

# INDUSTRIAL ENGINEERING

<b>Graduate Program Head</b>	Steven Landry
<b>Program Code</b>	IE
<b>Campus(es)</b>	University Park (Ph.D., M.S.) World Campus (M.Eng.)
<b>Degrees Conferred</b>	Doctor of Philosophy (Ph.D.) Master of Science (M.S.) Master of Engineering (M.Eng.) Dual-Title Ph.D. and M.S. in Industrial Engineering and Operations Research
<b>The Graduate Faculty</b>	View ( <a href="https://secure.gradsch.psu.edu/gpms/?searchType=fac&amp;prog=IE">https://secure.gradsch.psu.edu/gpms/?searchType=fac&amp;prog=IE</a> )

Graduate study and research are conducted in manufacturing, operations research-management science, production engineering, process design, systems engineering, human factors, ergonomics, service systems, and data analytics.

## 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 with a 3.00 grade-point average will be considered for admission. GRE scores are highly recommended for M.S. applicants only.

The language of instruction at Penn State is English. English proficiency test scores (TOEFL/IELTS) may be required for international applicants. See GCAC-305 Admission Requirements for International Students (<https://gradschool.psu.edu/graduate-education-policies/gcac/gcac-300/gcac-305-admission-requirements-international-students/>) for more information.

## Degree Requirements

### Master of Engineering (M.Eng.)

Requirements listed here are in addition to Graduate Council policies listed under GCAC-700 Professional Degree Policies (<https://gradschool.psu.edu/graduate-education-policies/>).

The primary focus of the M.Eng. degree is not current students, but the thousands of IE alumni who are working as professional engineers and cannot easily take leave from their careers to return physically to the University Park campus for on-site courses and degrees. This degree provides an opportunity for these professionals to seek further education in the form of a professional graduate degree.

The requirements for the online M.Eng. degree program include:

1. Minimum of 30 course credits at the 400, 500, or 800 level, of which 21 course credits must be earned at Penn State (i.e. only 9 credits can be transferred from other institutions).
2. All students must successfully complete three credits of IE 894 Capstone Design.

3. At least 18 credits in 500- or 800- level courses, with at least 6 at 500 level (including IE 894).
4. At least 15 credits in 500- level or 800-level IE courses (including IE 894).
5. At least 21 credits of IE courses (including IE 894).
6. The culminating experience for this professional degree will be satisfied with IE 894, which includes a written report summarizing the analyses and designs used to solve a problem in their workplace submitted to the course instructor.

Continuous registration is required for all graduate students until the paper, thesis, or dissertation is approved.

### 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 M.S. degree program is intended for students to gain advanced knowledge for research, analysis, and design in industrial engineering. The M.S. degree is offered with thesis or research paper tracks, both requiring 32 credits. For both tracks, a core curriculum is required that is composed of IE 505 and IE 511, which all the students must satisfy.

The M.S. degree with thesis track requires 24 credits of course work and two credits of IE 590. Out of the 24 credits of course work, at least 15 must be IE courses, and at least 12 must be at the 500 level. Of the 12 credits at the 500 level, at least nine must be IE courses. A thesis is required, for which six credits of IE 600 or IE 610 must be taken. The thesis must demonstrate comprehensive and in-depth knowledge of a topic in industrial engineering, and it should be suitable for submission for publication in a refereed journal as approved by the committee. The thesis must be accepted by the advisers and/ or committee members, the head of the graduate program, and the Graduate School.

The M.S. degree with non-thesis track requires 27 credits of course work, two credits of IE 590. Out of the 27 credits of course work, at least 18 must be IE courses, and at least 18 must be at the 500 level. Of the 18 credits at the 500 level, at least fifteen must be IE courses. A scholarly paper is required for the M.S. degree with non-thesis track for which three credits of IE 596 must be taken. The paper should demonstrate the ability of the student to integrate and apply concepts and techniques learnt in the courses to solve an engineering problem.

