ENGINEERING AT THE NANO-SCALE

Graduate Program Head	Albert Eliot Segall
Program Code	NANO
Campus(es)	University Park (M.S.)
Degrees Conferred	Master of Science (M.S.)
The Graduate Faculty	View (https://secure.gradsch.psu.edu/gpms/?searchType=fac&prog=NANO)

The Master of Science (M.S.) in Engineering at the Nano-scale is an intensive one-year, 30-credit program requiring completion of a scholarly paper. This interdisciplinary program is ideal for individuals with a bachelor's degree in science, engineering, mathematics, or related fields who wish to gain an expanded knowledge and hands-on practices of semiconductor processing, nanomanufacturing, and bionanotechnology that can be implemented in many engineering applications.

Admission Requirements

Applicants apply for admission to the program via the Graduate School application for admission (https://gradschool.psu.edu/graduate-admissions/how-to-apply/). Requirements listed here are in addition to Graduate Council policies listed under GCAC-300 Admissions Policies (https://gradschool.psu.edu/graduate-education-policies/).

Graduates in engineering, physical sciences, and mathematics who present a 3.00 grade-point average will be considered for admission. GRE scores are not required for admission.

Degree Requirements

Master of Science (M.S.)

Requirements listed here are in addition to Graduate Council policies listed under GCAC-600 Research Degree Policies. (https://gradschool.psu.edu/graduate-education-policies/)

The non-thesis residence-based Master of Science (M.S.) degree in Engineering at the Nano-scale is a one-year program. Students are required to start the program in the fall semester and complete their degree requirements, including all required course work and three credits of research resulting in a scholarly paper, and graduate by the end of summer following the second semester. The plan of study is as follows:

- Fall semester: 12 credits of course work+ 1 credit of ESC 596
- Spring semester: 12 credits of course work + 1 credit of ESC 596
- Summer semester: 3 credits of course work + 1 credit of ESC 596

At least 30 graduate credits must be earned, of which 18 must be from 500-level lecture/laboratory courses approved by the department. No more than 9 credits may be earned from 400-level courses including the required core course ESC 412.

Code	Title	Credits
Required Courses		
ESC 412	Nanotechnology: Materials, Infrastructure, and Safety	3
ESC 520	Engineering at the Nano-scale	3
ESC 521	Pattern Transfer at the Nano-scale	3
ESC 522	Fabrication and Characterization for Top-down Nano-manufacturing	3
ESC 523	Fabrication and Characterization for Bottom-up Nano-manufacturing	3
Electives		**12**
Culminating Experience		
ESC 596	Individual Studies (3 semesters of 1 credit each)	3
Total Credits		**30**

As the culminating experience, students must write a scholarly paper incorporating at least one area represented in the course work, upon successful completion of which 3 total credits of ESC 596 will be earned. The scholarly paper must demonstrate the student's capability to integrate and apply concepts and techniques learned in the courses and thereby demonstrate the technical, environmental, ethical, and safety knowledge needed to practice engineering at the nano-scale. This scholarly paper should reflect the high quality of research required to meet the Engineering Science and Mechanics M.S. degree standards, as determined by the ESM Graduate Officer and the ESM Graduate Curriculum Committee. Students who need more time to complete the final paper may extend the submission due date after the third semester (summer). The degree will be granted after the paper has been reviewed and approved, and all degree requirements have been met. Students are not required to remain in residence while they complete the final paper.

Minor

A graduate minor is available in any approved graduate major or dual-title program. The default requirements for a graduate minor are stated in Graduate Council policies listed under GCAC-600 Research Degree Policies (https://gradschool.psu.edu/graduate-education-policies/) and GCAC-700 Professional Degree Policies (https://gradschool.psu.edu/graduate-education-policies/), depending on the type of degree the student is pursuing:

- GCAC-611 Minor - Research Doctorate (https://gradschool.psu.edu/graduate-education-policies/gcac/gcac-600/gcac-611-minor-research-doctorate/)
- GCAC-641 Minor - Research Master's (https://gradschool.psu.edu/graduate-education-policies/gcac/gcac-600/gcac-641-minor-research-masters/)
- GCAC-709 Minor - Professional Doctorate (https://gradschool.psu.edu/graduate-education-policies/gcac/gcac-700/gcac-709-professional-doctoral-minor/)
- GCAC-741 Minor - Professional Master's (https://gradschool.psu.edu/graduate-education-policies/gcac/gcac-700/gcac-741-masters-minor-professional/)

Student Aid

Graduate assistantships available to students in this program and other forms of student aid are described in the Tuition & Funding (https://gradschool.psu.edu/graduate-funding/) section of The Graduate School's website. Students on graduate assistantships must adhere to the course load limits (https://gradschool.psu.edu/graduate-education-policies/gsad/gsad-900/gsad-901-graduate-assistants/) set by The Graduate School.

Courses

Graduate courses carry numbers from 500 to 699 and 800 to 899. Advanced undergraduate courses numbered between 400 and 499 may

be used to meet some graduate degree requirements when taken by graduate students. Courses below the 400 level may not. A graduate student may register for or audit these courses in order to make up deficiencies or to fill in gaps in previous education but not to meet requirements for an advanced degree.

Nanotechnology (NANO) Course List (https://bulletins.psu.edu/university-course-descriptions/graduate/nano/)

Learning Outcomes

1. **KNOW:** Demonstrate a mastery of core principles of nanoscience and nanotechnology.
2. **APPLY/CREATE:** Apply methods of fabrication and characterization of nanomaterials and nanodevices.
3. **COMMUNICATE:** Effectively communicate technical knowledge and laboratory practices including: ideas, designs, data analysis, findings, or decision justification in written, graphical and oral presentation formats.
4. **THINK:** Critically and creatively conceptualize and evaluate engineering problem formulations, analyses, and solutions.
5. **TEAMWORK:** Collaborate in a collegial and ethical manner with other professionals within their field and with diverse, cultural, scientific, and technical backgrounds.
6. **PROFESSIONAL PRACTICE:** Demonstrate a knowledge and the ability to practice the professional standards of safety and professional behavior.

Contact

Campus	University Park
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