Industrial Engineering, Ph.D.

Research and Study
Graduate study in industrial engineering is tailored individually. Study programs for all students are based on their background and career objectives, and are designed according to sound academic practice. The curriculum is highly flexible; the goal is academic excellence.

The program offers six principal academic focus areas: design and manufacturing, human factors engineering and ergonomics, engineering management, reliability and production systems, operations research and applied statistics, and information systems. Graduate students participate in research in their academic concentration areas.

Engineering Management
Current research in engineering management consists of entrepreneurship, parametric cash flow analysis, strategic management, and economic risk analysis. Engineering management studies concentrate on engineering administration, engineering economics, and information systems. This area is covered by courses in the 50 series.

Human Factors and Ergonomics
Current research in human factors and ergonomics includes investigation of the effects of visual and auditory displays on human information processing and development of computer systems that ease the challenges of controlling complex medical and robotic systems. This work examines how engineers should shape information technology to enhance productivity, safety, and customer satisfaction. Industrial engineering faculty members and students work to improve the effectiveness of robot systems for exploration of Mars and the Moon, to improve driving safety, and to design new cockpit interfaces. The department has several medical, flight, and driving simulators. It also conducts research in other facilities, including the National Advanced Driving Simulator, the most advanced simulation facility in the world.

Human factors and ergonomics studies concentrate on designing systems compatible with human capabilities and limitations. Human factors engineering integrates components from the fields of psychology, cognitive sciences, physiology, statistics, and technical sciences to address issues of human-interface design and human-systems design. Specific considerations include human cognitive abilities and limitations, visual performance, error reduction, workload assessment and mitigation, design of jobs in the industrial environment, information acquisition and processing, choice of action, operator performance measurement, and economic concerns. This area is covered by courses in the 40 series.

Information Systems
Studies in information systems concentrate on system design. Design problems involve devising information systems that meet a diverse set of requirements. Contemporary topics include network-based systems, client/server systems, internet systems, and medical informatics.

Manufacturing
Ongoing manufacturing research consists of flexible manufacturing systems, optimum control of processes, and reliability assessment. Manufacturing courses, denoted by the 30 series, delve into selecting appropriate manufacturing methods, planning processing operations, devising control strategies, and designing products and manufacturing systems. Contemporary topics include computer-aided process planning, computer-aided design, computer-controlled manufacturing, concurrent engineering, and applications of artificial intelligence in manufacturing.

Operations Research and Applied Statistics
Ongoing research in operations research and applied statistics deals with the application of optimization techniques for informed decision making in the public and private sectors. The primary focus of this work is modeling, simulating, and optimizing the design and operation of systems such as logistics, communications, health care, and manufacturing. Studies in operations research and applied statistics concentrate on mathematical programming, statistical, and computer sciences for modeling, analyzing, and optimizing systems. Various methodologies in this area include mathematical programming, heuristic optimization, statistical analysis, and digital systems simulation. This area is covered by courses in the 70 series.

Quality Control and Production Systems
Current research in quality control and production systems focuses on measures for corporate quality and reliability, computer-aided layout and scheduling, just-in-time production, inspection, and online expert systems in process control. Studies of quality control and production systems focus on reliability engineering, quality control, and production systems. This area is covered by courses in the 60 series.

Related Certificate Informatics
The Informatics Program offers the Certificate in Informatics with a health informatics subtrack. The subtrack emphasizes the organization, management, and use of health care information; health care research, education, and practice; and information technology developments in the socioeconomic context of health care. Industrial engineering students working toward the certificate complete IE:5860 Health Informatics I and approved electives. To learn more, see the Certificate in Informatics (Graduate College) in the Catalog.

Requirements
The Doctor of Philosophy program in industrial engineering requires a minimum of 72 s.h. It is granted upon demonstration of comprehensive knowledge and scholarly work at the highest level. A maximum of 36 s.h. earned toward the M.S. may be counted toward the 72 s.h. required for the Ph.D. Students must spend at least two semesters in residence at the University of Iowa. They also must maintain a g.p.a. of at least 3.25 on all graduate work at the University.

Students without a Master of Science in industrial engineering or a closely allied area must satisfy all requirements for the M.S. in industrial engineering before they may be admitted to the Ph.D. program.
Entering students are advised by the department chair or by a designated faculty advisor. During a student's first regular semester in residence, an advisor is assigned by the department chair or the graduate program coordinator. Students are expected to identify an industrial engineering faculty member willing to serve as their advisor by the end of their first regular semester in the program.

Once a student is assigned an advisor, the student works with the advisor to prepare a study plan, which is submitted to the department chair for approval. When the plan is approved by the department chair, it is filed with a student's record.

At the beginning of each academic year, the industrial and systems engineering faculty reviews the study plan and gives a student feedback regarding progress toward the degree objective. It is the student's responsibility to assure that the study plan is submitted to the program chair.