The students seeking the Master of Science degree in Industrial Engineering with non-thesis track are expected to start their degree in the Fall semester of every year and complete their degree including all the required course work and three credits of research resulting in a paper and graduate by the end of summer following the second semester. A research adviser will be assigned to students in their first semester. Students who need more time to complete the final paper will be allowed to complete the paper, and have it reviewed and approved after the third semester has ended. Students are not required to remain in residence while they complete the final paper. However, extensions granted to students in this program must comply with the Graduate Council policy on deferred grades (<http://gradschool.psu.edu/graduate-education-policies/gcac/gcac-400/gcac-401-grading-system/>). Non-thesis track students are typically not eligible for assistantships and therefore their plan of study is as follows:

- Fall semester: Twelve credits of course work, one credit of colloquium and one credit of research (IE 596).

- Spring semester: Twelve credits of course work, one credit of colloquium and one credit of research (IE 596).
- Summer semester: Three credits of course work and one credit of research (IE 596).

Continuous registration is required for all graduate students until the paper, thesis, or dissertation is approved.

An M.S. dual-title degree program in Industrial Engineering and Operations Research is also offered.

### **DOCTOR of Philosophy (Ph.D.)**

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 Ph.D. program emphasizes scholarly research, and prepares students for research and development careers in industry, government, and academe. Official entrance into the Ph.D. program occurs upon successful completion of a written qualifying examination. The Ph.D. is awarded upon completion of a program of advanced study that includes a minimum period of residence, passing the English competence and comprehensive examinations, completing a satisfactory dissertation, and passing the final oral examination. To earn the Ph.D. degree, doctoral candidates must write a dissertation that is accepted by the Ph.D. committee, the head of the graduate program, and the Graduate School. The degree requirements consist of 45 credits of course work and four IE 590 credits. Of the 45 credits of required course work, 36 must be prefixed IE, and at least 30 must be at the 500 level. Nine credits must be from outside the Department and must include a six-credit sequence, with at least three credits at the 500 level. A Ph.D. dual-title degree program in Industrial Engineering and Operations Research is also available.

Continuous registration is required for all graduate students until the paper, thesis, or dissertation is approved.

## **Dual-Titles**

### **Dual-Title M.S. and Ph.D. in Industrial Engineering and Operations Research**

Requirements listed here are in addition to requirements listed in GCAC-208 Dual-Title Graduate Degree Programs (<https://gradschool.psu.edu/graduate-education-policies/gcac/gcac-200/gcac-208-dual-titles/>).

#### **Admission Requirements**

Students must apply and be admitted to the graduate program in Industrial Engineering and The Graduate School before they can apply for admission to the dual-title degree program. After admission to their primary program, students must apply for admission to and meet the admissions requirements of the Operations Research dual-title program. Refer to the Admission Requirements section of the Operations Research Bulletin page (<http://bulletins.psu.edu/graduate/programs/majors/operations-research/>). Doctoral students must be admitted into the dual-title degree program in Operations Research prior to taking the qualifying examination in their primary graduate program.

#### **Degree Requirements**

To qualify for the dual-title degree, students must satisfy the degree requirements for the degree they are enrolled in Industrial Engineering. In addition, students must complete the degree requirements for the dual-title in Operations Research, listed on the Operations Research Bulletin

page (<http://bulletins.psu.edu/graduate/programs/majors/operations-research/>).

The qualifying examination committee for the dual-title Ph.D. degree will be composed of Graduate Faculty from Industrial Engineering and must include at least one Graduate Faculty member from the Operations Research program. Faculty members who hold appointments in both programs' Graduate Faculty may serve in a combined role. There will be a single qualifying examination, containing elements of both Industrial Engineering and Operations Research. Dual-title graduate degree students may require an additional semester to fulfill requirements for both areas of study and, therefore, the qualifying examination may be delayed one semester beyond the normal period allowable.

In addition to the general Graduate Council requirements for Ph.D. committees (<http://gradschool.psu.edu/graduate-education-policies/gcac/gcac-600/phd-dissertation-committee-formation/>), the Ph.D. committee of an Industrial Engineering and Operations Research dual-title Ph.D. student must include at least one member of the Operations Research Graduate Faculty. Faculty members who hold appointments in both programs' Graduate Faculty may serve in a combined role. If the chair of the Ph.D. committee is not also a member of the Graduate Faculty in Operations Research, the member of the committee representing Operations Research must be appointed as co-chair. The Operations Research representative on the student's Ph.D. committee will develop questions for and participate in the evaluation of the comprehensive examination.

