics	3

Synthesis and Applications (choose one course):

Code	Title	Units
EECE 504	Aerosol Science and Technology	3
EECE 534	Environmental Nanochemistry	3
EECE 595	Principles of Methods of Micro and Nanofabrication	3
ESE 436	Semiconductor Devices (EECE 595::Principles of Methods of Micro and Nanofabrication)	3
ESE 438	Applied Optics	3
ESE 532	Introduction to Nano-Photonic Devices	3
MEMS 463	Nanotechnology Concepts and Applications	3
MEMS 5606	Soft Nanomaterials	3

Characterization, Structure and Modeling (choose one course):

Code	Title	Units
Chem 479	Computational Chemistry and Molecular Modeling	3
Chem 543	Physical Properties of Quantum Nanostructures	3
Chem 550	Mass Spectrometry	3
EECE 516	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 5801	Micro-Electro-Mechanical Systems I	3
EECE 595	Principles of Methods of Micro and Nanofabrication	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

Rohan Mishra (https://engineering.wustl.edu/faculty/Rohan-Mishra.html) (MEMS, Coordinator), Elijah Thimsen (https://engineering.wustl.edu/faculty/Elijah-Thimsen.html) (EECE)

Visit the EECE website (https://eece.wustl.edu/undergraduate/programs/Pages/minors.aspx) for more information.