The degree requires broad academic background with considerable depth in at least one area of specialization that clearly demonstrates a student's capability to do high-level research. Students must complete a series of written and oral examinations and a written dissertation based upon the results of an original investigation.

Admission to degree candidacy requires a g.p.a. of at least 3.25 on all graduate work taken at the University of Iowa, demonstration of capacity for individual research achievement (typically a dissertation research proposal), and successful completion of the comprehensive examination given by the examining committee.

For more detailed information about program requirements, see the Industrial Engineering Graduate Handbook or view Industrial engineering graduate programs on the Department of Industrial and Systems Engineering website.

All Ph.D. students with a major in industrial engineering must satisfy the following requirements.

Students must register for IE:5000 Graduate Seminar: Industrial Engineering (1 s.h.) each semester of enrollment. They may not substitute seminar credit for regular course work or research credit.

Breadth Requirement

Each student must pass at least two 5000-level industrial engineering courses in each of three focus areas: human factors, operations research, and reliability and systems design. Students who have earned an M.S. in the program may already have satisfied this requirement.

Qualifying Exam

Each student must satisfy the qualifying exam requirement in two of the three focus areas. The requirement for a focus area can be satisfied by passing a written qualifying exam in the focus area or by earning a grade of A-minus or higher in each of two 5000-level industrial engineering courses in the focus area.

Focus Area

Students select one of the three focus areas and take additional course work in that area. They fulfill the minimum requirement of the focus area, completing at least two additional 5000-level industrial engineering courses in the area.

Comprehensive Examination

The comprehensive examination is scheduled with approval of a student's advisor and the industrial engineering program coordinator or the graduate coordinator once a student's study plan is essentially completed. The examining committee, made up of at least five industrial engineering and Graduate College faculty members, determines the composition of the exam, including written and oral parts, and determines whether a student is ready to begin dissertation research.

Each student must demonstrate ability to carry out creative individual research by completing and defending the dissertation research proposal. The exam is scheduled after the qualifying examination requirement has been satisfied. The examining committee determines whether a student is ready to begin dissertation research. Once a student has completed the comprehensive examination satisfactorily, the student is accepted as a candidate for the Ph.D.

Final Examination (Thesis Defense)

Each student must defend the completed dissertation in the final examination, which is conducted by the examining committee.

Concentration in Wind Power Management

Ph.D. students who concentrate in wind power management must meet all regular requirements for the doctoral degree. In addition, they must gain sufficient breadth and depth of domain knowledge in their study area by taking energy-related courses.

Admission

Applicants must meet the admission requirements of the Graduate College; for detailed information about Graduate College policies, see the Manual of Rules and Regulations of the Graduate College.

Reference letters, student research interests, grade-point average for previous graduate study, and factors such as faculty availability are considered in admission decisions.

Ph.D. applicants may be admitted from an ABET-accredited baccalaureate curriculum or a postbaccalaureate curriculum in any engineering discipline or in the mathematical sciences, computer science, or physical sciences with a g.p.a. of at least 3.25 and an acceptable score on the Graduate Record Examination (GRE) General Test. Applicants from institutions outside the United States must meet equivalent conditions for regular admission as determined by the University of Iowa. Students also may be admitted from business or social science programs as determined individually.

Applicants who intend to pursue a Ph.D. and who have a B.S. or an M.S. without thesis usually are admitted first to the M.S. program. All admissions to the Ph.D. program are reviewed by the graduate studies committee.

Financial Support

A number of one-quarter-time and one-half-time teaching and research assistantships are available for graduate students. Awards are based on students' academic records.
and assessment of their potential contribution to the research and teaching goals of the program. Advanced graduate students also may qualify for appointments as graduate teaching fellows. Contact the chair of the Department of Industrial and Systems Engineering for details.

## Career Advancement

Industrial and systems engineers have many opportunities for employment and service in industrial, government, research, and public service organizations. Employment opportunities are among the most varied in the engineering field. Industrial and systems engineers hold positions as advisors to management or may participate directly in management decisions. Representative job titles include industrial engineer, manufacturing engineer, systems analyst, quality specialist, operations research analyst, internal consultant, human factors specialist, supervisor, and manager. Industrial and systems engineers are employed by manufacturing and energy firms, wind turbine manufacturers, government agencies, and service organizations such as airlines, banks, hospitals, health care groups, and consulting companies.

Engineering Professional Development (EPD) develops and promotes experiential education and professional opportunities for students in the College of Engineering. Professional staff coordinate the college's co-op and internship program, engage in employer outreach, and provide opportunities for students to network with employers, including an engineering career fair each semester and other programming related to career development.

EPD also offers individual advising and class presentations on resume and cover letter preparation, job and internship search strategies, interviewing skills, and job offer evaluation.