Students in the dual-title program are required to write and orally defend a dissertation on a topic that is approved in advance by their Ph.D. committee and reflects their original research and education in Industrial Engineering and Operations Research. Upon completion of the doctoral dissertation, the candidate must pass a final oral examination (the dissertation defense) to earn the Ph.D. degree. The dissertation must be accepted by the Ph.D. committee, the head of the graduate program, and the Graduate School.

## **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.

In addition, the following awards typically has been available to graduate students in this program:

### Harold & Inge Marcus Graduate Fellowships

Consideration for these fellowships shall be given to students exhibiting academic excellence who have been admitted to Penn State as candidates for a graduate degree in the Department of Industrial and Manufacturing Engineering, College of Engineering.

### Benjamin W. Niebel Manufacturing Fellowship

Consideration for this fellowship shall be given to students exhibiting academic excellence who have been admitted to Penn State as candidates for a graduate degree in the Department of Industrial and Manufacturing Engineering, College of Engineering.

## 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.

Industrial Engineering (IE) Course List (<https://bulletins.psu.edu/university-course-descriptions/graduate/ie/>)

## Learning Outcomes

### Master of Engineering (M.Eng.)

1. **KNOW:** Students will be able to describe how core principles and methods from selected sub-fields of Industrial Engineering apply to their profession.
2. **APPLY/CREATE:** Students will adapt and apply industrial engineering methods and techniques to effectively solve problems in the workplace.
3. **COMMUNICATE:** Students will proficiently articulate and concisely convey findings, analysis, and insights from industrial engineering projects in widely accessible language.
4. **THINK:** Students will be able to analyze workplace data to prepare a problem solution using common methods and techniques in Industrial Engineering.
5. **PROFESSIONAL PRACTICE:** Students will apply best practices and ethical standards for the industrial engineering profession.

### Master of Science (M.S.)

1. **KNOW:** Students will be able to apply advanced core principles and methods from selected sub-fields of Industrial Engineering to a research problem.
2. **APPLY/CREATE:** Students will apply analytical skills gained through coursework to solve a research problem in industrial engineering.

3. **COMMUNICATE:** Students will adeptly articulate and succinctly present, both orally and in written form, research approaches and processes.
4. **THINK:** Students will survey methods and techniques in industrial engineering to design an effective problem-solving method.
5. **PROFESSIONAL PRACTICE:** Students will apply best practices and ethical standards in conducting research in industrial engineering.

### Doctor of Philosophy (Ph.D.)

1. **KNOW:** Students will be able to identify appropriate resources to summarize what is known, contextualize their research, and identify gaps in knowledge.
2. **APPLY/CREATE:** Students will survey content from coursework and apply methods to solve research questions.
3. **APPLY/CREATE:** Students will develop a research question and propose a solution process to a committee of faculty.
4. **COMMUNICATE:** Students will adeptly articulate an original research question and succinctly present, both orally and in written form, their approach, analyses, findings, and conclusions.
5. **THINK:** Students will review and analyze existing research in industrial engineering to formulate a research problem and to create an effective methodology to address the problem.
6. **PROFESSIONAL PRACTICE:** Students will apply best practices and ethical standards to advance research in the industrial engineering profession.

## Contact

<b>Campus</b>	University Park
<b>Graduate Program Head</b>	Steven James Landry
<b>Director of Graduate Studies (DGS) or Professor-in-Charge (PIC)</b>	Ling Rothrock
<b>Program Contact</b>	Lisa Kaye Fuoss 344 Leonhard Building University Park PA 16802 lkf1@psu.edu (814) 863-1269
<b>Program Website</b>	View ( <a href="http://www.ime.psu.edu/">http://www.ime.psu.edu/</a> )
<b>Campus</b>	World Campus
<b>Graduate Program Head</b>	Steven James Landry
<b>Director of Graduate Studies (DGS) or Professor-in-Charge (PIC)</b>	Ling Rothrock
<b>Program Contact</b>	310 Leonhard Building University Park PA 16802
<b>Program Website</b>	View ( <a href="https://www.worldcampus.psu.edu/degrees-and-certificates/penn-state-online-industrial-engineering-masters-degree/overview/">https://www.worldcampus.psu.edu/degrees-and-certificates/penn-state-online-industrial-engineering-masters-degree/overview/</a> )